IEEE Canadian Review
La revue canadienne de l'IEEE
Fall/Automne 2024, Winter/Hiver 2025 — No. 97

AI and Cybersecurity

AI Security, Application and Impacts

IEEE Canada Awards

IEEE Canadian Foundation Honor Roll

IEEE Canada
The Institute of Electrical and Electronic Engineers Inc.

IEEE Canadian Conference on Electrical and Computer Engineering & Industry Summit

Vancouver

26-29 May 2025

SPECIAL SESSION ON THE HISTORY OF TECHNOLOGY

- the history of electrical engineering, electronics, and computing, their applications, and their impact on social and economic development
- the people, programs, places, policies, institutions, and organizations that have shaped the history of electrical engineering, electronics and computing
- efforts to preserve and promote our technological history and heritage

https://ccece2025.ieee.ca

Topics for IEEE CCECE 2025 include:

- Communications, Networking, & Signal Processing
- Computer and Software Engineering
- Machine Learning, Data Analytics, and Artificial Intelligence
- Circuits, Devices, and Photonics
- Control, Robot, & Autonomous Systems
- Power Systems and Power Electronics
- History of Technology
- Engineering Education
- Marine Systems and Technology
- Clean, Connected & Intelligent Marine and Land Transportation
- Space Systems, CubeSats, and Amateur Radio

Industry theme days will offer professional development opportunities including plenary speakers, panel sessions, and hands on training on topics such as wireless communications, marine technology, and intelligent transportation.

Flexible one-day registration will be available to industry professionals.

Canadian Society for the History and Philosophy of Science
CSHPS
Société canadienne d'histoire et de philosophie des sciences

CSHPS/SCHPS is a Canadian forum bringing together historians, philosophers, sociologists, and a wide range of interdisciplinary scholars interested in exploring all aspects of science, past and present.

The Canadian Society for the History and Philosophy of Science (CSHPS) will hold its 2025 conference at George Brown College in Toronto as part of the annual Congress of the Humanities and Social Sciences (30 May – 6 Jun 2025).

https://cshps.ca/

IEEE Canadian Journal of Electrical and Computer Engineering

Since 1976, the IEEE Canadian Journal of Electrical and Computer Engineering (IEEE CJECE) has been publishing high-quality refereed scientific papers in all areas of electrical and computer engineering. It is indexed in both ISI and IEEE Xplore.

The IEEE CJECE invites submission of papers concerning the History of Science and Technology including:

1. Papers presenting new and original results, techniques or concepts, and,
2. Survey-style papers providing a rigorous analysis of existing results.

https://journal.ieee.ca

IEEE HISTELCON 2025

September 30 – October 2, 2025
Bonn, Germany

HIStory of ELectrotechnology CONference is the only conference in the IEEE that addresses the history of technology and its implications for modern society, industry and education.

HISTELCON is part of the R8 portfolio of conferences and was organized for the first time in France in 2008. The 2025 edition is the ninth. On March 31, 2024, an agreement among R8 and R7, R9 and R10 was signed to transform this conference into a multi-region event rotating among the four regions and always with the Technical Co-sponsorship of the IEEE History Center and IEEE History Committee.

https://www.ieee-histelcon.org

Tom Murad
P.Eng., Ph.D., F.E.C., SMIEEE

2024–2025 IEEE Canada President and Region 7 Director
2024–2025 Président de IEEE Canada et Directeur de la Région 7

Dear esteemed IEEE Canada members, once again I am honored to extend a warm welcome to each and every one of you as I am communicating with you halfway through, at the beginning of the second year of my term as president of IEEE Canada and director of IEEE Region 7 (R7) and after I had the opportunity to work side by side with many of you last year, 2024, enjoying our collective growth and success.

This new year, 2025, we are celebrating a special Milestone of our history: the 30th Anniversary of IEEE Canada's establishment, when, on 1 January 1995, the Canadian Society of Electrical and Computer Engineering, previously the Canadian Society of Electrical Engineering, joined with R7 and officially formed IEEE Canada to better serve the needs of engineering professionals across Canada.

In the previous edition of *IEEE Canadian Review*, I focused mainly on "positive change," while this time I would like to focus more on those individuals who can make that positive change happen: IEEE Canada's volunteers.

In preparation for building our volunteers team for 2025 and forming our new year's Operational Committees as well as the IEEE Board Standing Committees, our IEEE Canada's Nominations Committee connected all of our Canadian members and posted all the volunteers' positions for nomination, asking for new volunteers to join our operational leadership team. With that,

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Chers membres de l'IEEE Canada, je suis honoré de vous adresser une chaleureuse salutation et de vous souhaiter la bienvenue pour la deuxième année de mon mandat en tant que président de l'IEEE Canada et directeur de la région 7 (R7) de l'IEEE, après avoir eu l'occasion de travailler aux côtés de bon nombre d'entre vous l'année dernière, en 2024, en profitant de notre croissance collective et de notre succès. En cette nouvelle année 2025, nous célébrons un jalon spécial de notre histoire : le 30e anniversaire de la création de l'IEEE Canada, lorsque, le 1er janvier 1995, la Société canadienne de génie électrique et informatique, anciennement la Société canadienne de génie électrique, a rejoint la région R7 et a officiellement formé IEEE Canada pour mieux répondre aux besoins des professionnels du génie à travers le Canada.

Dans le précédent numéro de la Revue canadienne de l'IEEE, je me suis surtout concentré sur les « changements positifs », alors que cette fois-ci, je voudrais insister davantage sur les bénévoles d'IEEE Canada qui peuvent contribuer à la réalisation de ces changements positifs.

En préparation de la constitution de notre équipe de bénévoles pour 2025, de la formation des comités opérationnels du nouvel an et des comités permanents du conseil d'administration de l'IEEE, notre comité des nominations de l'IEEE Canada a

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the IEEE Canada Executive Committee is aiming to provide an equal opportunity for having a wider network of more diverse volunteers from different Sections and technical backgrounds from academia, industry, and government and encouraging the younger generations of professionals to contribute to our Positive Change plan that we introduced in 2024.

Volunteering in a professional organization like IEEE Canada can have a profound impact on our members' personal and professional growth, specifically for those who are in the early stages of their engineering and technology career as young professionals as well as graduate and undergraduate engineering and applied science students. It is not just an altruistic activity, it's an investment in their career and personal development. Whether looking to grow their network, hone their skills, or contribute to their specific industry, it offers unparalleled opportunities.

It is not just an altruistic activity, it's an investment in their career and personal development.

From my decades of experience volunteering in various engineering professional organizations as well as IEEE, here are a few reasons why I think it is important to consider volunteering:

- Volunteering enables members to connect with like-minded professionals, industry leaders, and peers. Building a strong network can lead to mentorship, collaborations, and career advancements, where professionals can gain practical experience in areas like leadership, event planning, communication, and problem solving. It can also help with acquiring and refining the skills that might not be a part of their current roles.
- Employers tend to value individuals who contribute to the advancement of their industry outside of their day-to-day job. Therefore, demonstrating involvement in a professional organization shows initiative and a commitment to the individual's specific field.
- By volunteering, professionals can contribute to the growth and improvement of their professional community. It's a way to give back, mentor others, and foster a supportive environment for future professionals.
- Being part of a professional organization helps our members to stay informed about trends, innovations, and changes in their field, knowing that volunteer roles often provide insider access to resources, conferences, and decision-making processes.
- Volunteering can lead to roles such as committee chairperson, board member, or event organizer, which are excellent for building leadership experience. Additionally, leading initiatives within the organization showcases the ability to manage and inspire others.
- Volunteering can help you to feel more connected to your profession and its broader impact. Many professionals find a sense of purpose and satisfaction in contributing to something larger than themselves.

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L'IEEE Canada a communiqué avec ses membres canadiens et a affiché les postes vacants des bénévoles, en invitant les nouveaux volontaires à rejoindre notre équipe de direction opérationnelle. Le Comité exécutif de l'IEEE Canada s'efforce de garantir un large éventail de bénévoles provenant de différentes sections et ayant une formation technique dans le milieu universitaire, l'industrie et le gouvernement, offrant ainsi des opportunités égales et inciter les jeunes générations de professionnels à prendre part à notre plan de changement positif que nous avons instauré en 2024.

Le bénévolat au sein d'une organisation professionnelle comme IEEE Canada peut avoir un impact significatif sur l'épanouissement personnel et professionnel de nos membres, et plus particulièrement pour ceux qui entament leur carrière en ingénierie et en technologie, en tant que jeunes professionnels ainsi que pour les étudiants de premier cycle en génie et en sciences appliquées. Que ce soit pour développer leur réseau, améliorer leurs compétences ou contribuer à leur secteur d'activité spécifique, cela offre des opportunités inédites. Ce n'est pas seulement une activité altruiste, c'est un investissement dans leur carrière et leur développement personnel.

Après des décennies de bénévolat au sein de diverses organisations professionnelles d'ingénierie et à l'IEEE, voici quelques raisons pour lesquelles je crois qu'il est essentiel de considérer le bénévolat :

- Le bénévolat favorise la connexion des membres avec des professionnels, des leaders de l'industrie et des pairs partageant leurs idées. Créer un réseau solide peut générer du mentorat, des collaborations et un développement professionnel, offrant ainsi aux professionnels l'opportunité d'acquérir de l'expérience pratique dans des domaines tels que le leadership, la planification d'événements, la communication et la résolution de problèmes. Il peut également contribuer à l'acquisition et à l'amélioration de compétences qui ne sont pas incluses dans leurs fonctions actuelles.
- Les employeurs accordent de l'importance aux personnes qui contribuent à l'avancement de leur industrie, en dehors de leur travail habituel. Ainsi, être membre d'une organisation professionnelle démontre de l'initiative et un engagement envers le domaine spécifique de chacun.
- En faisant du bénévolat, les professionnels peuvent jouer un rôle essentiel dans la croissance et l'amélioration de leur communauté professionnelle. C'est une manière de donner en retour, d'encourager les autres et de promouvoir un environnement favorable pour les futurs professionnels.
- En faisant partie d'une organisation professionnelle, nos membres sont mieux informés des tendances, des innovations et des changements dans leur domaine, car les bénévoles ont souvent un accès privilégié aux ressources, aux conférences et aux processus décisionnels.
- Le bénévolat peut conduire à des postes tels que président de comité, membre du conseil ou organisateur d'événements, qui sont très utiles pour acquérir de l'expérience en leadership. De plus, les actions entreprises au sein de l'organisation démontrent la capacité de la personne à gérer et à motiver les autres.
- Le fait de faire du bénévolat peut vous aider à vous sentir plus en phase avec votre profession et ses conséquences. De nombreux experts perçoivent une motivation et une

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- Engaging in volunteer activities pushes you out of your comfort zone and helps you to grow professionally. Handling responsibilities successfully in these roles builds confidence in your abilities.
- Active involvement in a professional organization positions volunteers as dedicated and reliable professionals. It enhances credibility and visibility in their specific industry.
- Working alongside professionals from various backgrounds gives the team members insights into different ways of thinking and problem solving. This broadens the individual's understanding of the field and helps them to become more adaptable and innovative.

In summary, growing as a volunteer leader in a professional organization like IEEE requires a combination of strategic involvement, skill development, and relationship building. To make a meaningful impact and advance your leadership role, you should consider true and active participation by attending the IEEE events regularly, and engage in conferences, webinars, and networking opportunities to become a familiar face. Volunteer for a committee that aligns with your skills or interests to contribute meaningfully and build connections.

I would also like to share some of the achievements of our volunteers during 2024. The most exciting one is that our webmaster

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satisfaction à participer à quelque chose qui va au-delà de leur propre personne.

- Le bénévolat vous encourage à sortir de votre zone de confort et vous aide à évoluer professionnellement. Assumer avec succès les responsabilités de ces postes renforce votre confiance en vos capacités.
- La participation active à une organisation professionnelle positionne les bénévoles comme des professionnels dévoués et fiables. Leur crédibilité et leur visibilité dans leur domaine spécifique s'en trouvent renforcées.
- Collaborer avec des professionnels de divers horizons offre aux membres de l'équipe une vision des différentes manières de penser et de résoudre les problèmes. Cela favorise l'élargissement de la compréhension des individus et contribue à leur capacité à s'adapter et à innover.

En résumé, pour devenir un leader bénévole au sein d'une organisation professionnelle comme l'IEEE, il est essentiel de concilier un engagement stratégique, le développement des compétences et l'établissement de relations. Pour avoir un impact significatif et faire progresser votre rôle de leadership, vous devriez envisager une participation réelle et active en assistant régulièrement aux événements de l'IEEE, en participant à des conférences, des webinaires et en saisissant les occasions de réseautage pour

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IEEE Canadian Review

La revue canadienne de l'IEEE

IEEE Canadian Review is published three times per year: Spring, Summer, and Fall.

Its **principal objectives** are:

- To inform Canadian members of IEEE on issues related to the impacts of technology and its role in supporting economic development and societal benefits within Canada.
- To foster growth in the size and quality of Canada's pool of technology professionals to serve our increasingly knowledge-based economy.

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(President's Message cont'd from p. 3)

and the website development team have concluded their work on IEEE Canada's new website, which will be launched in early 2025, and reflects the new image of our organization in a more user-friendly and interactive way.

Also in 2025, a new Section will be added to our 21 Canadian Sections from coast to coast: the Kelowna Okanagan Section in the West Area. We are so excited to welcome the new Section's leadership to our IEEE Canada Board and look forward to gaining and learning from their contributions and experiences.

Active involvement in a professional organization positions volunteers as dedicated and reliable professionals.

In 2025, the new editor-in-chief of IEEE Canada's *Canadian Journal of Electrical and Computer Engineering* will be selected and assigned, an important step in revamping and refining our journal's esteemed editorial team and to implement the new plan's processes for the journal's operations.

Finally, I would like to extend an invitation to all our members and colleagues to join us in May at the 2025 IEEE Canadian Conference on Electrical and Computer Engineering in Vancouver. Our conference leaders and committee chairs, with support from our Regions' IEEE Canada Conference Advisory Committee, are keen to have the most successful and high-quality Canadian IEEE conference, and we are all excited to see that happen!

In closing, 2025 is showing all the signs of success and growth, with our dedicated and hard-working team of volunteers and contributors and various exciting events. The IEEE Canada Board and I encourage you all to be a part of this exciting journey and join our volunteers team to enrich our experiences and achievements for further and better success and growth. ■

Tom Murad, P.Eng., Ph.D., F.E.C., SMIEEE
2024–2025 IEEE Canada President
2024–2025 Region 7 Director

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devenir un visage familier. Engagez-vous en tant que bénévole dans un comité qui correspond à vos compétences ou à vos intérêts, afin de contribuer de manière significative et de créer des liens.

J'aimerais également partager quelques-unes des réalisations de nos bénévoles en 2024. La plus excitante d'entre elles est que notre webmaster et l'équipe de développement du site web ont terminé leur travail sur le nouveau site web de l'IEEE Canada, qui sera lancé début 2025, et qui reflète la nouvelle image de notre organisation de manière plus conviviale et interactive.

En 2025, il y aura un ajout à nos 21 sections canadiennes d'un océan à l'autre, incluant la section de Kelowna Okanagan, dans la région de l'Ouest. Nous sommes très heureux d'accueillir les nouveaux dirigeants de la section au sein du conseil d'administration de l'IEEE Canada, et nous avons hâte de tirer parti de leurs contributions et de leur expérience.

En 2025, le rédacteur en chef du Journal canadien de génie électrique et informatique d'IEEE Canada sera désigné, une étape cruciale dans la refonte et le développement de l'équipe éditoriale de notre revue, et pour mettre en place les procédures du nouveau plan pour les opérations de la revue.

Enfin, je voudrais convier tous nos membres et collègues à nous rejoindre en mai lors de la Conférence canadienne IEEE 2025 sur le génie électrique et informatique à Vancouver. Nos responsables de conférence et présidents de comités, soutenus par notre Comité consultatif de conférences IEEE Canada, s'attendent à ce que la conférence IEEE canadienne soit la plus réussie et de la plus haute qualité possible, et nous sommes tous très heureux de voir cela se réaliser !

En résumé, 2025 montre tous les signes de succès et de croissance, grâce à notre équipe dévouée et active de bénévoles et de contributeurs, ainsi qu'à divers événements passionnants. Le conseil d'administration de l'IEEE Canada et moi-même vous incitons vivement à participer à ce voyage enthousiasmant et à rejoindre notre équipe de bénévoles pour enrichir nos expériences et nos réalisations, afin de continuer à progresser et à améliorer notre succès et notre croissance. ■

Tom Murad, P.Eng., Ph.D., F.E.C., SMIEEE
2024–2025 IEEE Canada President
2024–2025 Region 7 Director

IMPORTANT UPDATES

IEEE Canadian Review (*ICR*) is now a "default-digital" publication.

What does this mean?

- All IEEE Canada members will receive *ICR* in digital formats, either through the website or through the IEEE app.
- Members who have explicitly requested not to receive electronic communication will not receive the digital copies. Default mail delivery of print copies will be discontinued to those members in the future. Members are encouraged to opt in for print copies or modify their electronic communication preferences to receive digital copies.
- A print copy will be delivered only to those full-grade members who request it. This will be provided free of additional costs (included in the annual membership fee). Members can opt in for print or digital copies through IEEE membership renewal web page.

Gautam Srivastava, Ph.D., SMIEEE
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As we begin 2025 and can reflect on 2024 as a successful year for IEEE Canada Region 7 as well as for *IEEE Canadian Review* (*ICR*). At *ICR*, we embarked on new frontiers with some changes to our organization structure by adding vice editor-in-chief (EIC) positions, with myself and David Michelson taking on these new positions. These two new positions will help to assist our main EIC with the workload needed to successfully run *ICR*.

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Alors que nous entamons 2025 et pouvons considérer 2024 comme une année réussie pour IEEE Canada Région 7 ainsi que pour la Revue canadienne de l'IEEE (RCI). À la RCI, nous avons exploré de nouveaux horizons en apportant des changements à notre structure organisationnelle, notamment en ajoutant des postes de vice-rédacteur en chef (RC), avec David Michelson et moi-même assumant ces nouveaux rôles. Ces deux nouveaux postes aideront à soutenir notre rédacteur en

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(A Few Words From the Guest Editor cont'd from p. 5)

Two focal points for 2024 were, in my opinion, the rise of artificial intelligence (AI), in particular, ChatGPT, and other AI-based tools as well as the increased risk to Canadian infrastructure through countless cybersecurity breaches throughout Canada. Both of these areas have garnered an abundant amount of attention, both in academia and also within industry, not only in Canada but globally.

ChatGPT, for those who are unaware, is a generative AI tool that was developed by OpenAI and officially launched late in 2022. From 2023 and now into late 2024, its use has skyrocketed to being one of the highest visited sites globally. In academia, there are many potential issues with its use, including its ability to generate content that may be passable as self-generated. Although a powerful tool with many potential well-intended uses, it is yet to be seen how academia and universities across Canada will govern and police its use in teaching and research. It has limitations, and to be properly

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chef principal dans la gestion de la charge de travail nécessaire pour faire fonctionner la RCI avec succès.

Selon moi, l'année 2024 a été marquée par l'émergence de l'intelligence artificielle (IA), en particulier ChatGPT et d'autres outils basés sur l'IA, ainsi que par le risque accru pour les infrastructures canadiennes en raison des multiples violations de cybersécurité à travers le pays. Ces deux domaines ont attiré une grande attention, à la fois dans le milieu académique et dans l'industrie, non seulement au Canada, mais aussi à l'échelle mondiale.

ChatGPT, pour ceux qui ne le savent pas, est un outil d'IA générative développé par OpenAI et lancé officiellement fin 2022. Entre 2023 et 2024, il a connu un développement fulgurant pour devenir l'un des sites les plus populaires à l'échelle mondiale. Dans le milieu académique, de nombreux problèmes potentiels sont associés à son utilisation, y compris sa capacité à produire du contenu auto-généré de qualité acceptable. Bien qu'il soit un outil puissant qui pourrait être utilisé à bon escient, nous ne savons pas

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(A Few Words From the Guest Editor cont'd from p. 6)

embraced as a useful tool, some level of policy development is required at all levels of university life and further into industry.

Cybersecurity breaches are rampant globally and their effects also hit close to home in Canada as well. A quick search of news outlets across Canada for 2024 shows the seriousness of the issue, also keeping in mind that many cybersecurity breaches go unreported due to myriad issues, including the size of the breach, the public image of an organization, the need for public disclosure or public interest of the data involved in the breach, and other factors. The need for better security policies and infrastructure within organizations in Canada should be something of public interest in 2025.

In This Issue

After our customary articles that include the president of IEEE Canada's message [A1], there is added content to this issue with announcements of the IEEE Canada Awards. Following this, the *ICF* Honor Roll is presented, similar to the previous issue in 2023. A special tribute is also given to Terrance Malkinson [A2], who was the recipient of the Southern Alberta Institute of Technology's 2024 Distinguished Alumni Award.

The need for better security policies and infrastructure within organizations in Canada should be something of public interest in 2025.

This issue features three articles that focus on some of the issues mentioned earlier around AI and cybersecurity. In [A3], Jay Shah addresses issues in generative AI tools (like ChatGPT), providing some guidance when deploying AI tools, and the best way is to consult with a legal professional with expertise in Internet law, technology, cybersecurity, and data protection to help weigh the pros and cons of using open source AI platforms and to help draft contracts that protect the business from sharing its proprietary competitive data.

In [A4], author Hooman Razavi discusses what sort of cost organizations may incur from disruptions to their services. Specifically, how disruptions to cyber-physical systems due to heavy reliance on complex technology bring substantial cyber risks, which are advancing at an alarming rate.

Finally, in [A5], David Espinosa explores how AI and other related learning systems like machine learning and deep learning are becoming increasingly mainstream, so much so that organizations can use them to their benefit to improve many aspects of organizational necessities.

If you have enjoyed reading this issue of *ICR* and are interested in getting involved with our ongoing efforts, please reach out to me personally or Editor-in-Chief Jahangir Khan. As an IEEE volunteer myself, it is very rewarding to work with our team at *ICR*, and I hope that you as an IEEE Canada member can also connect with the *ICR* in some way as well. All the best to you for 2025! ■

(Continued on p. 8)

(Quelques mots de l'éditeur invite suite de p. 6)

encore comment les universités du Canada vont le gérer et garantir sa surveillance dans l'enseignement et la recherche. Il présente des limites, et pour être adopté de manière adéquate comme outil utile, il est indispensable d'établir un certain niveau de politique à tous les niveaux de la vie universitaire et même au-delà, dans l'industrie.

Les atteintes à la cybersécurité sont endémiques dans le monde entier, et leurs effets touchent aussi de près le Canada. Une analyse rapide des médias d'information au Canada pour 2024 met en lumière l'ampleur du problème, en gardant à l'esprit que de nombreuses violations de la cybersécurité restent non signalées en raison de multiples problèmes, notamment la taille de la violation et l'image publique d'une organisation, la nécessité de divulguer publiquement ou l'intérêt public aux données impliquées dans la violation, et d'autres facteurs. La mise en place de politiques et d'infrastructures de sécurité de meilleure qualité au sein des organisations canadiennes devrait être d'intérêt public en 2025.

In This Issue

Après nos publications habituelles, incluant le discours du président de l'IEEE Canada [A1], ce numéro présente également des annonces concernant les prix de l'IEEE Canada. Suite à cela, le tableau d'honneur du FCI est dévoilé, de la même manière que dans le numéro précédent de 2023. Un hommage spécial est également rendu à Terrance Malkinson [A2], qui a reçu le prix des anciens élèves distingués de l'Institut de technologie du sud de l'Alberta en 2024.

Ce numéro contient trois articles qui abordent certains des problèmes mentionnés précédemment concernant l'IA et la cybersécurité. Dans [A3], Jay Shah discute des questions liées aux outils d'IA générative (comme ChatGPT) en donnant des conseils pour le déploiement de ces outils. La meilleure option serait de consulter un professionnel du droit ayant des connaissances en droit de l'Internet, en technologie, en cybersécurité et en protection des données, afin de peser le pour et le contre de l'utilisation de plateformes d'IA open source et d'aider à rédiger des contrats qui protègent les entreprises du partage de leurs données concurrentielles et propriétaires.

Dans [A4], Hooman Razavi discute des coûts que les organisations peuvent subir en raison des interruptions de leurs services. En d'autres termes, la forte dépendance envers des technologies complexes entraîne des perturbations des systèmes cyberphysiques, ce qui crée d'importants risques cybernétiques qui progressent à un rythme alarmant. Enfin, dans [A5], David Espinosa explore comment l'IA et les autres systèmes d'apprentissage connexes, tels que l'apprentissage automatique et l'apprentissage profond, deviennent de plus en plus courants, au point que les organisations peuvent les utiliser à leur avantage pour améliorer de nombreux aspects de leurs besoins organisationnels.

Si vous avez apprécié la lecture de ce numéro de la RCI et êtes intéressé à participer à nos efforts continus, n'hésitez pas à me contacter personnellement ou à joindre le rédacteur en chef Khan. En tant que bénévole à l'IEEE, il est très gratifiant de travailler avec notre équipe à la RCI, et j'espère que vous, en tant que membre d'IEEE Canada, pourrez également vous connecter à la RCI d'une manière ou d'une autre. Tous mes vœux de succès pour 2025! ■

(Suite p. 8)

(A Few Words From the Guest Editor cont'd from p. 7)

Appendix: Related Articles

[A1] T. Murad, "[President's Message]," *IEEE Canadian Rev.*, vol. 36, no. 3, pp. 1–4, Fall/Automne 2024, Winter/Hiver 2025, doi: 10.1109/MICR.2025.3527780.
[A2] "Terrance Malkinson tribute," *IEEE Canadian Rev.*, vol. 36, no. 3, p. 9, Fall/Automne 2024, Winter/Hiver 2025, doi: 10.1109/MICR.2024.3512134.
[A3] J. Shah, "Securing artificial intelligence: Risks, governance, limitations, and regulations," *IEEE Canadian Rev.*, vol. 36, no. 3, pp. 10–13, Fall/Automne 2024, Winter/Hiver 2025, doi: 10.1109/MICR.2024.3512032.
[A4] H. Razavi, "Artificial-intelligence-driven cost estimation for disruptions in cyber-physical systems," *IEEE Canadian Rev.*, vol. 36, no. 3, pp. 14–18, Fall/Automne 2024, Winter/Hiver 2025, doi: 10.1109/MICR.2024.3512132.
[A5] D. Espinosa, "The impact on Canadian manufacturing workers from the adoption of intelligent systems in the workplace," *IEEE Canadian Rev.*, vol. 36, no. 3, pp. 19–23, Fall/Automne 2024, Winter/Hiver 2025, doi: 10.1109/MICR.2024.3515312.

(Quelques mots de l'éditeur invite suite de p. 7)

Appendix: Related Articles

[A1] T. Murad, "[President's Message]," *IEEE Canadian Rev.*, vol. 36, no. 3, pp. 1–4, Fall/Automne 2024, Winter/Hiver 2025, doi: 10.1109/MICR.2025.3527780.
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Terrance Malkinson Receives Southern Alberta Institute of Technology's 2024 Distinguished Alumni Award

Terrance Malkinson was the recipient of the Southern Alberta Institute of Technology's (SAIT's) 2024 Distinguished Alumni Award on 25 September 2024. Established in 1988, this award recognizes a SAIT graduate who demonstrates proven leadership skills, exceptional achievements in business or industry, outstanding contributions to the community, a history of support for SAIT, and has a good reputation. The Distinguished Alumni Award is considered to be the highest honor that an educational institution can bestow on its graduates. Further information on his award is available at www.sait.ca/link/stories/2024/09/terrance-malkinson.

Terrance Malkinson was named as one of Calgary's 2025 compelling citizens as an influential individual who made a difference with significant achievements that are at times outside the public domain.

Malkinson with his Distinguished Award.

Malkinson with President and CEO Dr. David Ross.

Malkinson is a Senior Life Member of IEEE and has been a contributing editor to *IEEE Canadian Review* continuously since 2006. He is a contributing author to *IEEE USA InSight*, formerly *IEEE USA Today's Engineer*, continuously since 2001. He has served in many IEEE governance and publication roles. He is the author of more than 600 peer- and editorial-reviewed earned well-read and cited publications and has spoken at many national and international conferences. His diverse career path includes 26 years in medical research at the University of Calgary, a three-year appointment as a business manager with the General Electric Company, followed by a one-year applied research appointment with SAIT Polytechnic.

During his career, he has advanced both basic and applied medical, health and wellness, scientific, and engineering knowledge. He has trained and mentored collegiate and university undergraduate, graduate, and postdoctoral students. He is the recipient of peer-selected earned awards, including induction into "The Order of the University of Calgary," and was an elected two-term member of the University of Calgary Senate. In retirement, he vigorously continues basic and applied research with an extensive portfolio of basic and applied research projects. His current research interest in emerging technologies and health and wellness extends to being an accomplished multi-sports triathlete, including, among other events, completion of 11 full-distance Ironman Triathlons and numerous charity fundraising runs as well as being a legacy donor and student–athlete annual award donor to collegiate athletics. His profile is posted on https://www.academia.edu/.

Terrance Malkinson prior to the Awards Ceremony.

Malkinson speaks at the Awards Ceremony.

Securing Artificial Intelligence: Risks, Governance, Limitations, and Regulations

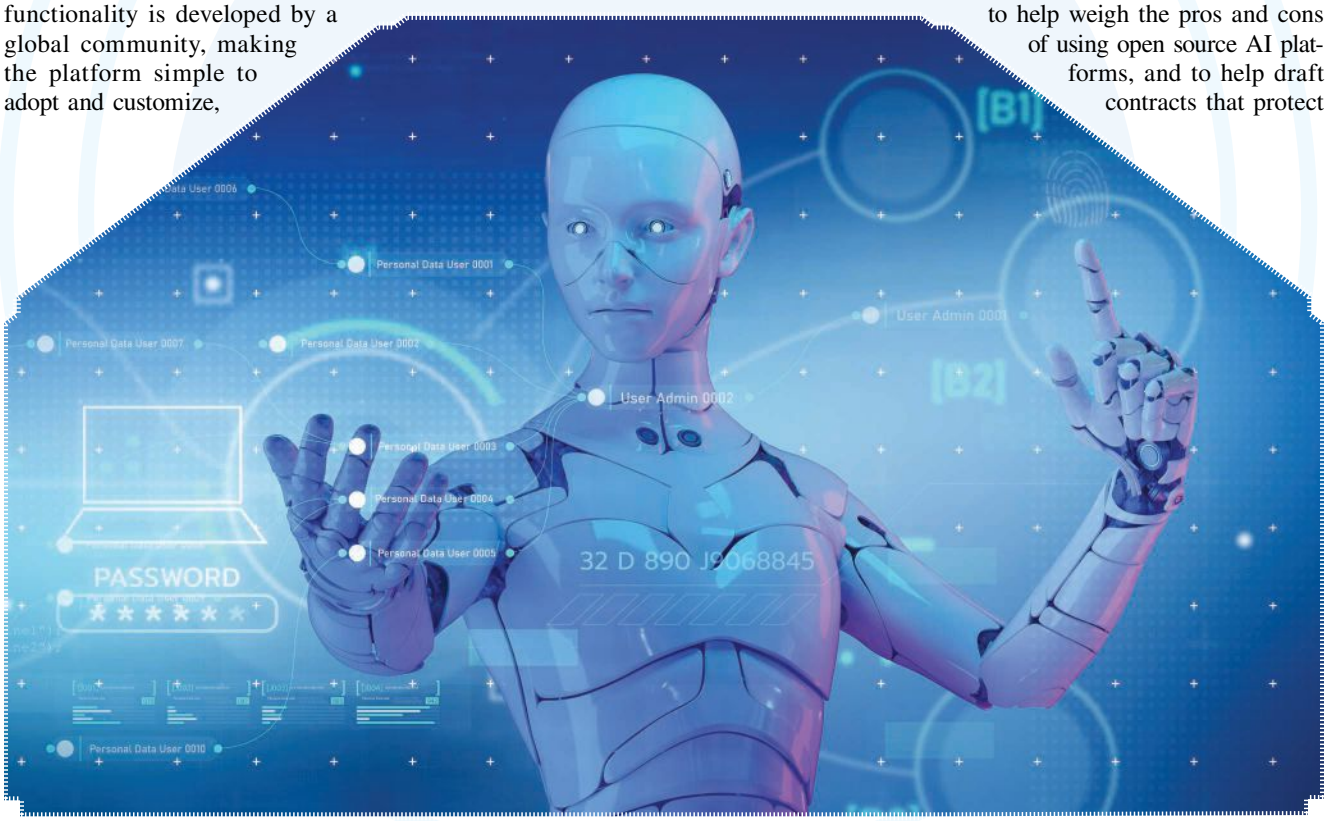
by Jay Shah

Generative artificial intelligence (GenAI) approaches provide varying degrees of openness and accountability, which is crucial for navigating the complexities related to data/model access, competition, intellectual property (IP) rights, risk control, and misuse. GenAI foundation models are trained on extensive datasets with foundation/generic models by using pretrained data, while fine-tuned models require additionally trained data. Data ownership may vary across layers of the model depending on user accessibility and open/closed sources of GenAI. Open source security best practices, such as secure coding, reduced external dependencies on code, assessment of upgrades and licenses, and so on, help to minimize security risks, build trust, and protect components from potential threats and vulnerabilities.

On one hand, cybersecurity and functionality is developed by a global community, making the platform simple to adopt and customize, and provides some measure of comfort regarding the safety of information in the face of a bad actor. With respect to a business's proprietary competitive information, open source AI platforms should keep this information safe from disclosure to the public, while the information may be less secure when closed source AI platforms are used.

On the other hand, the specific license terms to which open source AI platforms are subject may be full of minefields. The specific dangers to consider with open source AI platforms' licenses are the indemnities for hallucinations and misinformation, leading to trickle-down copyright infringement.

This article benefits the community and the wider ecosystem that seek to deploy AI, and the best way to do so is to consult with a legal professional who has expertise in Internet law, technology, cybersecurity, and data protection to help weigh the pros and cons of using open source AI platforms, and to help draft contracts that protect



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the business from sharing its proprietary competitive data.

Which Cybersecurity Risks Should Be Considered For GenAI's Business Adoption?

The adoption and activation of large language models (LLMs) introduces various cyber risks, including biases, data privacy, trust and ethics concerns, and cyberthreats throughout the AI model lifecycle. Enhancing AI frameworks with dynamic risk assessment models, robust data security privacy measures, and adaptive learning algorithms can address these challenges. Bias in AI algorithms is a significant ethical consideration in the use of AI in cybersecurity, and it is essential to take steps to identify and mitigate potential biases to ensure fair and responsible use of AI. This includes using diverse and representative training data, technical solutions such as adversarial training and fairness constraints, and governance structures, policies, and procedures (see Figure 1).

As organizations adopt GenAI, securing not only the AI models but also safeguarding the data and supporting systems from the following threats is crucial:

- *Data leaks*: GenAI and LLMs could inadvertently generate sensitive information from their training data or be manipulated to disclose confidential information, potentially leading to privacy breaches and security threats.
- *Training data poisoning:* Malicious actors tamper with training data to influence the model's behavior and output, potentially leading to the generation of harmful or misleading content.
- *Data supply chain attacks*: Adversaries compromise public data sources or the data-gathering process that is used for training the models, potentially resulting in biased, misleading, or harmful outputs.
- *Prompt injection*: Adversaries, even without knowing the specifics of the model (black box), or, conversely, with full knowledge of the model (white box), can craft inputs that are designed to trick the model into producing harmful, misleading, or unanticipated outputs.
- *Model theft:* Adversaries might replicate the model's functionality through techniques like model inversion or training data inference, potentially violating IP rights or enabling unauthorized use of the model's capabilities.
- *Model supply chain attacks*: Adversaries compromise various stages of the model's development, distribution, or deployment process, potentially leading to the generation of harmful or misleading outputs or enabling unauthorized access to sensitive data.

Presented next is a key example.

Prompt Injection: (Jailbreaking)

"To deliberately provide an LLM with input that attempts to cause it to ignore instructions, cause harm, or behave contrary to deployment expectations."

A prompt injection is a type of cyberattack against LLMs. Hackers disguise malicious inputs as legitimate prompts, manipulating GenAI systems into leaking sensitive data, spreading misinformation, or worse.

The most basic prompt injections can make an AI chatbot like ChatGPT ignore system guardrails and say things that it shouldn't be able to. Prompt injections pose even bigger security risks to GenAI apps that can access sensitive information and trigger actions through application programming interface integrations. Consider an LLM-powered virtual assistant that can edit files and write emails. With the right prompt, a hacker can trick this assistant into forwarding private documents.

Prompt injection is a concern any time an external entity is given the ability to contribute to the prompt. The common effects of prompt injection attacks include the following:

- prompt leaks
- remote code execution
- data theft
- misinformation campaigns
- malware transmission.

Why Should GenAI Adoption Start With Governance?

Establishing a governance framework while GenAI is in the early stages of adoption maximizes upside value and minimizes downside risk. Organizations that lead with AI governance understands and mitigates risks of AI before they materialize. They proactively identify high-value areas for AI deployment and scale the learnings and best practices that were discovered in early pilots. Firms accelerate return on investment (ROI) by protecting revenue in addition to generating it and can adopt AI at scale and maximize impact across functions and business units (BUs).

Companies that are still in the early stages of adapting AI governance adopt AI in silos, which limits scale, ROI, and visibility and creates prioritization chaos, which results in a fragmented investment. Somehow, they reactively address risks, damaging both reputation and finances,

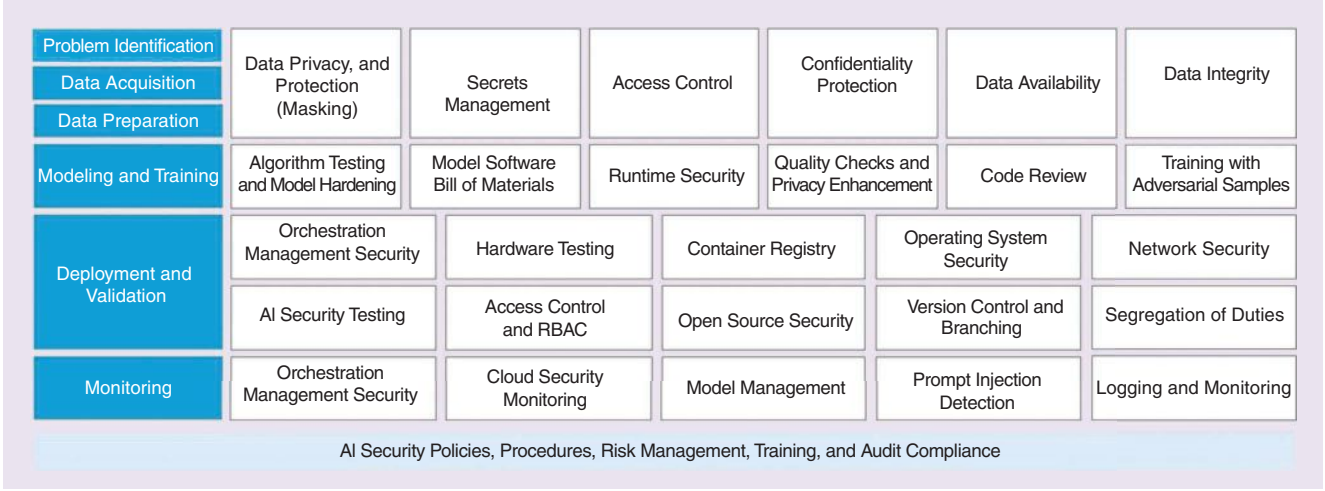

Figure 1: A sample AI security framework.

and repeat mistakes across BUs throughout the AI-adoption lifecycle.

Transparency, prioritization, unintended consequences, fairness, and data protection are all key considerations that should be taken into account when deploying AI-based cybersecurity systems. Additionally, by placing humans at the center of AI implementation, the ecosystem benefits from technology that aligns with societal values, ensuring that innovations contribute positively to the community and support long-term sustainability.

Trust and Accuracy

Poor-quality and low-accuracy training data lead to poor output results, low explainability, and traceability of generated outputs. Training data may become outdated or obsolete (e.g., "stale") if not regularly reviewed and updated. Fabrication of facts and data in generated information (commonly called *hallucinations* or *stochastic parroting*). Human overreliance on generated information without due diligence or corroborating sources.

Data Privacy

Data may be included in training sets without knowledge or express approval of the data subject. Data in public-cloud GenAI tools may be used or accessed inappropriately. Application of GenAI models may be used for ethically unclear means (e.g., surveillance applications). The security of the model and the training data may not be sufficient to protect against malicious actors.

Fairness and Bias

Bias toward or against certain subgroups within training data lead to generated content that reflects said bias. Poorly designed restrictions lead to the generation of hate speech or fake news. Human bias may influence the perception and application of AI-generated content.

Regulatory and Legal

Potential copyright and IP infringement issues Potential loss of confidential information or client/attorney privileged information in incidents. Liability of use leading to consumer lawsuits. Violation of privacy laws and regulations at the state, national, and international level. Customer/supply chain contract violations.

Why Does AI Governance Matter?

The following are reasons why AI governance matters:

- *Strategic alignment:* To realize the full value of GenAI, governance must be aligned with the organization's principles and strategy.
- *Regulatory compliance:* Organizations that have a clear view of compliance requirements, define their approach early, and revise as regulations change lower their investment risk and maintain momentum.
- *Cyber and data security:* Protocols and monitoring must come from the top down to protect against incidents.
- *Transparency*: GenAI adoption requires employees to understand its role in the organization as well as clear and understandable explanations for how it works.

Limitations to GenAI Models

Although GenAI has many positive applications, there are also concerns about its potential misuse, such as generating fake content or deepfake videos that can be used to deceive or manipulate people. Ethical considerations and responsible use of GenAI are important factors to address these risks. The use of AI in cybersecurity presents a number of ethical challenges, particularly when it comes to balancing security and privacy. On the one hand, AI can be a powerful tool for identifying and mitigating cyberthreats, potentially enhancing overall security. On the other hand, the use of AI in cybersecurity may also raise concerns about privacy violations, particularly if the technology is used in ways that are overly invasive or that collect too much personal data.

There are, however, several challenges that currently hinder the widespread enterprise-grade application of GenAI. Issues of reliability and functionality, with hallucination being a primary concern, have not yet been completely sorted out. There are also the following limitations with respect to orchestrating actions, which track multiple long-running transactions:

- *Incorrect answers*: GenAI sometimes produces responses that sound plausible or convincing but are incorrect or nonsensical. This phenomenon is called *hallucination* and it is common in language models.
- *Unable to understand context*: GenAI lacks the ability to understand emotional context, which can make it difficult for the model to provide empathetic or nuanced responses to certain inputs. It is also suboptimal in handling mathematical reasoning and expressions and can be confused about the task on which it is working.
- *Lack of conversational skills*: GenAI does not have personal experiences, feelings, or the ability to engage in conversations like humans do.
- *Confusion*: GenAI models can be confused by ambiguity and can generate irrelevant or off-topic responses when they encounter ambiguous inputs. GenAI can provide responses to inputs that require a deeper understanding of the topic and its context to be considered insightful or relevant.
- *Customization*: xLLM's size makes creating a private copy of a model expensive, necessitating reliance on existing models and service, and there are significant limitations with language.

AI Regulations

Although regulatory frameworks evolve, concerns around data privacy and data sovereignty are significant barriers to enterprises investing further in GenAI. Although the situation is changing, many proprietary models are not available on local infrastructure in many countries today.

The following are some AI regulatory bodies for which we have to watch:

- *Federal-level regulation*: To make "automated systems work for the American people," the White House has published a blueprint for the AI Bill of Rights. It emphasizes the criticality of safety, data privacy, bias protections, and transparent communication, among other needs.
- *State-level regulation*: Across the United States, there is plenty of momentum behind regulated AI, however, the requirements and expectations can be frustratingly fragmented. Seventeen states have passed one or more legislative acts for regulating the use of AI to increase transparency and safety.
- *European Union (EU) act*: The EU AI Act aims to categorize AI into four areas: unacceptable, high risk, limited risk, and minimal-to-no risk. It is expected to be complete by the end of year and is currently in discussion among the European Commission, the EU Parliament's AI Committee chairs, and the Council of the EU.
- *Third-party frameworks*: Independent from governmental and for-profit organizations, academics and nonprofit researchers have built accountability tools despite roadblocks in gathering data. The frameworks being developed

include NIST (National Institute of Standards and Technology) AI RMF 1.0, MITRE, OECD Recommendation on AI, the proposed EU AI Act, Executive Order 13960, and a blueprint for the AI Bill of Rights.

- *Bill C-27*: Bill C-27 features the following three key pieces of legislation:
  1. the Consumer Privacy Protection Act
  2. the Personal Information and Data Protection Tribunal Act
  3. the Artificial Intelligence and Data Act.

The following are the key objectives of the bill:

- to increase control and transparency for Canadians when organizations handle their personal information
- to enforce measures through broad, order-making powers; increased fines; and a new enforcement tribunal
- assign additional responsibilities to organizations that handle personal information
- address AI by regulating commerce and trade matters.

Key Takeaways

There is a need to develop a holistic-enterprise AI platform, integrating with existing architecture rather than focusing solely on AI models. Leverage both leading closed-source models like GPT-4 for initial development and mature open-source options for sustainable growth, ensuring alignment with traditional AI methods, enterprise automation technologies, and GenAI functionalities. We have to reinforce AI governance frameworks by setting clear priorities and policies across various AI use cases. Enhancing data security measures is also a key element so as to protect against data leaks and ensure compliance with data sovereignty. Finally, we have to monitor the financial implications and accessibility of AI models, as they can opt for a hybrid approach in selecting language models based on specific needs and cost-effectiveness, while keeping abreast of significant cost differences among leading models like GPT-4 and its alternatives. ■

About the Author

Jay Shah (jay.shah@ieee.org) is a Cybersecurity, DevSecOps, and Generative Artificial Intelligence consultant. He received his master's degree in telecommunication and network engineering from Southern Methodist University, Texas, USA. He has more than eight years of industry experience and has various cloud, DevSecOps, and cybersecurity certifications. He has published seven academic and technical research papers in various journal publications and been a global speaker at various conferences and universities. He is part of Canada DevOps Community of Practice. He has been an IEEE Young Professional member for more than seven years and has served various IEEE Regions and Sections (R10 – Bombay, India; R5- Dallas, TX; R7 – London, Ontario, Canada).

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Artificial-Intelligence-Driven Cost Estimation for Disruptions in Cyber-Physical Systems

by Hooman Razavi

In July 2024, CrowdStrike, a prominent American cybersecurity firm, released a flawed update to its Falcon Sensor security software, leading to significant disruptions on the Microsoft Windows computers that used the software. The malfunction caused approximately 8.5 million systems to crash, rendering them unable to restart properly. This incident has been described as the largest outage in IT history. The outage had far-reaching effects, impacting industries worldwide, including airlines, airports, banks, hospitals, hotels, manufacturing, stock markets, broadcasting, and retail. Government services such as emergency response systems and websites were also affected. The global financial losses have been estimated at more than US$10 billion [1].

In today's digital world, businesses are more dependent than ever on advanced IT infrastructure to drive their growth and scalability. Robust and secure technology systems are crucial for companies to expand their operations, handle increasing numbers of data, and quickly adjust to shifting market dynamics. However, this heavy reliance on complex technology brings substantial cyber risks, which are advancing at an alarming rate. The rising number and sophistication of cyberthreats underscore the pressing need for innovative strategies in cyber risk evaluation and management. Figure 1 highlights that cyber incidents were identified as the leading risk to businesses globally in 2024, according to a survey conducted among risk management experts in late 2023. These incidents include cybercrime, malware, and ransomware and cause system downtime, IT failures or outages, data breaches, and regulatory fines and penalties. As a result, the global cyber insurance market is expected to experience steady growth in the coming years.

Estimating the financial damage from large-scale cyber incidents is inherently complex due to several factors. First, the impact extends beyond direct financial losses, such as system downtime and repair costs, to include long-term effects like reputational damage, loss of customer trust, and regulatory penalties. Additionally, the interconnected nature of modern systems means that disruptions ripple across supply chains, affecting multiple industries in ways that are difficult to quantify. Indirect costs, such as lost business opportunities and decreased productivity, further complicate the calculation. Moreover, financial damage often includes intangible elements like future legal liabilities or shifts in market value, which are challenging to measure immediately. Each of these factors, combined with varying recovery timelines and geographical scope, makes accurate estimation a highly intricate process.

Costs of Disruptions in Cyber-Physical Systems

As cyber-physical systems (CPSs) become more complex and interconnected, they also face a growing risk of cyber disruptions, which can lead to widespread operational failures across multiple sectors [3]. The financial impact of such disruptions extends far beyond immediate system failures and repair costs, affecting supply chains, customer trust, and overall market performance. Understanding the full spectrum of costs associated with CPS disruptions is crucial for businesses and governments alike as it enables better preparation, risk management, and mitigation strategies in an increasingly digitized world [4]. This section outlines the various direct, indirect, and intangible costs that organizations must consider when assessing the potential financial damage from disruptions in CPSs.

Direct Costs

These costs reflect the tangible financial impact of system downtime, repairs, lost revenue, and legal penalties, which can significantly affect an organization's bottom line. Understanding the following direct costs is crucial for assessing the immediate damage caused by such incidents [5]:

- *System downtime*: The financial losses that are incurred due to the unavailability of critical infrastructure and services, which impact business operations.
- *Repair and recovery expenses*: The costs that are associated with identifying, fixing, and restoring affected systems, including hardware and software repairs as well as hiring external experts or consultants.
- *Lost revenue*: The revenue that is lost during downtime, such as unprocessed transactions, halted production, or unfulfilled customer orders.
- *Labor costs*: The increased labor expenses, including overtime pay for the IT staff and cybersecurity teams that work to address and resolve the issue.
- *Regulatory fines and penalties*: The legal and regulatory fines that are imposed due to cybersecurity violations, data protection laws, or service-level agreements (SLAs).

Indirect Costs

Indirect costs are the secondary financial impacts that arise from disruptions in CPSs. These costs, although less immediately visible, can ripple through supply chains, reduce productivity, and lead to increased operational expenses. Understanding the following indirect costs is essential for capturing the broader financial consequences that extend beyond the initial disruption [6]:

Intangible costs refer to the less-quantifiable—but significant—long-term impacts of CPS disruptions.

- *Supply-chain disruptions*: The increased costs that result from delayed production, transportation, or services due to failures in interconnected systems.
- *Decreased productivity*: Thee loss of employee productivity, particularly in industries that are reliant on automated systems, manufacturing, or logistics.
- *Customer compensation*: The reimbursements or refunds that are provided to customers for service interruptions.
- *Insurance premium increases*: The higher cybersecurity insurance premiums that result from an elevated risk profile postincident.
- *Contractual penalties*: The financial penalties that are incurred for failing to meet SLAs with clients or business partners.

Intangible Costs

Intangible costs refer to the less-quantifiable—but significant—long-term impacts of CPS disruptions. These include reputational damage, loss of customer trust, and diminished brand value, which can affect future revenue and market positioning. Although harder to measure, understanding the following intangible costs is critical for assessing the full scope of financial damage and long-term recovery [7]:

- *Reputational damage*: The loss of trust from customers, investors, and stakeholders, which leads to reduced revenues and market share.
- *Customer attrition*: The loss of customers to competitors as a result of perceived unreliability or security concerns.
- *Market value impact*: The reduction in stock price and overall market capitalization due to decreased investor confidence.
- *Brand erosion*: The diminished brand equity that follows negative media coverage, legal battles, and customer dissatisfaction.

AI-Driven Cost Estimation

AI enhances the accuracy and efficiency of estimating the direct, indirect, and intangible costs that are associated with cyber incidents, which equips organizations with valuable insights for improved decision making and risk management. Techniques such as machine learning algorithms for predictive analytics, and natural language processing for sentiment analysis enable businesses to navigate the intricate financial landscape created by cyberthreats more effectively.

AI significantly improves the estimation of direct costs by analyzing historical data and identifying the patterns that are related to system failures and financial losses. For instance, machine learning models can predict the financial impact of system downtime by evaluating past incidents, while predictive

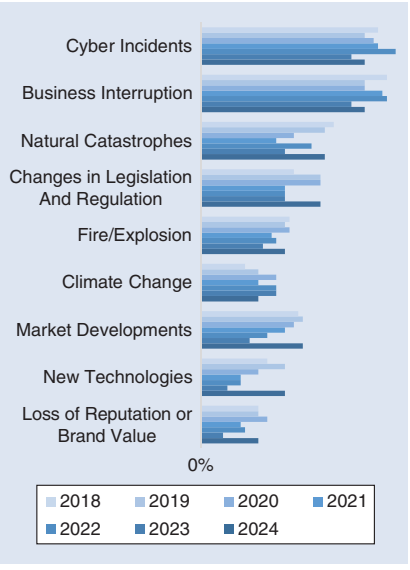

Figure 1: The leading risks to businesses worldwide [2].

analytics can forecast repair expenses based on the extent of damage. Additionally, AI can enhance labor cost estimations through real-time insights into workforce allocation, and evaluate compliance history by using data analysis to predict regulatory fines. These applications help organizations capture the immediate financial damage caused by disruptions more accurately.

In addition to direct costs, AI aids in estimating indirect and intangible costs, revealing the broader financial implications of cyber disruptions. AI algorithms can model supply-chain interconnectedness to forecast increased costs due to delays, assess productivity losses, and predict customer compensation needs. For example, reinforcement learning can optimize decision-making processes in supply-chain management. Additionally, sentiment analysis using natural language processing tools can gauge public perception and potential reputational damage, while machine learning models estimate losses from customer attrition and market value impacts. By harnessing AI technologies, organizations can achieve a comprehensive understanding of the financial consequences of cyber disruptions, enhancing their risk management strategies and enabling better preparation for future incidents.

Revenue-Lost Estimation

This article presents a model for estimating lost revenue during system downtime, utilizing predictive analytics through machine learning and data analysis to assess the financial impact of disruptions. Figure 2 illustrates the schematic of this model, which is designed to estimate lost revenue during system downtime. The process begins with data collection and preparation, where relevant transaction records and historical data are gathered from various sources. This stage ensures data quality and completeness, forming the foundation for accurate analysis. Next is the extract, transform, load (ETL) phase, where the collected data are extracted from their sources (such as databases and logs), transformed into an analyzable format, and loaded into a data warehouse. Cloud data warehousing follows, providing an organized and efficient environment for managing large datasets and ensuring quick retrieval for analysis.

Once the data are prepared, they undergo data analytics by using advanced techniques to uncover patterns, trends, and insights. This prepares the information for the business activity pattern estimation engine, a deep-learning-powered tool that identifies normal transaction patterns by analyzing historical data. By comparing these patterns with actual transaction data during a cyber incident, the machine learning model detects deviations and estimates lost revenue. In the final cost estimation phase, the financial impact of downtime is assessed, encompassing direct operational costs and lost business opportunities. By leveraging historical data analytics, the statistical distribution of transaction values is determined based on the organization's business model. Combined with the number of lost transactions estimated by the Business Pattern Activity Estimation Engine, this approach enables an accurate calculation of lost revenue, offering a comprehensive estimate of the total financial damage caused by disruptions.

AI-driven predictive analytics not only streamline the process but also provide organizations with real-time risk assessment capabilities. As businesses face increasing cyberthreats, this dynamic approach enables proactive risk management, allowing companies to anticipate potential revenue losses and develop mitigation strategies before incidents occur. By integrating machine learning and deep learning techniques, this model helps organizations to optimize response efforts, minimize downtime, and safeguard financial stability amid rising cyber disruptions.

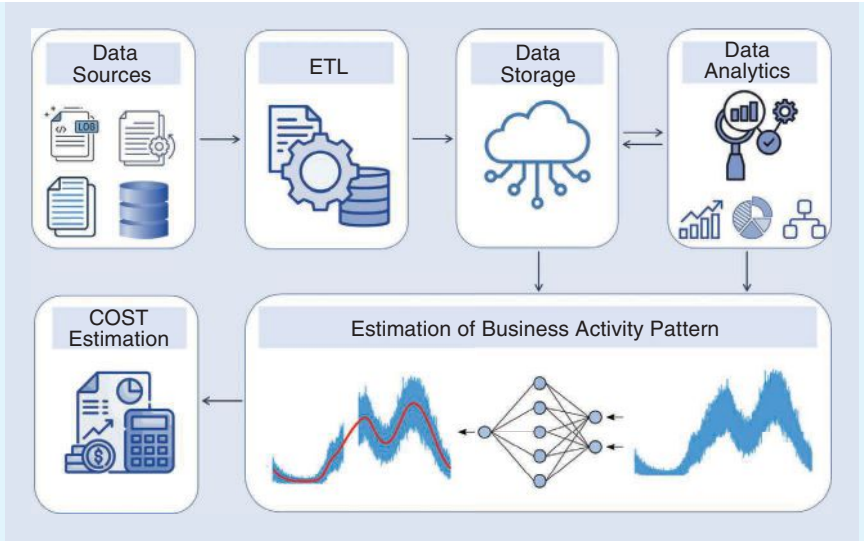

Figure 2: Machine learning for estimating lost revenue. ETL: extract, transform, load.

Table 1: A summary of notable stakeholders.

Stakeholders	Benefits
Senior executives	Accurate financial impact assessment of downtime
IT and cybersecurity teams	Data-driven insights for improving system resilience and response
Financial analysts	Reliable cost estimation for financial planning
Insurance companies	Precise risk evaluation and premium adjustment
Regulatory authorities	Enhanced compliance and risk management oversight
Customers	Improved service reliability and trust in the organization

Stakeholders

As cyber disruptions grow in frequency and impact, coupled with the increasing digitalization of businesses, the approach to estimating lost revenue during system downtime now involves several key stakeholders. With more sectors becoming vulnerable to cyberrisks, a wider range of industries must adopt AI-driven models for cost estimation to mitigate financial risks effectively. These stakeholders are essential to drive decision making, resource allocation, and strategic planning to address the growing challenges of digital transformation and cybersecurity threats. The main stakeholders are summarized in Table 1.

Senior Management and Executives

Senior management, including CEOs, CFOs, and chief information officers, are primary stakeholders as they are responsible for overseeing an organization's strategic direction and financial stability. The insights provided by AI models for estimating lost revenue help them to make informed decisions about risk management, budget allocation, and investments in cybersecurity infrastructure. Accurate financial impact assessments allow executives to prioritize cybersecurity initiatives and ensure that resources are allocated efficiently to minimize potential disruptions.

IT and Cybersecurity Teams

IT and cybersecurity professionals are directly involved in managing and mitigating system disruptions. These teams work on implementing AI-powered predictive analytics models and ensuring that data pipelines (such as the ETL process) run smoothly. By leveraging AI to estimate lost revenue during downtimes, IT teams can enhance their incident response strategies and optimize recovery efforts. The insights provided by the model also help cybersecurity teams to develop better defenses, focusing on areas that could cause the most significant financial impact.

Financial Analysts and Risk Management Teams

Financial analysts play a crucial role in assessing the economic impact of downtime and disruptions. They rely on accurate predictions of lost revenue and other direct and indirect costs that are provided by the AI model to forecast financial performance under different cyberthreat scenarios. Risk management teams, working closely with financial analysts, use these data to develop strategies that minimize the organization's exposure to potential losses. AI-driven models empower these stakeholders to assess both short- and long-term risks, enabling more precise financial planning and risk mitigation strategies.

Compliance and Legal Teams

Compliance and legal teams are responsible for ensuring that the organization adheres to regulatory standards and avoids penalties. AI-based cost estimation models provide these teams with a better understanding of the potential regulatory fines and penalties that could arise from data breaches or system failures. Armed with this information, legal and compliance professionals can ensure that the organization meets its obligations and proactively prepare for any legal challenges associated with cyber incidents.

Insurance Companies

Insurance companies are critical stakeholders, especially in the context of cyber insurance policies that cover financial losses due to system downtimes and cyber incidents. AI-driven models that accurately estimate lost revenue help insurers to assess potential claims more precisely and set appropriate premium levels for cybersecurity insurance. By collaborating with organizations that leverage these models, insurance companies can better understand the risk profiles of their clients, forecast potential payouts, and adjust coverage accordingly. This collaboration benefits both insurers and policyholders, leading to more-informed risk assessments and more-accurate pricing models.

By leveraging AI to estimate lost revenue during downtimes, IT teams can enhance their incident response strategies and optimize recovery efforts.

Customers and Business Partners

Although indirectly involved, customers and business partners are also key stakeholders affected by system downtime. Accurate cost estimation allows organizations to manage relationships with customers by preparing compensation strategies and communication plans in the event of disruptions. Similarly, business partners, including suppliers and vendors, rely on an organization's ability to manage risk. By using AI models to predict financial impacts, organizations can maintain stronger relationships by minimizing service interruptions and building trust with both customers and partners.

Practical Limitations

AI-driven models for estimating costs during disruptions in CPSs face several practical limitations that can affect their effectiveness. A key concern is the quality and availability of data. These models depend on comprehensive, high-quality datasets to generate accurate predictions. Inconsistent, outdated, or incomplete information can lead to significant inaccuracies in cost estimations, undermining the reliability of the model and limiting its utility for informed decision making.

Another important limitation is the complexity and interpretability of the AI models used. Advanced techniques like deep learning often function as "black boxes," making it difficult for stakeholders to understand the rationale behind specific predictions. This lack of transparency can reduce trust among users and hinder the adoption of AI solutions within organizations. Additionally, the high costs that are associated with developing and deploying these AI models can be prohibitive, particularly for smaller organizations that may lack the necessary resources and technical expertise.

Estimating the costs that are associated with lost revenue and other direct expenses tends to be more straightforward as these figures can often be quantified through concrete metrics such as downtime duration, repair expenses, and immediate revenue losses. However, identifying indirect and intangible costs poses a significant challenge. These costs, which include factors like reputational damage, customer attrition, and long-term productivity losses, are often more elusive and harder to quantify. They require a nuanced understanding of how cyber incidents ripple through various aspects of a business. As organizations increasingly rely on digital infrastructure, the importance of accurately estimating these indirect and intangible costs becomes critical for comprehensive risk assessment. This complexity underscores the necessity for advanced AI techniques that can capture the full spectrum of financial impacts that result from cyber disruptions, enabling organizations to make informed decisions and develop effective mitigation strategies.

Moreover, there are inherent risks related to cybersecurity and data privacy in utilizing these AI-driven models. The use of extensive datasets for training can expose sensitive information to potential cyberthreats, necessitating robust security measures to safeguard data. Furthermore, models that are trained on historical data may struggle to adapt to new or unforeseen disruptions, reducing their accuracy in dynamic environments. Finally, an overreliance on AI-generated insights can lead organizations to overlook critical human judgment and expertise, highlighting the need for a balanced approach that integrates AI tools with informed decision making and expert analysis.

Future R&D directions for AI-driven cost estimation in CPSs should prioritize enhancing data integration and quality while incorporating real-time

analytics to boost predictive accuracy. Researchers should focus on creating more interpretable AI models to build trust and improve user understanding. Exploring advanced techniques such as reinforcement learning and hybrid models that integrate AI with traditional risk assessment methods could lead to more robust estimations. Collaboration between academia and industry is vital to tackle practical challenges and ensure that models remain adaptable to evolving cyberthreats. Additionally, developing models that utilize data fusion techniques to better understand customer behavior will enhance the estimation of indirect and intangible costs, ultimately improving the performance of AI-driven solutions in assessing the financial impacts of disruptions. ■

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IEEE

The Impact on Canadian Manufacturing Workers From the Adoption of Intelligent Systems in the Workplace

by David Espinosa

Artificial intelligence (AI) is no longer just a field of academic inquiry. Machine learning (ML) and deep learning (DL) have become mainstream technologies that any organization can harness [1]. Many recent developments in robotics are driven by advances in AI [2]. The impact of robotics varies depending on industry, geographic area, and population groups. However, its biggest impact is in manufacturing, where we find 38% of the 1.3 million existing industrial robots in production [3]. Industrial robots; cobots driven by AI, ML, and DL and equipped with advanced sensors; data analytics capabilities; and integrated machine vision systems and onboard field-programmable gate array/GPU accelerators constitute what we now refer to as *intelligent systems for manufacturing* (*ISMs*), which, are reaching their plateau of productivity [6]. This means that they are becoming commodities with a global outreach.

ISMs: Adoption and Training Gap

There is an ongoing debate about the true social consequences of the widespread adoption of ISMs. Some studies find no evidence of net job destruction at the broad country level but report that employment growth has been much lower in jobs at high risk of automation [5]. Others argue that AI complements and augments labor rather than replacing it because only less than 10% of jobs can be fully automated [1]. And there are predictions that technology will expand aggressively to the point where robots will quadruple worldwide by 2025, triggering a 2% decrease in manufacturing wage growth between 2015 and 2025 [3] plus a 15% reduction of the global workforce, or roughly 400 million workers, could be displaced by automation by 2030 [7].

But for all the differences of opinion on which tasks, jobs, and industries will be most affected by ISM-based automation,

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most experts agree that it is imperative to provide the current and future workforce with the skills to integrate with and profit from the higher-skilled and potentially higher-paying opportunities that are being driven by the new technology. At the same time, decision makers need a clearer picture of low-skilled job opportunities that are indirectly created by technology-driven innovation. This will foster the development of policies and initiatives around training to assist low-skilled workers who are, for whatever reason, unable to upskill and move into other sectors [4].

To reduce the risk posed by automation, Canada must reduce the training gap between high/medium and low-skilled workers. Despite the need for upskilling, the opposite happens as individuals with high school credentials or apprenticeships/trade certificates receive less training in ISM development and management than those with college or university diplomas and degrees. According to Statistics Canada, in 2016, approximately 46% of the potential workforce nationally had low levels of formal education. Although this number has decreased since the turn of the century, it was still 38% in 2020. According to Canadian employment figures, the employment rate among this workforce has remained at roughly 50% for the past decade, meaning that only 4–5 million people are employed partially or full time. Canada's population is expected to grow 21% by 2050. If current training and employment trends continue, in 30 years, there will be approximately 11 million low-educated workers; only 5.5 million of them will be at work, and they will be mostly in the 35–59 age range. This is consistent with findings by the Organisation for Economic Cooperation and Development (OECD) that the ratio of working-age Canadians (ages 15–64) to every senior (ages 65 and over) will fall from 3.9 in 2018 to 2.4 in 2055, meaning that population aging is having an impact on both the supply and demand for labor. This will translate to 5.5 million people potentially, but not necessarily, who will be actively getting trained by midcentury.

The reasons why such a large percentage of the target population may not be getting access to training include struggling with their basic needs [14] while in school, and a still-insufficient policy direction regarding diversity and inclusion, assistance with mobility, and instruments to facilitate on-the-job learning. Evidence of this is that the primary providers of training, that is, public colleges, get 68% of all tuition fee revenue from international students, who pay, on average, CAD$14,306 in annual tuition fees, compared to a little more than CAD$3,000 for domestic students [8]. Furthermore, the average Canadian student debt is in the middle-to-high CAD$20,000 range. The Canadian Federation of Students pegs it at CAD$27,000, which is close to the nearly CAD$26,300 that many students said they expected to owe after graduation [9]. Clearly, Canada is on par with other OECD countries, where low-skilled workers participate much less than higher-skilled ones in training, including for developing and/or managing ISMs.

Most people still agree that getting a degree, diploma, or certificate leads to a better job. But they also concur that three-quarters of Canada's best jobs are inaccessible to 77.3% of working-age Canadians, namely, those without a degree [11]. Furthermore, the Canadian education system is finding it difficult to keep up with changes in the economy, social mobility, and the Fourth Industrial Revolution. Previously, we had multiple generations to adapt to a technological disruption. This time around, we'll have less than one generation to skill and reskill people [12].

Strategy for Reskilling the Canadian Workforce

Adapting to "look beyond skills" when developing training programs is still a work in progress for most Canadian colleges. We hypothesize that next-generation experiential training could help people learn new skills and use them to empower their talents as they are provided with motivators in the workplace. Skills can be learned in an institution and then perfected to achieve success. Talent is the innate ability of someone to do something. It often brings recognition and respect. Motivators are situations that provide a reason or a stimulus to get something done [13]. Next-generation experiential learning could be an engaged project-oriented learning process whereby students learn new skills that boost their talents by getting motivated and reflecting on the experience. It would require that employers work closely with academic institutions to align perceived business needs and projects with specific training products for targeting trainees.

The expected outcome of implementing a next-generation training method is to cut the number of low-skilled workers from 38% of the national workforce to 10% by 2050, thus narrowing the gap with high-/medium-skilled workers. This will in turn reduce the risk posed by automation by increasing the pool of low-skilled job opportunities that will be triggered by the widespread adoption of ISMs in manufacturing facilities across Canada.

The goals of the research, therefore, are to 1) provide a theoretical background to validate or refute our hypothesis, 2) clearly describe a staggered approach to address current and ideal national conditions on the state of risk to jobs and wages posed by automation and the Fourth Industrial Revolution, and 3) propose a set of countermeasures to prevent further economic deterioration of the low-skilled class, mostly because, as stated by Georgieff and Milanez [5]:

> "While automation does not appear to have had a negative net impact on employment over the long run, the job destruction narrative has persisted and perhaps even intensified. The crux of the reasoning underlying it is a belief that the present technological revolution is distinct from those of the past."

Each goal is broken down in the next sections.

Strategy for Reskilling the Canadian Workforce

Our theoretical background starts with the assumption that more needs to be done to bridge the widening gap between learning outcomes and the perceived skills/knowledge needed at work, which motivates "ordinary," "low," and "overly specialized" skilled workers to reskill and adapt to the changing workplace.

The challenges to this goal include, according to the OECD [17], that Canada displays one of the largest gaps in participation rates between high-/medium-skilled workers and low-skilled ones. Across OECD countries, low-skilled workers participate much less than higher-skilled workers in training, but this gap is particularly large in Canada (28 percentage points relative to 23 percentage points). Although changes in skills requirements due to technological change affect all workers, the growing demand for high-level cognitive skills and complex social interaction skills suggests that low-skilled workers in jobs that are intensive in repetitive or manual tasks are likely to bear the brunt of these changes [18]).

Despite having a greater need for upskilling, low-skilled workers receive less training than high-skilled workers. This is partially because the working class, especially women and visible minorities, lack the time or resources to enroll in and

complete training programs as they exist. Even with the advent of long-distance education, online courseware and in-class dynamics have consistently failed to deliver, as witnessed by Canada's COVID-19 elementary home-schooling programs.

From a policy standpoint, the structure of Canadian secondary systems, in virtually all provinces and territories, does not have a prominent vocational track. The apprenticeship system plays an important role in Canada's postsecondary education system as a source of workplace training. The Industrial Research and Development Internship program matches talented graduates with businesses in science, technology, engineering, and mathematics to help transition into the labor market. The Aboriginal Skills and Employment Training Strategy, funded at CAD$1.68 billion over five years (2010–2015), is the Government of Canada's broad-based labor market program for Aboriginal people across Canada. Apprentices in Red Seal trades can apply for grants (Apprenticeship Incentive Grants, 2007; Apprenticeship Completion Grants, 2009) up to CAD$4,000 to cover their expenses. Other financial support includes the Apprenticeship Job Creation Tax Credit (2006) for employers (up to CAD$2,000 per year for each apprentice), the Tradesperson's Tools Deduction (2007), and tax eligibility of examination fees for trade certification.

Education counselling strategies that strengthen student pathways, support learning and skills development, and retain or attract skilled individuals to participate in the labor market have yet to directly address the specifics of adjusting to an increasingly technological skill set. Governments must invest time and effort in reforming education standards to make them more agile, cross disciplinary, and connected to reality in the workplace.

Another challenge is that public and private education has not fundamentally changed since it was first implemented. We still take classes, write exams, and segregate knowledge according to curricula and learning objectives. Courses and adult training programs are implemented around instructional design, needs assessment results to define outcome statements, and ensuring that learning objectives align with them. Even though cross-disciplinary programs are now widely offered across all postsecondary and trade schools, and there have been many new approaches to alternative education, like constructivism, project-oriented learning, flipped classrooms, and open universities, most of these innovations have not been implemented in adult education. Concerning ISM-based automation, current training does not seem to equip graduates with the skills that are needed to become stakeholders in adopting AI in the workplace.

At the instructional level, the challenge lies in applying "skills" in a highly intradisciplinary environment. Some workers have years of experience and are experts in their core competence area, but they may find it hard to find the motivation to adapt and retrain. However, ISMs (AI, data science, and ML) are starting to require less coding and software engineering, but more data manipulation, classification, interpretation, and visualization, which leads to cross- and multidisciplinary activities. This trend has been augmented by the introduction of generative AI (GenAI) as a tool that can simplify and make accessible an increasing number of engineering and software development tasks, like those that are uses to develop AI and ML software.

Nevertheless, GenAI is still unable to replace humans at work because it requires using criteria, judgment, analytical thinking, and experience, all of which generally come from more than one area. Therefore, we need to apply skills in a cross-disciplinary fashion.

There is no standardized academic-to-industrial process to assist with keeping training on par with industrial needs. Toyota Business Practice (TBP) [19], Genchi Genbutsu, and JKK are excellent tools for building a structured approach to problem-solving. They can be adapted well to tackle ISM technical problems from an ISM requirement.

Necessary Skills for the Successful Adoption of AI in the Workplace

According to the IBM Institute for Business Value [15], behavioral skills now make up 50% of the skill set now seen as critical for workforce members today (see Figure 1). Behavioral skills are the top four in the list compiled by IBM. Many other studies point in the same direction.

Among the core and technical skills, the ability to make good judgments and quick analytical and business decisions stands out as a transdisciplinary core competence that people typically acquire through on-the-job experience but not necessarily out of school, college, or

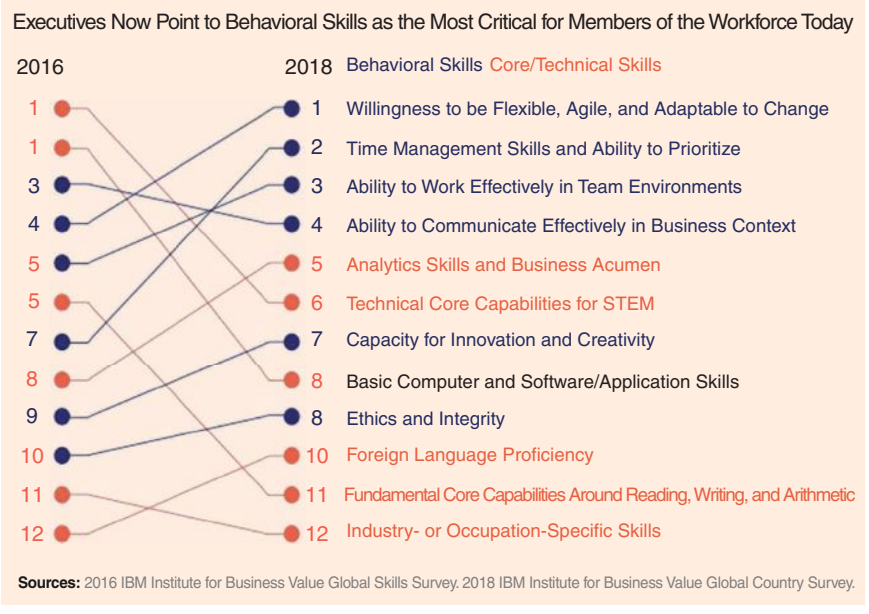

Figure 1: The behavioral skills that are critical for members of the workforce today. STEM: science, technology, engineering, and mathematics.

Table 1: Activity profiles that fit workplace reskilling.

Primary Activity	Professional, Scientific, and Technical Services Industry	Manufacturing Industry
Planning	Business management	Engineering management
Organizing	Product/service tactical direction	Industrial process direction
Implementing	Software development	Industrial activity execution

university training. Table 1 shows three sample profiles that fit many possible scenarios in the workplace, as classified by industry according to the North American Industry Classification System [16].

There seem to be two intradisciplinary and opposite lines of thinking among software developers. One is that development is done for the sake of business ("planning" or "organizing" in Table 1); hence, developers must understand problems at stake as gaps between a quantifiable current and a target/ideal condition, as is done on the TBP methodology. The second point of view is not to cross the line between coding and strategy planning or business analysis, making a purely technical achievement the path to follow ("implementing" in Table 1). We argue that any future academic design for a corporate training program must include a transition and a road map for moving from intradisciplinary to transdisciplinary, which is the same as reskilling the workforce in ideally a mix of all three types of primary activities. Figure 2 shows the proposed road map.

Next-Generation Training Strategy

The strategy brings together a network of stakeholders from academia, business, and labor as well as students to look for the relevant initiatives that support education and skills development and lead to labor market participation. In particular, the strategy aims to enhance the education and preparation of students for the labor force, for example, by providing them with labor market information, connecting them with employment counselors at an earlier age, expanding teen apprenticeship programs, working with high school students to create transition plans to postsecondary education and/or the labor market, partnering with postsecondary institutions and employers to increase opportunities for experiential learning, and facilitating credit transfers between postsecondary institutions.

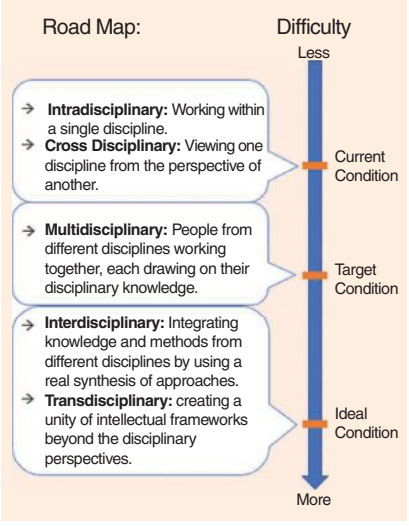

Figure 2: A road map for incorporating new skills into training programs.

Learners need to become good at negotiating, pitching, reporting, making conference calls, programming, testing, documenting, deploying, confirming, maintaining, managing, moving, and improving applications or processes that rely on or use intelligent systems. In other words, workers could reinvent themselves to become the administrators of the technology that is perceived as a threat to their job security. Training for adaptive reinvention of soft skills and technical competence must be offered as internships with direct collaboration between academics and employers.

Classrooms must stop being controlled environments where computers, software, and learning resources are preset and in perfect working order. Rather, they should resemble the workplace, where things don't work or are incomplete or are simply ideas, proofs of concept, or designs that need to be finished, preferably by teams of people with diverse backgrounds and expertise levels.

A staggered approach is proposed to address current and ideal national conditions on the state of risk to the jobs and wages posed by automation. The strategy suggests bridging over to AI-ISM-enhanced educational counselling in three levels, each more innovative than the previous:

1. *Level 1—performance-driven automation*: This approach is more cognizant of humans' role in the loop. Processes and systems are re-engineered to utilize automation while using human skills and capabilities to fill in technological shortfalls. The target is to lower the risk to jobs and wages posed by automation by giving workers core technical skills to blend with their previous experience, and integrate processes and best practices that the ISM innovations cannot provide (the "implementing" activity in Table 1).
2. *Level 2—worker-centered automation*: At this level, the business goal is performance optimization, worker development, and enrichment. In these systems, the goal of automation is not to sideline people or replace them with machines but to encourage new forms of human–machine interaction that augment human capabilities. The target is to lower the risk to jobs and wages posed by automation by giving workers cognitive skills to help them become experts in the new AI or ML technology (the "organizing" activity in Table 1).
3. *Level 3—socially responsible automation*: At the top of the pyramid, automation is deployed to produce more and better jobs for humans, driving economic growth and promoting societal well-being. Attaining such a lofty goal requires "explicit, active interventions." Business leaders must commit to proactively identifying new revenue streams and job-enabling growth as they roll out and refine automation. The target is to lower the risk to jobs and wages posed by automation by giving workers analytical and business skills to help them become managers of the new ISM, AI, or ML technology (the "planning" activity in Table 1).

Next-Generation Training Program

This is a glimpse into an education counselling project between a college or university and a company, organization, start-up, federal agency, or business partner. It characterizes the following set of countermeasures to help reskill members of the worker class and help them achieve work security:

- Offer TBP and JKK training to the academia involved in the process.
- Collect the milestones, strategic goals, and perceived gaps that are associated with AI, Industry 4.0, and the Internet of Things (IoT) from the business partner.
- The business project teams produce a TBP from each milestone in step 2.
- The academic partner works with the business to sign project-specific nondisclosure agreements.
- The business shares selected TBPs with the faculty.
- The faculty meets with business project teams to reach a consensus on internship rules and intern profiles.
- The college faculty provides TBP and JKK training to prospective interns.
- The college works with business human resource and project teams to interview and hire interns for a one-year term.
- Before the start of the internship, the business project teams meet with college faculty and selected interns to define the one-year project TBP, scope, expectations, and schedule.
- Before starting the internship, students take additional college courses to help with technical, business, and skills training.

- The academic internship begins at the business partner's premises.
- The college faculty continues to mentor students in technology and process engineering.
- Students and academics help train the business team members on project-specific AI, Industry 4.0, and IoT products and technology.
- Student evaluations come from company business and project teams.

The hypothesis is that this methodology will provision technological innovation that is well implemented in the business workplace and improve the learning and skills development of the business workforce by giving them the ability to make good judgments and quick analytical and business decisions to make them developers and administrators of ISM systems, rather than keeping them at risk of being displaced.

The following key performance indicators should be looked for during and after the project:

- Was the outcome focused on manpower reduction or on process re-engineering?
- Are business team members able to manage the technology?
- Was the student able to introduce new technology as a tool with an added value to the business?
- Does the student understand the process of provisioning, deploying, testing, training, and using UAT technology?
- Were all the completed (even if not-yet successfully implemented) projects made visible across the organization to encourage participation in future endeavors?
- Is the business partner on the right track to promote and manage a healthy balance of performance-driven, worker-centered, and socially responsible automation initiatives?
- Can the faculty team communicate the importance of designing and implementing a road map for moving from their specific current condition to their desired target and/or ideal conditions as portrayed in Figure 2?

Conclusions

Canada is well positioned as a global leader in AI, particularly in developing world-class research, skilled talent, and leadership on important topics and considerations such as privacy, transparency, and ethical use of this technology. Canada is quickly developing outstanding post-secondary research institutions with substantial expertise in world-renowned AI clusters in Montréal, Toronto, and Edmonton. Many leading companies worldwide have recognized these strengths and established research labs and other operations in Canada to capitalize on Canadian AI development. The ability to generate economic, social, industrial, and cultural opportunities from our current strengths will depend, to some extent, on our ability to transform the technological threat into an opportunity for the development and well-being of the working class, especially those low-skilled workers in jobs that are intensive in repetitive or manual tasks. ■

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About the Author

David Espinosa (eespinosa@conestogac.on.ca) is with the School of Applied Computer Science and Information Technology, Conestoga College Institute of Technology and Advanced Learning. He holds a Ph.D. in Artificial Intelligence and a Masters in business, entrepreneurship and technology.


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pour service méritoire dans l'est du Canada au niveau des sections et zones locales de l'IEEE

IEEE Canada Operational Committees Leaders at their Annual 2025 General meeting in Toronto on Feb 08, 2025.

2024 IEEE CANADA A.G.L. MCNAUGHTON AWARD
PRIX A.G.L. MCNAUGHTON DE L'IEEE CANADA 2024

For contributions to engineering in digital speech processing and wireless networks as well as to pioneering educational programs in sustainable energy, technology innovation management, and biomedical engineering.
En raison de son implication dans l'ingénierie du traitement numérique de la parole et des réseaux sans fil, ainsi que dans la création de programmes éducatifs novateurs dans les domaines de l'énergie durable, de la gestion de l'innovation technologique et de l'ingénierie biomédicale.

Samy A. Mahmoud, Ottawa, ON

Dr. Samy A. Mahmoud received his master's and Ph.D. degrees in electrical engineering from Carleton University in 1971 and 1975, respectively. He joined the Faculty of Engineering in 1975 and held the positions of chair of the Department of Systems and Computer Engineering, dean of the Faculty of Engineering and Design, and president and vice chancellor (interim) of Carleton (2008–2006). At present, he is professor emeritus with the Faculty of Engineering and Design at Carleton University.

His research efforts over the past 35 years have focused on two interrelated areas. The first is the measurements and characterization of wireless radio channels in different frequency bands, which contributed to the development of LTE and 5G networks. The second is the statistical characterization of speech, including the development of low-bit-rate speech coding techniques that were transferred to industry. The results of his research have been presented in 190 archived publications. Dr. Mahmoud has supervised 40 doctoral and 84 master's degree students and 15 postdoctoral fellows in his research programs. He has

received several Canadian national and international awards in recognition of his original research contributions that have led to technology transfer to industry. He was also a cofounder of several national networks of excellence in R&D.

On the engineering education front, several pioneering engineering programs were introduced under his leadership. The first master's degree program in Canada in technology innovation management was introduced in 1996. One of the first undergraduate engineering programs on sustainable energy in Canada was launched in 2004. In addition, undergraduate and graduate programs in biomedical engineering, among the first in Canada, were developed and launched in early 2000. ■

Le Dr. Samy A. Mahmoud a obtenu une maîtrise et un doctorat en génie électrique de l'Université Carleton en 1971 et 1975, respectivement. En 1975, il a intégré la faculté d'ingénierie et a assumé les fonctions de président du département de génie des systèmes et de l'informatique, ainsi que de doyen de la faculté d'ingénierie et de conception. Il a aussi occupé le poste de président et vice-chancelier (par intérim) de l'Université Carleton de 2006 à 2008. À l'heure actuelle, il est professeur émérite en ingénierie et conception à l'Université Carleton.

Au cours des 35 dernières années, il a mené des recherches dans deux domaines interreliés. Le premier est la caractérisation des canaux radio sans fil dans différentes bandes de fréquences, ce qui a contribué au développement des réseaux LTE et 5G. Le deuxième concerne la caractérisation statistique du discours, en incluant l'élaboration de techniques de codage du langage à faible Débit binaire qui ont été déployées dans l'industrie. Il a présenté les résultats de ses recherches dans 190 publications archivées. Le professeur Mahmoud a supervisé 40 doctorants, 84 étudiants de maîtrise ainsi que 15 boursiers postdoctoraux dans ses programmes de recherche. Ses contributions originales à la recherche, qui ont abouti au transfert de technologie vers l'industrie, lui ont valu plusieurs récompenses nationales et internationales. Il a aussi contribué à la création de plusieurs réseaux nationaux d'excellence en recherche et développement.

Il a présenté les résultats de ses recherches dans 190 publications archivées.

Il a dirigé la mise en place de plusieurs programmes d'ingénierie pionniers dans le domaine de l'éducation en génie. Le premier programme de maîtrise au Canada a été instauré en 1996 dans le domaine de la gestion de l'innovation technologique. En 2004, l'un des premiers programmes de premier cycle en génie sur l'énergie durable au Canada a été initié. De plus, des programmes de premier et deuxième cycle en génie biomédical, parmi les premiers au Canada, ont été développés et initiés au début de 2000. ■

C.C. GOTLIEB COMPUTER AWARD
PRIX C.C. GOTLIEB EN INFORMATIQUE

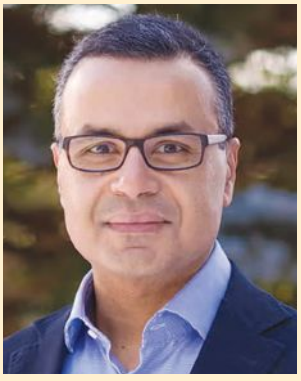
For contributions to building large-scale machine learning systems for data integration, data cleaning, and knowledge construction.
Pour sa participation à la mise en place de systèmes d'apprentissage automatique à grande échelle pour l'intégration des données, la purification des données et la création de connaissances.

Ihab Ilyas, Waterloo, ON

Dr. Ihab Ilyas (Fellow, IEEE) is a professor of computer science and the Thomson Reuters Research Chair on Data Quality at the University of Waterloo. He is currently on leave at Apple as a distinguished engineer. His main research focuses on data science and data management, with a special interest in data quality and integration, managing uncertain data, machine learning for data curation, and information extraction.

Dr. Ilyas is a cofounder of Tamr, a start-up focusing on large-scale data integration, and was the cofounder of Inductiv (acquired by Apple), a Waterloo-based start-up that uses artificial intelligence for structured data cleaning.

He is a Fellow of IEEE and the Association for Computing Machinery (ACM). He is also a recipient of the Ontario Early Researcher Award, a Cheriton Faculty Fellowship, an NSERC Discovery Accelerator Award, and a Google Faculty Award. He was an elected member of the VLDB Endowment Board of Trustees (2016–2021) and was elected the ACM SIGMOD vice chair (2016–2021).



Dr. Ilyas has authored numerous high-impact publications in top research venues, including a textbook on data cleaning. He received his Ph.D. degree in computer science from Purdue University, West Lafayette. ■

Le Dr. Ihab Ilyas (Fellow, IEEE) est professeur d'informatique, titulaire de la chaire de recherche Thomson Reuters sur la qualité des données, à l'Université de Waterloo. Il est actuellement détaché chez Apple en qualité d'ingénieur distingué. Ses recherches principales portent sur la science des données et la gestion des données, avec un intérêt particulier pour la qualité et l'intégration des données, la gestion des données incertaines, l'apprentissage automatique pour la curation des données, et l'extraction de l'information.

Ihab est le co-fondateur de Tamr, une startup qui se spécialise dans l'intégration de données à grande échelle, et il a également été le co-fondateur d'Inductiv (acquis par Apple), une start-up établie à Waterloo qui utilise l'intelligence artificielle pour purifier les données structurées.

Il est membre fellow de l'ACM et de l'IEEE. Il a également reçu le prix nouveaux chercheurs de l'Ontario, la bourse de recherche pour les professeurs Cheriton, du supplément accélération à la découverte du CRSNG et du prix Google Faculty. Il a été élu membre du conseil d'administration de la VLDB Endowment (2016–2021) et a été élu vice-président de l'ACM SIGMOD (2016–2021).

Il est l'auteur de plusieurs publications qui ont eu un impact considérable, y compris un manuel sur le nettoyage des données. Il est titulaire d'un doctorat en informatique de l'université Purdue, à West Lafayette. ■

EIC Medals/Médailles ICI

Julian C. Smith Medal
For achievement in the development of Canada
Samuel Pierre, Ph.D., FEIC, FCAE, O.C., O.Q.
Professor, Polytechnique Montreal, QC

P.D. ZIOGAS ELECTRIC POWER AWARD
PRIX P.D. ZIOGAS DE L'ENERGIE ELECTRIQUE

For contributions to the field of power system operations, including ancillary services and demand response programs, economics, and planning.
Pour sa contribution au domaine de l'exploitation des réseaux électriques, y compris les services auxiliaires et les programmes de réponse à la demande, l'économie et la planification.

Kankar Bhattacharya, Waterloo, ON

Dr. Kankar Bhattacharya (Fellow, IEEE; P. Eng.) received his Ph.D. degree from Indian Institute of Technology Delhi, India. He is a professor and university research chair and IEEE department chair with the Department of Electrical and Computer Engineering at the University of Waterloo.

Prof. Bhattacharya has made important contributions to the development and understanding of electricity markets, reactive power ancillary services, demand response, various topics in smart grids, energy storage systems in electricity markets, and electric vehicle integration to distribution systems. He has published extensively in international journals of repute and has a Google Scholar citation count of more than 13,000 with an H-index of 58. He has supervised to graduation 35 Ph.D. and 29 M.Sc. students.

Prof. Bhattacharya received the 2001 Gunnar Engstrom Foundation Award

from ABB Sweden for research in power system economics. At the University of Waterloo, he received the Outstanding Performance Award and the 2019–2020 Award for Excellence in Graduate Supervision. Prof. Bhattacharya is a distinguished member of CIGRE and received the 2018 CIGRE Technical Council Award for contributions to CIGRE Study Committee C5, in which he is active and served as Canadian National Member (2014–2024). He is a Fellow of IEEE for contributions to electricity markets and reactive power ancillary services. ■

Kankar Bhattacharya (Fellow, IEEE; P. Eng.; PhD, IIT Delhi, Inde), est professeur, titulaire d'une chaire de recherche universitaire et président du département d'ingénierie électrique et informatique de l'Université de Waterloo.

Le professeur Bhattacharya a apporté d'importantes contributions au développement et à la compréhension des marchés de l'électricité, des services auxiliaires de puissance réactive, de la réponse à la demande, de divers sujets dans les réseaux intelligents, les systèmes de stockage d'énergie sur les marchés de l'électricité et l'intégration des véhicules électriques dans les réseaux de distribution. Ses publications dans des revues internationales renommées ont suscité plus de 13000 citations sur Google Scholar, avec un indice H de 58. Il a supervisé 35 doctorants et 29 étudiants en maîtrise.

Le professeur Bhattacharya a été distingué en 2001 par le prix de la fondation Gunnar Engstrom d'ABB Suède pour ses travaux de recherche en économie des systèmes électriques. À l'Université de Waterloo, il a reçu le prix pour la performance exceptionnelle et le prix 2019–2020 pour l'excellence dans l'encadrement d'étudiants aux études supérieures. Dr. Bhattacharya est un membre distingué du CIGRE et récipiendaire du prix 2018

Il a été désigné Fellow IEEE pour avoir contribué aux marchés de l'électricité et aux services auxiliaires de puissance réactive.

du conseil technique du CIGRE pour ses contributions au comité d'étude C5 du CIGRE. Il est membre actif du Conseil d'administration de l'ACDI, dont il est membre national (2014–2024). Il a été désigné Fellow IEEE pour avoir contribué aux marchés de l'électricité et aux services auxiliaires de puissance réactive. ■

R.A. FESSENDEN AWARD
PRIX R.A. FESSENDEN

For contributions to the field of telecommunications and industry leadership.
Pour sa contribution au domaine des télécommunications et son rôle de meneur dans l'industrie.

Octavia A. Dobre, St. John's, NF

Dr. Octavia A. Dobre (Fellow, IEEE) is a Tier-1 Canada Research chair and professor with Memorial University, Canada. She was a visiting professor with the Massachusetts Institute of Technology, USA, and Universite de Bretagne Occidentale, France.

Her research interests encompass wireless communication and networking technologies as well as optical and underwater communications. She has (co-)authored more than 500 refereed papers in these areas. Dr. Dobre serves as VP Publications of the IEEE Communications Society. She was the founding editor-in-chief (EIC) of *IEEE Open Journal of the Communications Society* and EIC of *IEEE Communications Letters* as well as the inaugural chair of the Women in Communications Engineering Standing Committee.

Dr. Dobre was a Fulbright Scholar, Royal Society Scholar, and Distinguished Lecturer of the IEEE Communications Society. She obtained seven IEEE Best Paper Awards, including the 2024 Heinrich Hertz Award. Dr. Dobre is an elected member of the European Academy of Sciences and Arts and a Fellow of IEEE, the Engineering Institute of Canada, and Canadian Academy of Engineering. ■

Octavia A. Dobre (Fellow, IEEE) occupe le poste de professeure à l'Université Memorial, au Canada, et détient une chaire de recherche du Canada de niveau 1. Elle a été professeur invité au Massachusetts Institute of Technology, USA, et à l'Université de Bretagne Occidentale, France.

Ses recherches portent sur les technologies de communication sans fil et de réseautage, ainsi que sur les communications optiques et sous-marines. Elle a (co-) écrit plus de 500 articles référencés dans ces domaines. Dr. Dobre exerce en tant que vice-présidente des publications au sein de l'IEEE Communications Society. Elle a été rédactrice en chef et fondatrice du journal IEEE Open Journal of the Communications Society, rédactrice en chef de IEEE Communications Letters, ainsi que la première présidente du comité permanent des femmes en génie des communications.

La Dr Dobre était boursière Fulbright, boursière de la Royal Society et conférencière émérite de l'IEEE Communications Society. Elle a été récompensée par sept prix du meilleur papier IEEE, y compris le Heinrich Hertz Award 2024. La Dr Dobre est membre élue de l'Académie européenne des sciences et des arts, fellow de l'Institut canadien d'ingénierie, fellow de l'Académie canadienne du génie et fellow de l'IEEE. ■

La Dr Dobre était boursière Fulbright, boursière de la Royal Society et conférencière émérite de l'IEEE Communications Society.

EIC Fellows/Fellows ICI
Inducted as 2024 EIC Fellows

For excellence in engineering and services to the profession and society
David Anthony Clausi, Professor, Univ. of Waterloo, Waterloo, ON
Naser El-Sheimy, Professor, Univ. of Calgary, Calgary, AB
Elise Fear, Professor and Assoc. Dept Head, Univ. of Calgary, Calgary, AB
Baochun Li, Professor, Univ. of Toronto, Toronto, ON
Zhenguo Lu, Team Lead, National Research Council of Canada, Ottawa, ON
Medhat Moussa, Professor and Dept Head, Univ. of Guelph, Guelph, ON
Thamir (Tom) Murad, Country Lead (VP), Siemens Mobility, Oakville, ON
Vincent Wong, Professor, Univ. of British Columbia, Vancouver, BC
Svetlana Yanushkevich, Assoc. Dean Research, Univ. of Calgary, Calgary, AB

J.M. HAM OUTSTANDING ENGINEERING EDUCATOR AWARD
PRIX J.M. HAM D'ÉDUCATEUR EXCEPTIONNEL EN GÉNIE

For contributions to education and training in wireless communications and networks.
Pour sa contribution à l'éducation et à la formation dans le domaine des communications et des réseaux sans fil.

Ekram Hossain, Winnipeg, MB

Dr. Ekram Hossain (Fellow, IEEE) is a professor and the associate head (graduate studies) of the Department of Electrical and Computer Engineering at the University of Manitoba, Canada.

He is a member (Class of 2016) of the College of the Royal Society of Canada. He is also a fellow of the Canadian Academy of Engineering and the Engineering Institute of Canada. His current research interests include the design, analysis, and optimization of next-generation cellular wireless networks, applied machine learning, and communication network economics.

Dr. Hossain was elevated to IEEE Fellow for contributions to spectrum management and resource allocation in cognitive and cellular radio networks. He was listed as a Clarivate Analytics Highly Cited Researcher in Computer Science (2017–2023).

He has won several research awards, including the 2017 IEEE Communications Society Best Survey Paper Award and the 2011 IEEE Communications Society Fred Ellersick Prize Paper Award. Dr. Hossain was a Distinguished Lecturer of the IEEE Communications Society and the IEEE Vehicular Technology Society. He served as editor-in-chief for *IEEE Press* (2018–2021) and *IEEE Communications Surveys and Tutorials* (2012–2016). He served as director of magazines (2020–2021) and director of online content (2022–2023) for the IEEE Communications Society. ■

Ekram Hossain (Fellow, IEEE) est professeur et directeur associé (études supérieures) du département de génie électrique et informatique de l'Université du Manitoba, au Canada. Il est membre (promotion de 2016) du Collège de la Société royale du Canada. Il est également membre de l'Académie canadienne du génie et de l'Institut canadien d'ingénierie. Ses recherches actuelles portent sur la conception, l'analyse et l'optimisation des réseaux sans fil cellulaires de nouvelle génération (xG), Apprentissage machine appliqué et économie des réseaux de communication.

Ses contributions à la gestion du spectre et à l'allocation des ressources dans les réseaux de radio cellulaire et cognitifs lui ont valu le titre de Fellow IEEE. Selon Clarivate Analytics, il est classé parmi les chercheurs en informatique les plus cités pour la période de 2017 à 2023. Il a remporté plusieurs prix de recherche, dont le prix 2017 IEEE Communications Society (ComSoc) Best Survey Paper et le prix 2011 IEEE Communications Society Fred Ellersick Prize Paper. Il a été un conférencier distingué de la IEEE Communications Society et de l'IEEE Vehicular Technology Society. Il a été rédacteur en chef de la revue IEEE Press (2018–2021) et IEEE Communications Surveys and Tutorials (2012–2016). En 2020–2021, il a pris en charge les rôles de directeur des magazines et de directeur du contenu en ligne au sein de l'IEEE Communications Society. ■

2024 MGA Young Professionals Achievement Award

(Up to six awarded annually, receive plaque and US$250)

To recognize those substantive projects or achievements of a relatively short nature (one to three years), but which have left an undeniable imprint on the fabric of IEEE Young Professionals' operations.

Anand Rajendrabhai Shah (R7), Vancouver Section
For the creation, development and implementation of the IEEE wide Virtual Paid Internship and career fairs.

OUTSTANDING ENGINEER
PRIX D'EXCELLENCE EN GÉNIE AWARD

For contributions to the theory and applications of networked and distributed control, model predictive control, autonomous intelligent mechatronics, and industrial cyber-physical systems.
Pour les contributions à la théorie et aux applications du contrôle en réseau distribué, contrôle prédictif par modèle, mécatronique intelligente autonome et aux systèmes cyber-physiques industriels.

Yang Shi, Victoria, BC

Dr. Yang Shi (Fellow, IEEE) received his B.Sc. and Ph.D. degrees in mechanical engineering and automatic control from Northwestern Polytechnical University, Xi'an, China, in 1994 and 1998, respectively, and his Ph.D. degree in electrical and computer engineering from the University of Alberta, Edmonton, AB, Canada, in 2005.

He is a professor in the Department of Mechanical Engineering at the University of Victoria, Victoria, BC, Canada. His current research interests include networked and distributed systems, model predictive control, cyber-physical systems, robotics and mechatronics, navigation and control of autonomous systems (autonomous underwater vehicles and autonomous aerial vehicles), and energy system applications.

For teaching and mentorship, Dr. Shi received the University of Saskatchewan Student Union Teaching Excellence Award (2007), and the Faculty of Engineering Teaching Excellence Award (2012) at the University of Victoria (UVic), and the 2023 REACH Award for Excellence in Graduate Student Supervision and Mentorship. For research, he is the recipient of the JSPS Invitation Fellowship (short term) (2013), the UVic Craigdarroch Silver Medal for Excellence in Research (2015), the 2017 IEEE Transactions on Fuzzy Systems Outstanding Paper Award, the Humboldt

Research Fellowship for Experienced Researchers (2018), the CSME Mechatronics Medal (2023), and the IEEE Dr.-Ing. Eugene Mittelmann Achievement Award (2023). Dr. Shi is an International Federation of Automatic Control council member (2023–2026) and the vice president on conference activities of the IEEE Industrial Electronics Society (IES) (2022–2025). He was the founding co-chair (2014–2018) and then chair of the IEEE IES Technical Committee on Industrial Cyber-Physical Systems (2018–2022). During 2017–2023, he served as co-editor-in-chief of *IEEE Transactions on Industrial Electronics*. Currently, he serves as associate editor for *Automatica*, *IEEE Transactions on Automatic Control*, and *Annual Review in Controls*, among others. Dr. Shi is a Distinguished Lecturer of the IES. He is a Fellow of IEEE, the American Society of Mechanical Engineers, CSME, EIC, CAE, and a registered professional engineer in British Columbia, Canada. ■

Yang Shi (Fellow, IEEE) a obtenu son B.Sc. et doctorat. diplômes en génie mécanique et contrôle automatique de l'Université polytechnique du Nord-Ouest, Xi'an, Chine, en 1994 et 1998, respectivement, et doctorat. diplôme en génie électrique et informatique de l'Université de l'Alberta, Edmonton, AB, Canada, en 2005.

Il est professeur au Département de génie mécanique, Université de Victoria, Victoria, Colombie-Britannique, Canada. Ses intérêts de recherche actuels comprennent les systèmes en réseau et distribués, le contrôle prédictif de modèles (MPC), les systèmes cyber-physiques (CPS), la robotique et la mécatronique, la navigation et le contrôle des systèmes autonomes (AUV et UAV) et les applications des systèmes énergétiques.

En matière d'enseignement et de mentorat, Dr. Shi a reçu le prix d'excellence en enseignement de l'University of Saskatchewan Student Union en 2007 et le Prix d'excellence en enseignement en 2012 de la faculté d'ingénierie de l'Université de Victoria, ainsi que le Prix REACH pour l'excellence en supervision et mentorat des étudiants en cycles supérieurs en 2023. En ce qui concerne la recherche, il a reçu la bourse JSPS Invitation (court terme) en 2013, la médaille d'argent UVic Craigdarroch pour l'excellence en recherche en 2015, le prix IEEE Transactions on Fuzzy Systems Outstanding Paper Award 2017, la bourse de recherche Humboldt pour chercheurs expérimentés en 2018; médaille de CSME Mechatronics (2023); IEEE Dr.-Ing. Prix d'excellence Eugene Mittelmann Achievement Award (2023). Il est membre du conseil d'administration de l'IFAC (2023–2026); vice-président des activités de conférence de l'IEEE IES (2022–2025); de 2014 à 2018, il a été coprésident fondateur, puis président du comité technique de l'IEEE IES sur les systèmes cyber-physiques industriels, de 2018 à 2022. De 2017 à 2023, il a été corédacteur en chef de IEEE Transactions on Industrial Electronics. Il est actuellement rédacteur associé pour Automatica, IEEE Transactions on Automatic Control, Annual Review in Controls, etc. Il est un conférencier distingué de l'IES. Il est membre de l'IEEE, de l'ASME, du CSME, de l'EIC et du CAE, et ingénieur professionnel agréé en Colombie-Britannique, au Canada. ■

J.J. ARCHAMBAULT EASTERN CANADA MERIT AWARD
PRIX DU MERITE J.J. ARCHAMBAULT POUR L'EST DU CANADA

For volunteering contributions as chair of the IEEE Montréal Section and its EMC Chapter, and for promoting science, technology, engineering, and mathematics and women in engineering.
Pour ses contributions bénévoles en tant que président(e) de la section IEEE de Montréal et de son chapitre CEM, et pour la promotion de STEM et des femmes en ingénierie.

Amy Pinchuk, Pointe-Claire, PQ

Dr. Amy Pinchuk is the president and founder of InField Scientific Inc, which specializes in electromagnetic compatibility and electromagnetic interference (EMC/EMI), electromagnetic environmental effects (E3), radiation hazards, and computational electromagnetic analysis. For the past 30 years, her primary focus has been on electromagnetic analysis, EMI troubleshooting, and testing of military shipboard environments.

Dr. Pinchuk has taught short courses on EMC/EMI/E3 and computational electromagnetics to civilian and military audiences of all levels. She received her B. Eng. (1983), M. Eng. (1985), and Ph.D. degrees (1988) from McGill University under the supervision of Dr. Peter Silvester.

Dr. Pinchuk has served on the organizing committee of many International IEEE EMC Symposiums and initiated the IEEE EMC Symposium Youth Technical Program. She was also a member of the IEEE EMC Society Board of Directors, the IEEE Montréal Section chair, the Canadian chair for URSI Section B, and chair of the Montréal IEEE EMC Chapter. She is also the author of several children's books that focus on engineering for youngsters. ■

Dr Amy Pinchuk est présidente et fondatrice d'InField Scientific Inc., spécialisée dans les domaines de la compatibilité électromagnétique et des interférences (CEM/EMI), effets de l'environnement électromagnétique (E3), risques radiologiques (RADHAZ) et analyse électromagnétique computationnelle. Depuis trente ans, son domaine d'expertise principal est l'analyse électromagnétique, le diagnostic des problèmes associés aux interférences et les essais effectués dans les environnements des navires militaires.

Dr. Pinchuk a donné des cours intensifs sur l'électromagnétique CEM/EMI/E3 et calcul électromagnétique à l'intention d'audiences civiles ou militaires de tous niveaux. Elle a obtenu son doctorat (1988), le M. Eng. (1985) et le B. Eng. (1983) de l'Université McGill sous la supervision du Dr Peter Silvester.

Dr. Pinchuk a pris part aux comités d'organisation de nombreux symposiums internationaux de l'IEEE EMC et a mis en place le programme technique pour les jeunes lors du symposium IEEE EMC. Elle a aussi fait partie du conseil d'administration de la IEEE EMC Society, a été présidente de la section IEEE Montréal, a présidé la section B de l'URSI et a dirigé le chapitre IEEE EMC de Montréal. Elle est aussi l'auteur de plusieurs ouvrages pour enfants qui se penchent sur l'ingénierie pour les jeunes. ■

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Dennis Cecic (R7), Toronto Section
For outstanding contributions, dedication and exemplary leadership of IEEE Student Activities through STEM workshops for high school students and teachers.

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2023 YEAR IN REVIEW—We want to thank you again and recognize your support to the IEEE Canadian Foundation in 2023. Each gift has an impact on future generations and current practitioners and is managed to meet the highest expectations of donor intentions.

Donations from individuals and organizations were $17,272 to General Fund programs, $2,168 to designated funds, and $110,812 to new enduring endowments. All programs continued for support of the IEEE Canada community, despite the disruptions to student, academic, industry and professional life.

Our Mission—Your gifts enhance the learning experience for electrical, electronics, and computer engineering students across Canada with our programs of McNaughton Centres and Scholarships.

Students and other recipients also benefit through the cofunding of special projects that develop engineering enthusiasm and skills at all levels. Increasingly, these projects use technology for the benefit of humanity. "Success Stories" on our website, the monthly IEEE Canada newsletter, and in this magazine demonstrate the wide range of technical, professional, and development opportunities that your gifts support.

Our General Fund is crucial to our ability to operate each and every year, and your undirected donations allow us to keep our base strong.

Our endowed funds support a wide range of awards, prizes and scholarships. Please consider a directed donation to endow a new IEEE Canada award of your choosing.

Donor Impact—Gifts may be designated to any one of the following funds of the IEEE Canadian Foundation.

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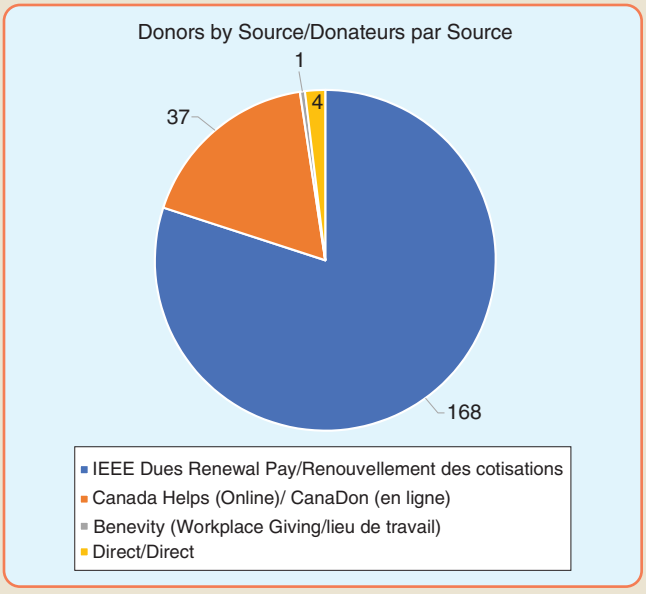

BILAN DE L'ANNÉE 2023—Nous tenons à vous remercier encore une fois et à rcconnaître votre soutien à la Fondation canadienne de l'IEEE en 2023. Chaque don a un impact sur les générations futures et les praticiens actuels et aussi est géré pour rédpondre aux attentes les plus élévees des intentions des donateurs.

Les dons de particuliers et d'organismes ont été 17 272 $ aux programmes du Fonds général, 2 168 $ aux programmes désignés et 110 812 $ aux nouvelles dotations durables. Tous les programmes se sont poursuivis pour soutenir la communauté IEEE Canada, malgré les perturbations de la vie étudiante, universitaire, industrielle et professionnelle.

Notre mission—Vos dons améliorent l'expérience d'apprentissage des étudiants en électricité, en électronique et en génie informatique à travers le Canada grâce à nos programmes de centres McNaughton et de bourses.

Les étudiants et les autres bénéficiaires bénéficient également du cofinancement de projets spéciaux qui développent l'enthousiasme et les compétences en ingénierie à tous les niveaux. De plus en plus, ces projets utilisent la technologie au profit de l'humanité. Les «histoires de réussite» sur notre site Web, le bulletin mensuel de l'IEEE Canada et dans ce magazine illustrent le large éventail d'opportunités techniques, professionnelles et de développement que vos dons soutiennent.

Notre fonds général est crucial pour notre capacité a fonctionner chaque année, et vos dons non dirigés nous permettent de maintenir notre base solide. Nos fonds de dotation soutiennent un large éventail de récompenses, prix et bourses. Veuillez considérer un don dirigé pour doter un nouveau prix de l'IEEE Canada prix de votre choix.

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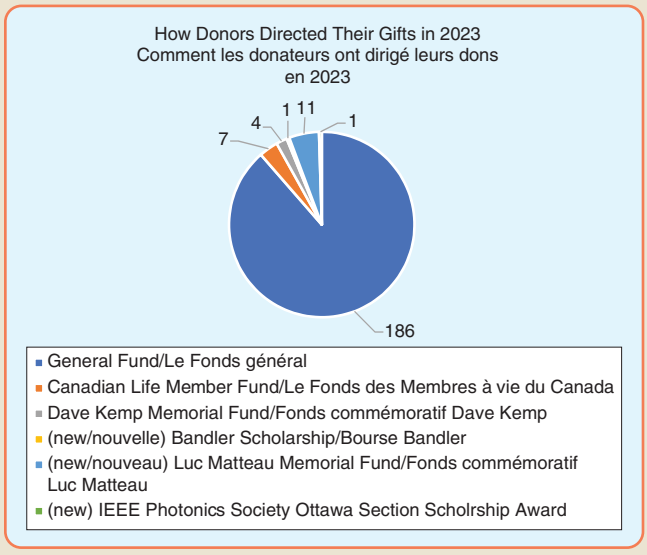
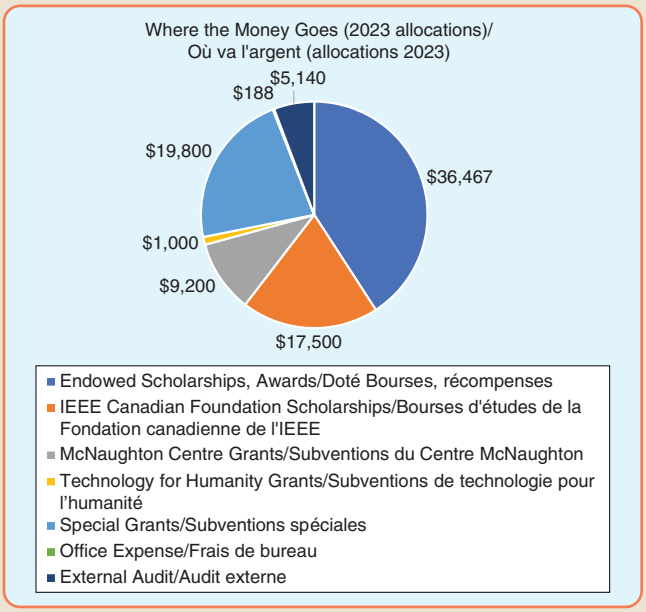
- **Le Fonds général**—soutient les centres de ressources d'apprentissage McNaughton de l'IEEE à travers le Canada, les bourses d'études connexes et les subventions spéciales
- **Le Fonds des Membres à vie du Canada**—soutient les activités qui intéressent les membres à vie, les ingénieurs potentiels et les étudiants en génie
- **Fonds Technologie pour l'humanitê**—soutient des projets nouveaux et innovants qui cherchent à appliquer la technologie au profit de l'humanité
- **Vancouver Section Scholarship Fund**—soutient les bourses accordées par la section Vancouver de l'IEEE
- **La Fondation canadienne de l'IEEE Nick Cercone Graduate Scholarship in Computer Science Fund**—soutient une bourse en informatique, un domaine d'études intéressant l'IEEE
- **Le Fonds de bourses d'études de la section de Kingston**—soutient les bourses accordées par la section de Kingston de l'IEEE
- **La Bourse annuelle de premier cycle Raymond D. Findlay**—soutient une bourse nationale reconnaissant le leadership et le professionnalisme





- **Canadian Life Members Fund**—supports activities of interest to Life Members, potential engineers, and engineering students
- **Technology for Humanity Fund**—supports new and innovative projects that seek to apply technology for the benefit of humanity.
- **Vancouver Section Scholarship Fund**—supports scholarships awarded by the IEEE Vancouver Section
- **The IEEE Canadian Foundation Nick Cercone Graduate Scholarship in Computer Science Fund**—supports a scholarship in computer science, a field of studies of interest to IEEE
- **Kingston Section Scholarship Fund**—supports scholarships awarded by the IEEE Kingston Section
- **Raymond D. Findlay Annual Undergraduate Scholarship**—supports a national scholarship recognizing leadership and professionalism
- **Dave Kemp Memorial Fund**—perpetuates Dave's memory by supporting IEEE programs that match his passions, including Young Professionals and Students in Canada
- **The IEEE Canadian Foundation Dr. John Bandler Graduate Scholarship in Engineering Design Fund**—supports a national scholarship in microwave and millimeter-wave engineering, imaging, inverse-scattering, engineering design optimization, or space mapping
- **Luc Matteau Memorial Fund**—perpetuates Luc's memory by supporting IEEE programs that match his passions.

Donate

Looking ahead—We appreciate your past support and urge you to continue to do so and increase your contributions where possible. If you have not yet made a donation, please join your peers—this is your opportunity to stand with others who choose to make a difference. We could do so much more with your financial support. All the different ways to give and donor recognition programs are fully described on our website.

- **Fonds commémoratif Dave Kemp**—perpétue la mémoire de Dave en soutenant les programmes de l'IEEE qui correspondent à ses passions - y compris les jeunes professionnels et les étudiants au Canada.
- **Bourse de la Fondation canadienne de l'IEEE Dr. John William Bandler d'études supérieures en conception technique**—soutient une bourse nationale reconnaissant en ingénierie des micro-ondes et des ondes millimétriques, en imagerie et en diffusion inverse; en optimisation de la conception technique; ou en cartographie spatiale
- **Fonds commémoratif Luc Matteau**—perpétue la mémoire de Luc en soutenant les programmes de l'IEEE qui correspondent à ses passions

Faire un don

Regarder vers l'avant—Nous apprécions votre soutien passé et vous exhortons à continuer de donner et d'augmenter vos contributions dans la mesure du possible. Si vous n'avez pas encore fait de don, veuillez vous joindre à vos pairs - c'est l'occasion de vous tenir aux côtés de ceux qui choisissent de faire la différence. Nous pourrions faire bien plus avec votre soutien financier. Toutes les différentes façons de donner et les programmes de reconnaissance des donateurs sont décrits en détail sur notre site Web.

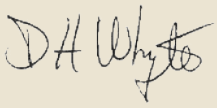
La Fondation canadienne de l'IEEE veut vous entendre - si nous pouvons mieux engager et soutenir votre communauté, veuillez nous le faire savoir. Vous pouvez me contacter à info.ieeecanadianfoundation@ieee.ca

De nombreux membres de l'IEEE au Canada contribuent à l'effort de bénévolat de la Fondation canadienne de l'IEEE, y

The IEEE Canadian Foundation wants to hear from you—if we can better engage and support our community, please let us know info.ieeecanadianfoundation@ieee.ca.

Many IEEE members in Canada contribute to the all-volunteer effort that is the IEEE Canadian Foundation, including the invaluable assistance of Dan Coode, John Mowbray, and many others in the preparation of this 2023 Honour Roll of Donors.

Yours sincerely,



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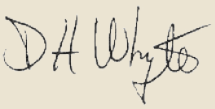
compris l'aide inestimable de Dan Coode, John Mowbray et de nombreuses autres personnes pour péeparer ce tableau d'honneur des donateurs 2023.

Cordialement,



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