IMIRS

Review by Students

Institute for Management & Innovation
University of Toronto

Volume 5

RE-IMAGINING SYSTEMS

Connecting disciplines for innovative perspectives

- Supporting a food system that prioritizes health, sustainability, and equity
- Toronto flood mitigation strategies for planners, policymakers, and local communities
- A promising alternative financing mechanism for accelerating sustainable development

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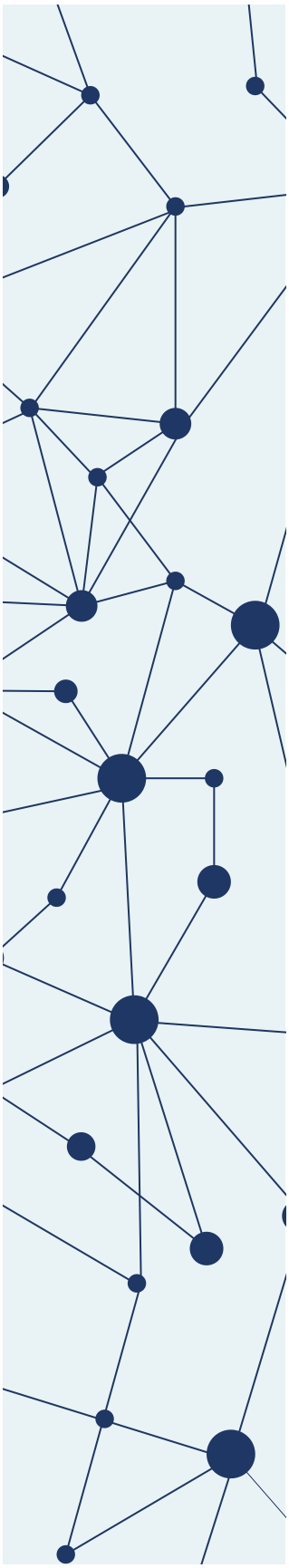

EDITORS NOTE

We are proud to present the 5th Volume of IMIRS, marking a significant milestone in our journey. IMIRS is a platform for graduate students from the Institute of Innovation and Management to come together and showcase their own work, findings, or give innovative trends a platform. This year, we embraced a new challenge: designing a new logo and rebranding the look and feel of our magazine to make IMIRS stand out and better represent graduate student work. Our rebrand reflects our commitment to staying relevant in a continuously evolving world.

This year's theme, **Re-Imagining Systems**, urges us to rethink our current environmental, social, and political structures. In a time of complexity, we believe that multifaceted solutions, that take on different perspectives, are essential. By applying Systems Thinking, the approach comes from multiple angles, recognizing that there is no perfect solution or silver bullet but a series of small, interconnected efforts that, together, address larger systemic issues over time. This volume draws connections between five different sub-themes—Cities/Communities, Food Systems, Science and Innovation, Policy, and Finance—and explores how they interact with each other. We chose these sub-themes with today's global challenges in mind. They are very closely connected and offer an opportunity for us to innovate and make a significant positive impact on people and communities.

Collaboration is at the heart of the theme, bringing together diverse multi-disciplinary perspectives on our most challenging issues. We've challenged our writers to find critical connections between these sub-themes, and they have done an incredible job identifying problems and evaluating solutions that impact more than one sub-theme. We hope that as you read through this issue, you gain new perspectives, learn something valuable, and feel inspired.

Lastly, to our IMIRS Team, thank you so much for contributing your time and effort into making this year's publication a success!

- **The IMIRS Managerial Team**

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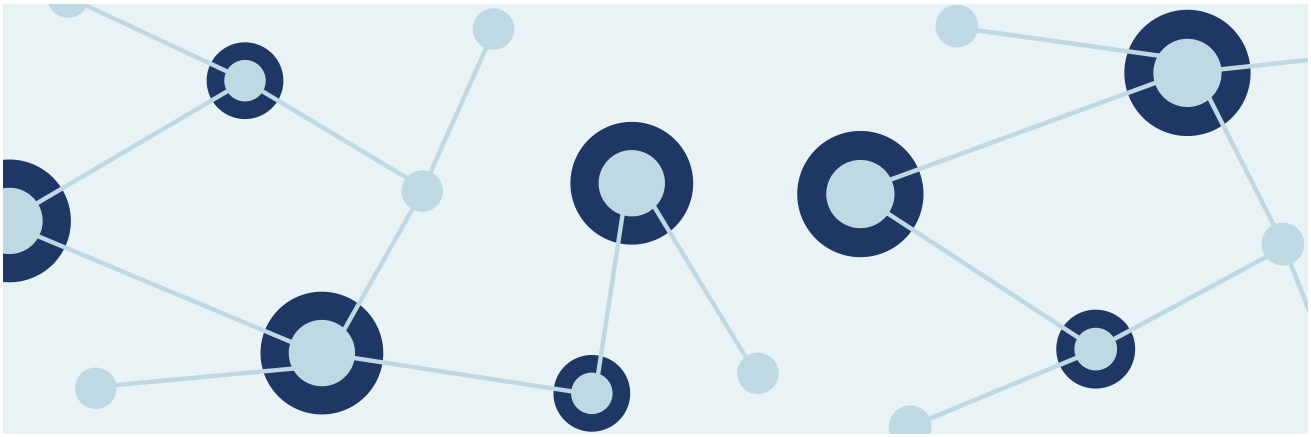

DIRECTOR'S NOTE

Welcome to the 5th edition of the Institute for Management & Innovation Review by Students (IMIRS) - a publication led, designed and written by IMI students. This year's edition is focused on the theme of Reimagining Systems. The theme, much like IMI, asks the reader to look at a range of complex issues through an interdisciplinary lens.

At IMI, our mission is to constantly transform thinking to solve the hardest problems facing people, their communities and societies globally. Throughout our six professional master's programs, undergraduate minor and certificate, and executive education and social entrepreneurship hubs, we focus on training students and learners to work collaboratively, creatively and with purpose.

To the IMIRS team: Your efforts are a showcase of what's possible when smart, imaginative people work together to address complex problems, demonstrating the value and necessity of multifaceted solutions. IMI owes a debt of thanks to you for contributing your time, energy and intellect to IMIRS. Our future is brighter thanks to you.

Thank you for reading!

Shauna Brail

Associate Professor & Director, Institute for Management & Innovation
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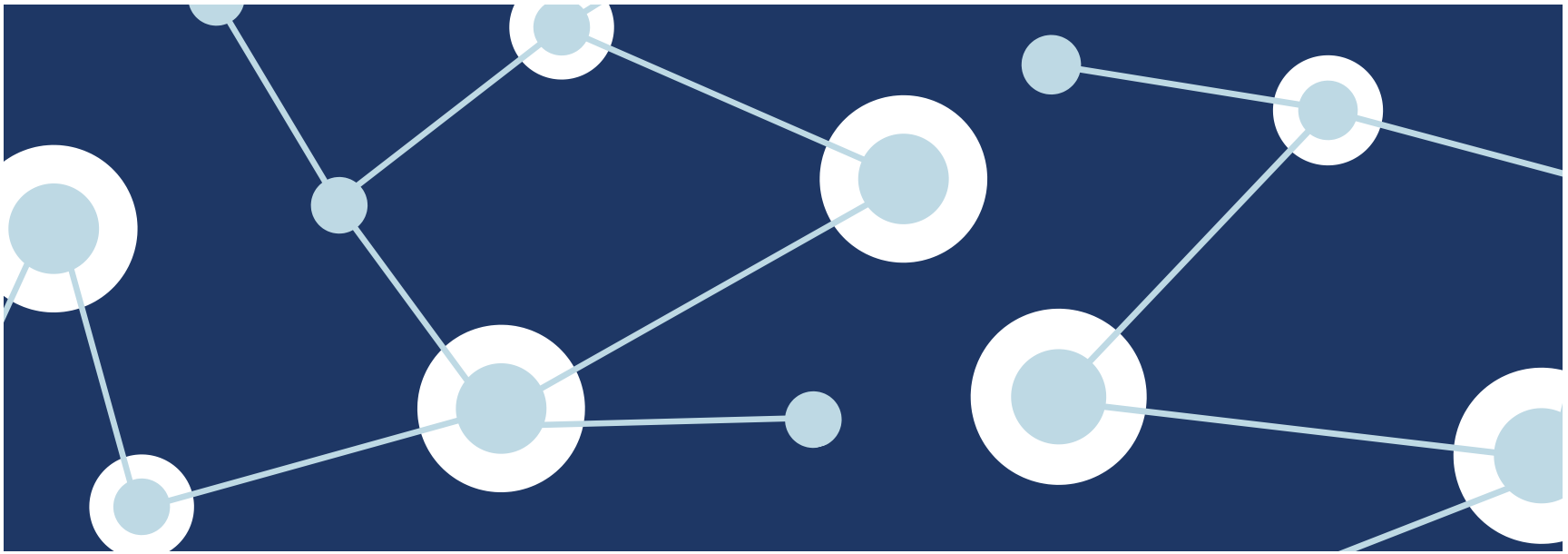

A PERSONAL REFLECTION: SYSTEMS THINKING AND HOW IT HELPED ME SUCCEED IN 2 CASE COMPETITIONS

By Usman Salim

I have always gravitated towards interdisciplinary subjects and academic programs, however, I have continuously been met with the questions: what I am learning and what the use or outcome will be.

In my undergraduate engineering degree, following a general first year, students rank their specialties to be placed in a discipline according to their grades and the number of spaces available. Integrated Engineering, which was my top choice, ended up having one of the lowest enrolments. The professor who led the info session on the various disciplines said verbatim, “I am not pitching this as an option, but I am just putting this out there for the 10-15 students who may be interested.”

I didn’t see myself choosing any other option.

The thought of taking courses across the disciplines and seeing how they connect in the big picture to solve systemic problems sounded perfect to me. So, why did so few people take it up?

Because we are taught to think in silos and to specialize very early.

Whether it’s in athletics or academia, where you are forced to decide your career by the time you’re 18 and enroll in largely singular-disciplinary subjects, it is embedded in our psyche that early specialization leads to success.

That was the case for me - until I read a book that challenged my approach.

David Epstein's book "Range" exposed me to the idea of generalization over specialization. Epstein initially had a slow start to his career. He studied influential figures like Roger Federer and Van Gogh, who tried many disciplines before their respective specialties. Some followed a typical path, but there are benefits to gaining skills across contexts that help in novel or complex situations (Epstein, 2019).

When I read about the MScSM (Master of Science in Sustainability Management) program and its interdisciplinary nature, particularly what the alumni were doing, I knew it was right for me. We are exposed to systems thinking across multiple courses, which involves two key components.

The first is emphasis on the problem – pinpointing exactly where the overarching issue lies is complex since there are many factors at play. It requires an in-depth understanding of the systems contributing to the issue, taking time with the process rather than jumping to solutions. It also requires input from those involved to gain a holistic view.

This leads to the second component: stakeholder engagement.

Big problems are perpetuated by a combination of regular citizens, governmental organizations, communities, shareholders, and more – referred to as 'stakeholders.' It is important to understand each stakeholder's involvement and perspective while improving relationships between stakeholders.

For those who are not adept at this collaborative way of thinking and problem-solving, it takes practice, and I'm glad I recently had the opportunity to apply these principles within two case competitions.

I competed in Innovation North's Systems Challenge in collaboration with the Ivey School of Business and BMO alongside a group of 4 other students from my cohort. It consisted of 3 stages related to mental health: the first task was battling student absenteeism; the second was tackling mental health challenges in a specific demographic (we chose international students); and the third was improving engagement with mental health resources at BMO. My group was one of 12 that advanced to the final round.

We attended lectures on problem categorization, leverage points, mind-mapping, and storytelling. In the first challenge, I had jumped right into brainstorming solutions, but by the last one, my group spent weeks trying to understand the underlying symptoms perpetuating BMO's issues before selecting an intervention. It was frustrating, but our mentors encouraged us to embrace these feelings rather than backing down and choosing easy solutions. We also realized our solution did not have to be ground-breaking – it could involve resources that already existed and making them interact more seamlessly. Additionally, as David Stroh mentions in his book "Systems Thinking for Social Change," people need to take esponsibility for their complicity in issues they are trying to solve, rather than solely blaming other parties or systems at play (2015).

We had to step into BMO's shoes to understand why the lack of engagement in their mental health programming could have arose. It was four long and intense months, and although my team did not bring home a prize (shout-out to the group from the senior MScSM cohort that won TWO prizes), we learned a lot and felt much more comfortable thinking in systems.

I also participated in Sobey's Innovation Challenge, where we were tasked with helping transition their fleet from diesel to electric to meet their sustainability ambitions. It involved the knowledge and application of logistics, supply chain, financial modeling, and more. Although my group did not have academic expertise in these disciplines, we were able to bring our own perspectives and experiences. One of my group members had work experience in supply chain, another was particularly strong in finance, and my experience driving an EV helped mitigate potential frictions in our solutions. Together, we were able to collaborate on specific tasks while keeping the big picture in mind, aligning it with Sobey's current operations and goals. We were one of 5 teams to advance to the finals.

Systems thinking can transcend boundaries – it is a way of thinking that applies to our personal lives and relationships as well. It can allow us to analyze our individual feelings and connections, look at the contributing factors before reacting, and understand other perspectives. Yes, we need experts in siloed fields, such as electronics engineers who design chips or doctors in cardiology, but to truly solve the multifaceted issues humanity is facing, we need a new framework. One that embraces complexity, converges seemingly opposing points of view, and rejects black-and-white thinking.

That framework is systems thinking.

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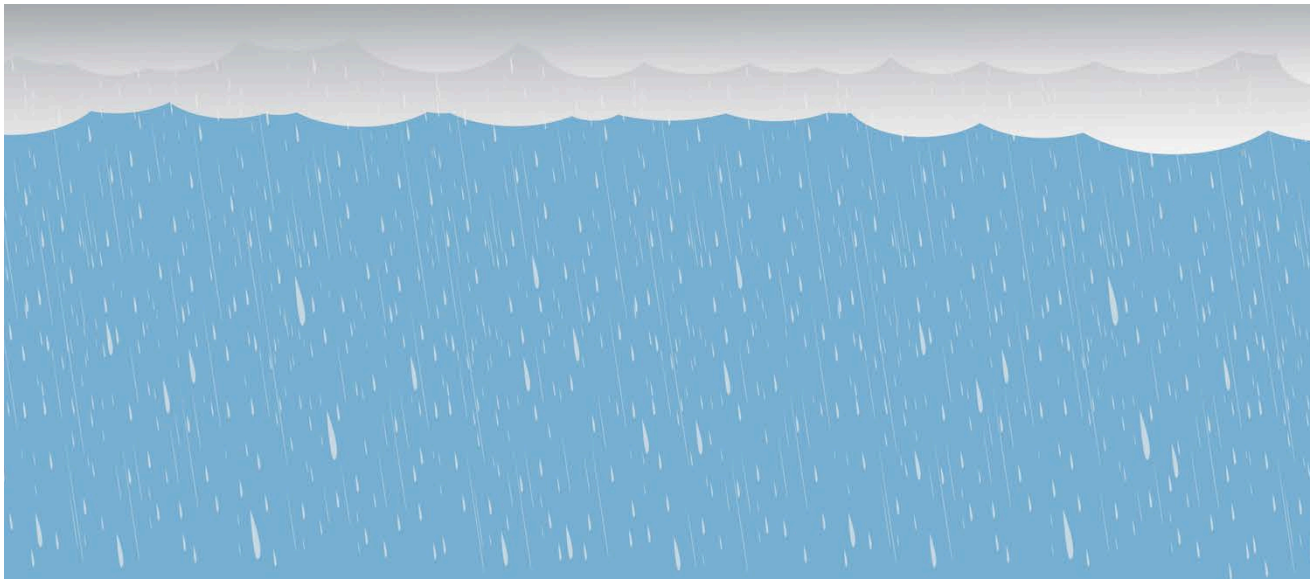
About Usman Salim

I am from Brantford, ON, with a Pakistani descent. I am pursuing a Master of Science in Sustainability Management with an interest in sociology, systems thinking, and environmental & human sustainability. In the future, I hope to converge my technical background, leadership experience, and passion for the environment in a multi-faceted role to solve big issues relating to sustainability.



EXPLORING THE SOCIO-ECONOMIC DISPARITIES IN TORONTO AND HOW THIS CONTRIBUTES TO INCREASED FLOOD RISK

By Annabelle Bartos

Climate change is intensifying extreme weather events worldwide, and one of its most pressing consequences is the increased risk of urban flooding. In Toronto, Canada's largest and most densely populated city with a population of approximately 2.8 million people, flood risk is an urgent concern. The city has experienced a rise in extreme precipitation events, which overwhelms stormwater infrastructure, causes extensive property damage, transportation disruptions, and environmental degradation. The economic impacts from flooding are also significant. According to the Insurance Bureau of Canada, floods have averaged $800 million in insured losses annually1. Many Canadian cities are built on floodplains, including 1.5 million homes located in areas with high flood risk (Brule, 2024). Extreme rainfall events are increasing in frequency, with time between events shortening to every 5 years from 20 (Armenakis & Nirupama, 2014). This is especially problematic for Canadians that live in vulnerable, high-risk communities prone to flooding. Understanding the contributing factors to flood risk is critical for sustainable city planning and greater resilience.

Urban flooding is influenced by land cover characteristics, including topography and greenspace availability. The natural ability of land to absorb and channel water is compromised when urban expansion replaces permeable surfaces with impervious ones, such as roads, buildings, and parking lots. Surfaces such as wetlands, forests, and heavily vegetated areas fare well in water absorption, helping mitigate runoff 2 . By replacing these surfaces with impermeable ones, surface runoff increases, which leads to flash floods that threaten communities, ecosystems, and infrastructure. In Toronto, this issue is further complicated by varied topography. Certain areas are more vulnerable to water accumulation due to elevation differences and drainage patterns. Significant flooding events in Toronto occurred in 1954, 2013, and most recently, this past summer. Arguably, the most memorable event was in 2013, where in just 90 minutes, the city received 126 millimeters of rain (Mortillaro, 2024). The typical threshold in Toronto for a flooding event is 40 millimeters, so receiving over triple causes infrastructure damage and increased risk for vulnerable communities. The Don River overflowed and caused major traffic anomalies that shut down the Don Valley Parkway (DVP), a vital transportation artery connecting Toronto's north and south ends. The flooding also caused public transit disruptions that left 1,400 passengers on GO Trains stranded, along with 300,000 residents without power (Mortillaro, 2024). Aside from disruptions, flooding can also lead to displacement and injury. Although recent flooding in Toronto did not pose significant health risk, flash floods can typically cause over $940 million in insured damages, increasing to over $1 billion in uninsured damages (Brule, 2024).

According to Toronto and Region Conservation Authority, several communities are vulnerable to flooding, including Rockliffe-Smythe, Lower Don, Brickworks, and Albion Road. These areas are situated in low-elevation zones where natural drainage patterns contribute to water accumulation, increasing susceptibility to flood events. Beyond physical geography, socio-economic factors play a critical role in determining a community's ability to prepare for, respond to, and recover from flooding. Populations at risk include older adults (65+), young children (under 14), and single parent households, as they may face greater challenges in evacuation and disaster preparedness (Armenakis & Nirupama, 2014). Additionally, linguistic barriers among English and non-French speakers can hinder access to crucial emergency resources. Economic factors, such as high unemployment rates, household incomes below $50,000, and lower levels of educational attainment (high school or less) further contribute to financial instability, enhancing difficulties for residents recovering from flood-related damages (Armenakis & Nirupama, 2014). Furthermore, a higher proportion of renters in an area means many residents have limited control over flood mitigation infrastructure in their homes, facing greater displacement risks. To minimize the damages from flooding and better protect

residents of these communities, the factors above are crucial for assessing flood impacts and identifying priority areas for targeted investments in mitigation and resilience. Flooding in Toronto is not only a hydrological issue but also a deeply socio-environmental one. The findings from spatial analysis show that flood susceptibility is concentrated in areas with both low elevation and reduced vegetation coverage, conditions that are disproportionately found in communities like Rockcliffe-Smythe and the Lower Don. The data further confirms that the Downtown Core, with an average slope of just 1.38° and mean NDVI of 0.155, is particularly vulnerable due to flat topography and minimal greenspace, intensifying runoff during storm events.

These patterns underscore a need for coordinated action between planners, policymakers, and local communities. Urban flood mitigation must integrate nature-based solutions. Expanding permeable surfaces, restoring ravines and wetlands, and implementing green roofs will improve stormwater absorption and reduce runoff. Land use planning should consider elevation and vegetation data to identify high-risk zones where intensified infrastructure resilience is needed. Equitable flood adaptation requires targeted investments in under-resourced neighborhoods that face systemic barriers to recovery and preparedness. Stakeholders including the City of Toronto, the TRCA, community organizations, housing authorities, and public health agencies must be aware of where vulnerabilities concentrate to better address inadequacies in flood preparedness. A collaborative, data-informed approach that bridges environmental science and social equity is essential for building flood-resilient, climate-adaptive cities.

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About Annabelle Bartos

Hi everyone I've lived just outside Toronto all my life and am currently pursuing a Master of Science at UofT. After I graduate this coming April I hope to build off my internship and work in the energy sector as a possible policy analyst.

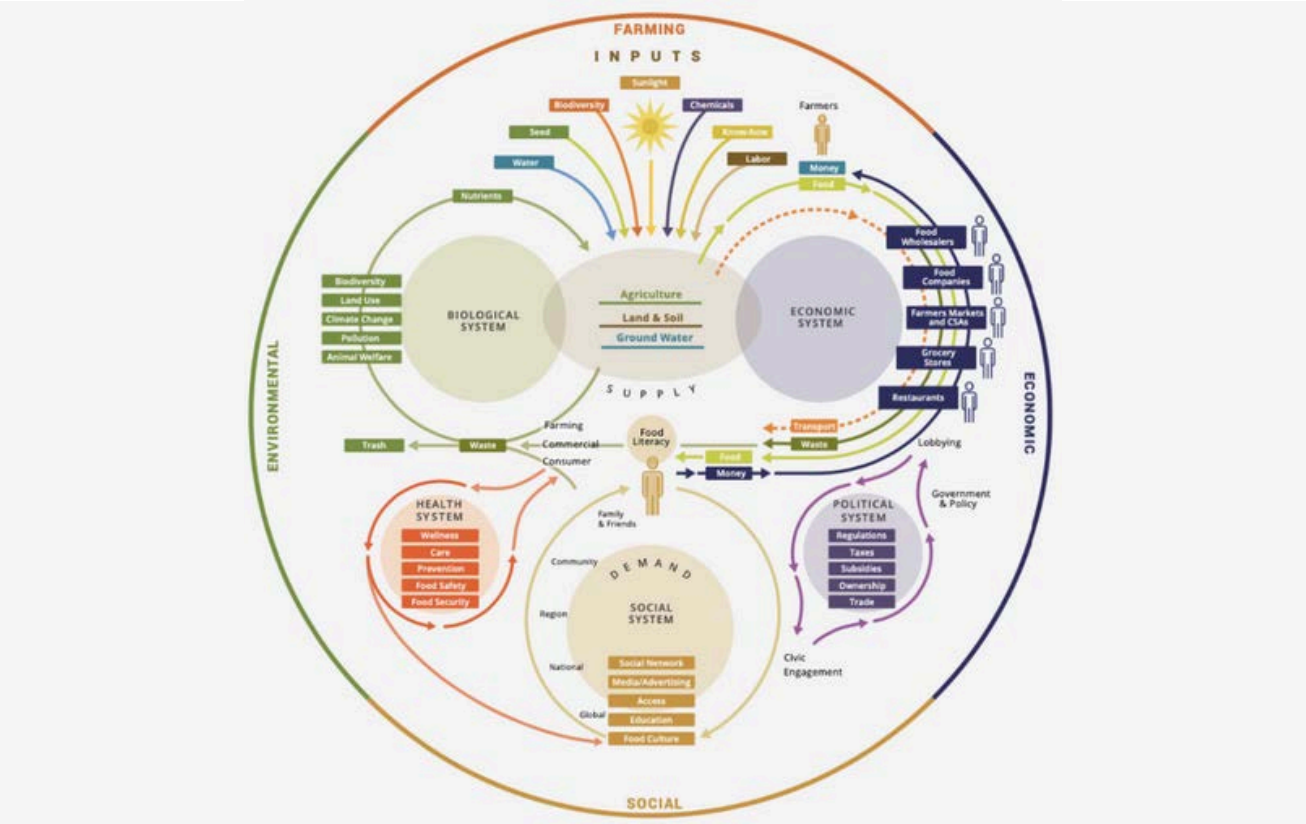

Figure 1. Food systems are highly interdisciplinary and demand careful decision-making throughout each subsystem to result in the most beneficial outcomes. (Zhang et al., 2018, p.39)

THE HIDDEN COSTS OF OUR FOOD SYSTEMS: TIME TO REGENERATE

By Mary Jo Easley

When was the last time you read the back label of a food package?

Most of us glance past the fine print, assuming what we eat and drink is a simple matter of choice. The reality is far more complex. Our food does not just appear in grocery aisles or on restaurant plates, it is the product of a vast and intricate system, one that connects environmental, economic, social, and political forces (see Figure 1). While it is impressive that global food systems feed billions daily, we must question whether the way we produce, distribute, and consume food has exceeded some of Earth's environmental thresholds and ethical standards. Have we become too oblivious and disconnected from the farms and factories that sustain us?

The Green Revolution: A Double-Edged Sword

The modern food system stems largely from the Green Revolution of the mid to late 20th century. This period saw dramatic increases in crop yields, driven by chemical fertilizers, genetic modification, and mechanized farming. While these advancements reduced famine risks, they simultaneously created new problems like crop monocultures depleting soil health, excessive fertilizer use leading to water pollution, and corporate agri-business gaining a stronghold on food production. This transformation was not just about feeding people; it was about controlling food supply chains, often at the expense of marginalized communities. Some of the driving forces behind these changes were rooted in fears of overpopulation, with influential figures like Garret Hardin (known for his seminal piece “The Tragedy of the Commons”) pushing alarmist and racialized arguments that shaped food policy. The result? A system optimized for efficiency and profit, not for human or planetary health.

Western Capitalism’s Role in a Broken Food Chain

As Figure 1 illustrates, our agricultural system is deeply entangled with social, economic, and political systems. In its current state, our global food system is shaped by powerful corporations that have influenced almost every aspect of the food system, with their greatest influence being shaping dietary norms to maximize profits. Investigative journalism and works by academics like Marion Nestle (an ironic but non-relational connection to the Nestle food conglomerate) have exposed relationships between companies such as Coca-Cola working with the US federal government to influence nutritional standards and research funding to benefit their brands (Nestle, 2018). The worst culprits of this scheme are the massive meat, dairy, grain (for livestock consumption), and sugar corporations, propped up by subsidies and aggressive marketing. This funding should be allocated to more nutritionally and environmentally sound agricultural practices and horticultural products. (Springmann & Freund, 2022).

Food norms that were once considered luxuries, such as daily meat consumption or sweet treats, have become the expectation. Everyone should have the right to choose what they consume, but at what point do we acknowledge that a lot of the “choices” we are making are the result of insidious manipulation? We, the consumers, are given the illusion of choice when, in reality, the vast majority of our food options are heavily processed, resource-intensive options, with whole-food and regenerative agriculture-based options being financially or physically inaccessible. There are better ways to cultivate our food systems, but systems-wide change is no easy task.

Reimagining Food Systems for a Sustainable Future

There is hope for change. As Figure 1 suggests, food intersects with nearly every aspect of society. A restructured food system must account for these intersections and prioritize sustainability, public health, and ethical consumption. Here are key actions to achieve this goal:

- **Policy Reforms**: Governments must shift subsidies away from industrial meat and monocultures toward regenerative agriculture and plant-based alternatives.
- **Finance and Market Innovations**: More financial support systems need to be offered to local and regenerative farms so they can operate independently from large agri-business firms. Exploration into farm co-operatives and the sharing economy for expensive physical capital assets is needed.
- **Technology and Research Advancements**: Continuing to minimize agricultural inputs through precision and regenerative ag practices is key to limiting the negative externalities of food systems at the root.
- **Education and Food Literacy**: Schools, governments, and media must emphasize food literacy to help people understand how their choices impact global food systems and their health. Removing industry funding from these campaigns is vital to ensure impartiality.

Your Role in Reshaping the Food System

Food systems are not static. They evolve based on the choices of consumers, businesses, and policymakers. The next time you pick up a product at the grocery store, take a moment to read the label, not just for ingredients but for where it was produced and who produced it. Consider checking for third-party certifications that indicate a more conscious production process. The question that should run through our minds more often than not is, are we supporting a system that prioritizes health, sustainability, and equity? Or one that perpetuates environmental destruction and inequality? We each have a role to play in demanding better food policies, supporting local food movements, and advocating for a more equitable and sustainable system. The food on our plates is not just a meal, it is a reflection of the systems that shape our world. It is time to rethink and rebuild food systems for the better.

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About Mary Jo Easley

Hi, my name is Mary Jo, but you can call me MJ. I'm a Fulbright Canada grantee from Indianapolis, Indiana, USA. Nothing excites me more than discussing food systems, ranging from regenerative agriculture practices to circular packaging. My wish for the world is that everyone has access to whole food, plant-based food options, which would help address many of the human and environmental health challenges we face today.

VERTICAL FARMING: BEYOND THE HYPE— CHALLENGES, OPPORTUNITIES, AND THE FUTURE OF URBAN FOOD SECURITY

By Tim Truong

Introduction

According to updated projections from the United Nations (2024), the global population is expected to grow by an additional two billion people by 2061. It will peak at 10.3 billion in the mid-2080s. Urban areas are also expected to grow rapidly. By 2030, nearly 5 billion people will live in cities, adding to growing food insecurity.

Vertical farming is an innovative response to growing food demands and urbanization challenges. By stacking crops in controlled indoor environments, it reduces land use, water consumption, and transportation emissions while increasing crop yield and resilience to climate change (Despommier, 2010; Sarkar & Majumder, 2015). As farmland shrinks and cities expand, vertical farms—whether indoor, rooftop, or skyscraper—offer sustainable, high-density food production close to consumers readily available to consumers (Al-Kodmany, 2018). Though environmentally promising, many ventures face economic hurdles in achieving profitable models (Gerrewey et al., 2021). Still, their potential to transform urban food systems remains significant.

Global Adoption and Growth

Vertical farming is expanding quickly as cities grow and the demand for sustainable food increases. In 2022, the global market was worth around $5.6 billion and is expected to grow to over $35 billion by 2032 (Roy, 2024). The U.S. leads development, with significant investments also underway in Asia, Europe, and the Middle East. Countries like Singapore, Japan, the UK, and the UAE are advancing projects to boost food security and reduce imports . Despite the excitement around vertical farming as a game changer for urban food, there are ongoing challenges. High operating costs, a limited variety of crops, and complex technology continue to raise questions about its long-term economic sustainability.

Singapore's Vertical Farming Efforts: High-Tech but Low Return?

With less than 1% of land for farming, Singapore launched the "30 by 30" goal to meet 30% of nutritional needs domestically by 2030 (Huiying, 2023). Despite grants and agri-tech investment, outcomes have lagged. An example is SkyGreens in Singapore, once celebrated as the world's largest high-tech vertical farm. But in 2024, the company began dismantling greenhouses without explanation (Tan, 2024). Singapore's struggles mirror global trends. Major vertical farming startups such as InFarm, Kalera, AeroFarms, and Future Crops, once valued highly, later faced significant losses and bankruptcies tied to unsustainable business models (Nott, 2023). Since 2021, venture capital in agri-tech has dropped 60%, driven by economic uncertainty (Loh, 2024).

Challenges of Vertical Farming

Despite these setbacks, vertical farming still holds potential for food security. However, its future depends on addressing high operational costs, scalability, and long-term economic sustainability. Watson (2025) suggest early signs of cautious optimism and a slow recovery in agri-tech investment, which could help revive the vertical farming industry.

Food norms that were once considered luxuries, such as daily meat consumption or sweet treats, have become the expectation. Everyone should have the right to choose what they consume, but at what point do we acknowledge that a lot of the "choices" we are making are the result of insidious manipulation? We, the consumers, are given the illusion of choice when, in reality, the vast majority of our food options are heavily processed, resource-intensive options, with whole-food and regenerative agriculture-based options being financially or physically inaccessible. There are better ways to cultivate our food systems, but systems-wide change is no easy task.

One major barrier is initial investment and operational costs, particularly energy expenses. Setting up a high-tech vertical farm requires approximately $11 million

per acre, nearly twice the cost of a high-tech greenhouse at $6 million per acre (Avgoustaki & Xydis, 2020) . To improve economic viability, cost-reduction strategies are essential. Advancements in system design, improvements in resource use efficiency, and adopting circular farming approaches could help lower expenses.

Vertical farming systems rely on sophisticated technology and specialized expertise. Operators must be knowledgeable in the fields of agricultural science, engineering, and computer technology to monitor environmental conditions and troubleshoot issues. Operators must manage lighting, climate, and resources precisely, which adds to energy costs. Shifting to renewable energy and improving lighting technology could help lower both expenses and emissions (Avgoustaki & Xydis, 2020) . To enhance sustainability, research should focus on cost-cutting innovations that optimize energy use.

Despite offering the highest yield per surface area, vertical farming is still largely limited to growing herbs and leafy vegetables. This restriction reduces scalability and limits its contribution to mainstream agriculture. Profitability remains low, and breeding specialized genotypes for vertical farming is still in its early stages. However, advancements in plant breeding could improve resource use efficiency and product quality, expanding the variety of crops grown (Avgoustaki & Xydis, 2020) .

Despite the growing need for food security, public skepticism remains a major barrier to the widespread adoption of vertical farming. Consumers question its environmental impact and cost-effectiveness, similar to concerns about genetically modified crops, food nanotechnology, and artificial irradiation (Avgoustaki & Xydis, 2020) . Education and awareness are crucial to improving public acceptance. A study by Jürkenbeck et al. (2019) found that 46.7% of consumers are willing to buy vertical farm products, while only 16.8% are unwilling. Building awareness and trust in the legitimacy of a scalable solution will be key to increasing acceptance.

Conclusion

Vertical farming offers promising urban food solutions through the possibility of high yields and resource efficiency. However, economic hurdles, crop limits, and recent startup failures show it's no cure-all. Its future depends on cutting costs, diversifying crops, and building public trust. If integrated into broader food system strategies, it can pay a vital role, especially in dense or water-scarce areas.

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About Tim Truong

I am an international student from Vietnam. I am a first-year master's student in urban innovation. I have a strong interest in understanding the dynamics between different stakeholders in regional and local development. I enjoy thinking outside the box to challenge conventional practices.

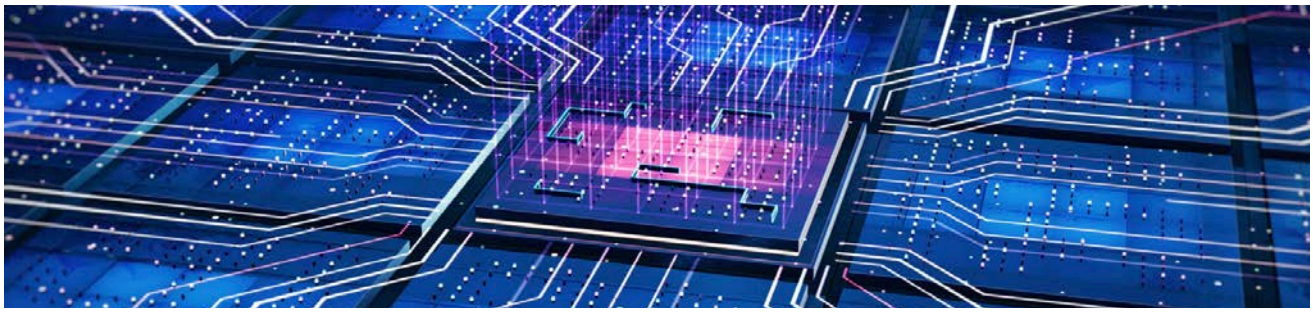
SEMICONDUCTORS: CANADA'S NEW OIL?

By Purav Patel

Abstract

Semiconductors have become the critical resource of the digital age, underpinning technologies essential to Canada's net-zero ambitions, economic prosperity, and national security. By enabling precise control over the movement of electrons, semiconductors serve as the foundational material for the essential components that power and shape modern society. The global semiconductor landscape today mirrors the mid-20th-century oil industry, characterized by rapid economic growth, geopolitical competition, market dominance, and environmental concerns. To improve Canada's semiconductor strategy, lessons Learned from fossil fuel development can be employed to understand the complex systems involved in the global value chain.

Lessons learned from the development of fossil fuels can be used to understand the complex systems involved in the global advanced semiconductor value chain and apply them to improve Canada's semiconductor strategy.



Semiconductor production involves a complex global value chain characterized by high barriers to entry and concentrated market power. Taiwan Semiconductor Manufacturing Company (TSMC), for example, manufactures over 90% of all advanced semiconductors (Bu, 2024). Advanced semiconductors, which are growing in strategic value, are essential for leading-edge technologies, while standard chips reliably power everyday electronics. While TSMC holds a near-monopoly for manufacturing advanced semiconductors, it also relies on the Dutch firm ASML as the only supplier of the state-of-the-art equipment it requires (Hübner, 2025). Further down the value chain, NVIDIA relies on TSMC’s advanced manufacturing capabilities to dominate the graphics processing unit (GPU) and artificial intelligence (AI) computer market. Such concentration parallels historical oil industry dynamics, where a highly stratified value chain is controlled by a small number of key players.

Geopolitical tensions further complicate the global semiconductor value chain, as semiconductor dominance has become a central strategy for major powers. China’s pursuit of becoming the global leader of advanced chips has led to its involvement in trade restrictions, corporate espionage, and heightened risks of military conflict (Germann et al., 2024). The United States’ export ban on advanced GPUs to China illustrates how geopolitical tensions can undermine economies and national security interests (Bu, 2024). Due to the importance of the industry and the uncertainties it faces, access to advanced semiconductors presents a critical challenge Canada cannot ignore.

Canada finds itself in a position reminiscent of its early days in the fossil fuel industry. As one of the world’s most advanced economies, Canada possesses foundational strengths, including a highly educated population and key input materials, that are necessary to establish itself as a leader in semiconductors (ISED Canada, 2024). However, developing capabilities required for advanced semiconductor manufacturing poses significant barriers. These barriers are due to limited capital investment historically, resulting in a lag behind its peers in terms of infrastructure and technology (Germann et al., 2024). Facing complex domestic and international challenges, Canada must weigh investing heavily in domestic capabilities against continued reliance on other nations for advanced semiconductors.

Due to its ever-increasing strategic value, Canada has already made efforts to develop its advanced semiconductor sector. Initiatives such as Canada's CAD 150 million Semiconductor Challenge and the CAD 2 billion AI Sovereign Compute Strategy show promise, but the size and scope are modest (ISED Canada, 2024). Unlike other industries, Canada may not be able to fully onshore advanced semiconductor manufacturing to meet its needs (Hübner, 2025). Considering these risks and barriers, its optimal approach would likely require a mix of major domestic investment and carefully constructed geopolitical relationships (Germann et al., 2024).

As Canada strengthens its domestic capabilities for advanced semiconductors, sustainability concerns will inevitably arise due to the industry’s impact on social and natural systems. The analogy between semiconductors

today and Canada's historical experience with fossil fuels offers critical lessons. Unchecked expansion of domestic industries without adequate strategic foresight regarding sustainability led to significant long-term economic and environmental consequences (Nikiforuk, 2008). Similarly, rapidly expanding data centers to power AI and cloud-based technologies have enormous energy demands, often relying on fossil fuels (Chow, 2024). Without an emphasis on sustainability from inception, as well as a long-term strategic plan centered around climate-related risks, the Canadian semiconductor industry risks replicating the pitfalls of the oil and gas sector.

Supporting a sustainable advanced semiconductor value chain will require innovation in related Canadian industries like energy, mining, and manufacturing. Large-scale infrastructure will require substantial resources, capital investment, and specialized workforce training. Geopolitical partnerships may also have to be reimagined, as evolving risk could leave Canada vulnerable by jeopardizing critical relationships, market access, and supply chain resiliency (Bu, 2024).

Canada's potential pursuit of global semiconductor leadership presents both opportunities and risks reminiscent of its historical experiences with fossil fuel production. Lessons from the nation’s boom-and-bust cycles include the importance of economic diversification, sustainability integration from inception, and cautious navigation of geopolitical alliances (Nikiforuk, 2008). Canada's current modest investments suggest an awareness of the semiconductor industry’s strategic value, but an emphasis on embedding sustainability into the value chain is lacking. Future research should further explore the viability of niche specializations in advanced semiconductors suited to Canada's resources and policy landscape, including how capabilities can be developed responsibly.

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About Purav Patel

Purav is an MSc Sustainability Management graduate interested in the intersection of climate, technology, and finance. With a background in economics and biological sciences, his research modelled how net-zero policies impact the scale-up of carbon removal technologies.

AI-DRIVEN DRUG DISCOVERY – FAILING FASTER AND DISCOVERING SOONER

By Ramiz Khan

Eroom's law (the play-on of the classical Moore's law from microchip processing) states that drug discovery is becoming slower and more expensive over time [1] . People understand the expensive part of this hypothesis, but slower? How could drug discovery be slowed down, especially with our advancements in bioengineering, computational chemistry, and the vast amount of literature published year after year? Well, novel therapies have a challenge of having to beat existing therapies in either effectiveness or risk tolerance and Food and Drug Administration (FDA) guidelines have become more stringent in drug discovery as time passes [1] .

In 2024, the FDA approved 50 small molecule drugs, and the pharmaceutical industry collectively spent on average $2.23 Billion USD for each drug [1]. Clearly, there needs to be better ways to find novel drug candidates without having to spend an extraneous amount of capital to drive programs and testing. Introducing, artificial intelligence (AI)-driven drug discovery, combining technology with biology to find new drugs faster through an early-failure driven system. AI drug discovery is a broad term that encompasses individuals from disciplines such as software engineering, machine learning (ML), and computational biology. These disciplines together to create modules and predictive models that assist in the pursuit of novel drug targets in specific disease models [4] . AI-driven drug discovery is not a single-solution math problem, it is more of a differential equation with multiple derivatives and integrals.

Companies have taken several approaches for integrating computation and automation in their drug discovery workstreams to optimize and find useful targets for clinical testing. Insilico Medicine, Exscientia, and BenevolentAI, and Recursion Pharmaceuticals are all leaders in the “TechBio” (spin-off of BioTech) space [4]. Insilico Medicine uses AI to accelerate de novo drug design (designing molecules from scratch) [5]. Exscientia also utilizes de novo drug design but with an emphasis on automation and precision medicine [6] . Benevolent AI has created a platform that synthesizes literature and datasets to amplify their scientists’ drug discovery direction [7]. Likewise, Recursion has built a drug discovery platform based on proprietary high throughput phenotypic screenings to build and analyze datasets [8]. The commonality between these players is their use of technology. From super computers to experienced software developers, these companies have made substantial investments with the hopes that their AI-driven drugs can pass the notoriously difficult clinical trial progress and FDA regulation.

As of May 2024, 39 AI-driven small molecules are currently in clinical trials, while 114 companies are currently directing their focus towards using AI and ML for discovering new therapeutics [9]. These companies sit in differing parts of the clinical development timeline with Recursion, Exscientia, and Insilico Medicine leading the race. Clinical trials are the make-or-break of companies, so it is impossible to tell what the economic output will be of AI-derived drugs but one thing for sure is that it is creating noise in the biopharmaceutical space.

Major players like Roche-Genentech, Bayer, Sanofi, Bristol Myers Squibb (BMS) all have partnered agreements with the three aforementioned Techbio companies for pushing forward specific disease areas through their data driven approaches. Disease areas such as GI-Oncology, Neuroscience, and Immunotherapy are no longer struggling as these TechBio companies are meeting partnership milestones at a rapid pace to help formulate new treatments in novel therapeutic areas.

Deloitte's 2024 Global Life Sciences Sector Reports chapter on “Accelerating speed of time to value in R&D” touches on topics of generative AI and ML and its effects on the entire drug development pipeline. Key value levers such as improving clinical success rate, reducing failure rates in pre-clinical modelling and increased number of New Drug Applications (NDAs) are highlighted as key quantitative metrics to justify the increase in speed and precision with AI-driven drug discovery [10]. Additionally, Deloitte identifies partnership events to be the greatest driver for market cap change in biotechnology companies [10].

AI-driven drug discovery is ultimately built out as a platform, so that companies can scale and explore massive amounts of targets and therapeutic areas at once. Ultimately, the benefit of these industrialized and scalable technologies is the value they drive for the company as a platform. Any one of the Techbio leaders can pivot to a SaaS (Software as a Service) model at any given point. While the potential revenues are unknown and most likely much less than pursuing a therapeutic to market, this kind of flexibility allows companies to leverage two fronts of revenue models, ultimately diversifying their cash flows. This induces financial stability and potential to scale the company further down the road in each of its respective domains.

Biopharmaceuticals are constantly evolving, as regulation, investments, and technology are ever-changing, so will the landscape and potential for innovation in such a dire industry. With appropriate leveraging of government support, investor turnout, and proof of concepts by the big players, AI driven drug discovery will become a household norm for any company within the pharmaceutical industry in the upcoming years. Exploring the potential of partnerships and alternative revenue models makes the Techbio space revolutionary and resistance to the economic downturns that companies may face. It is only a matter of time before patients are treated with therapeutics that are driven by AI.

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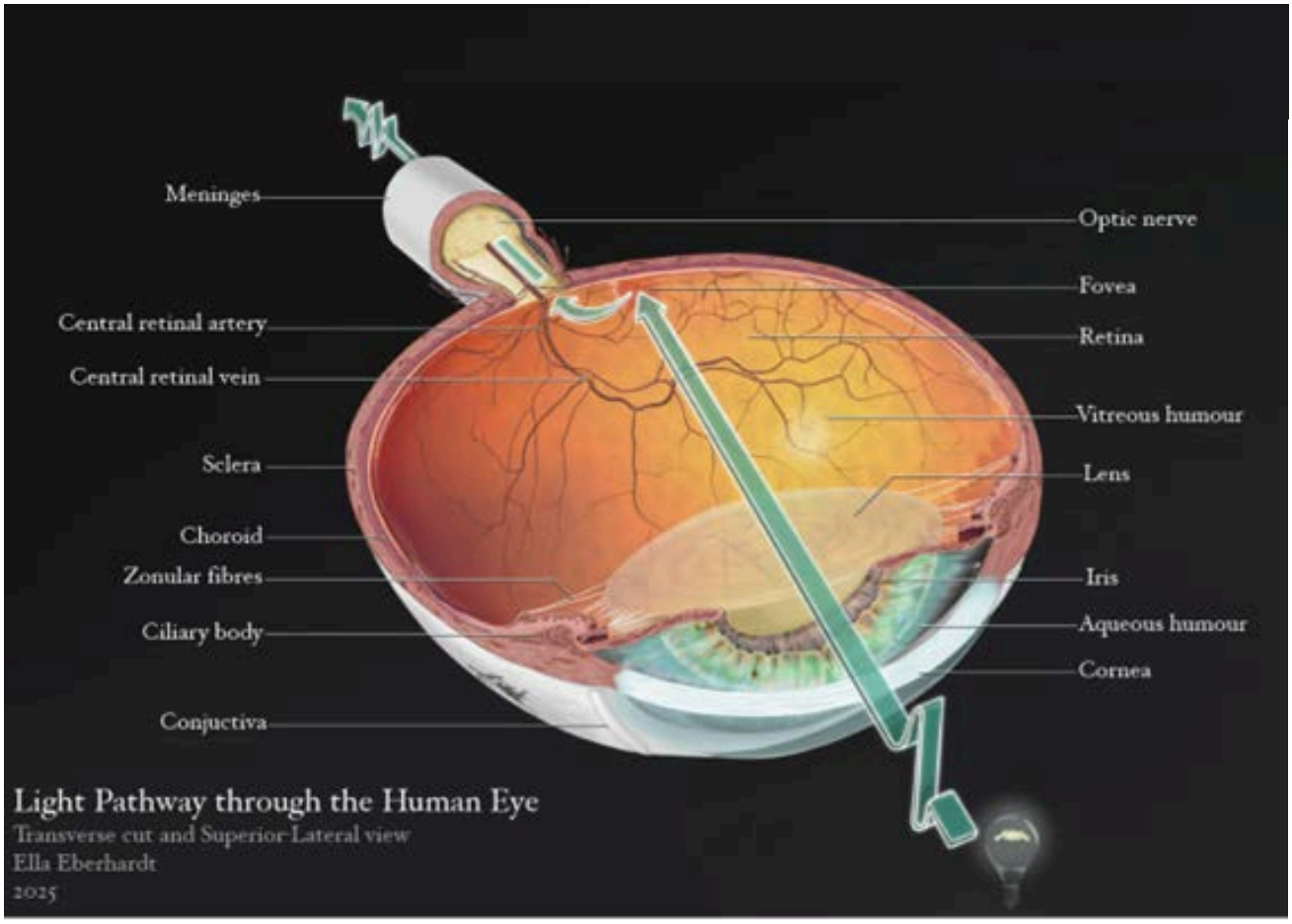
About Ramiz Khan

Ramiz is a Master of Biotechnology graduate who is passionate about driving technological innovation in industry. With the rise of AI skepticism, Ramiz looks to debunk and provide a clear lens on the future of the life sciences and how we can enable healthier lives for patients around the world.



TIME TO SEE SCIENCE

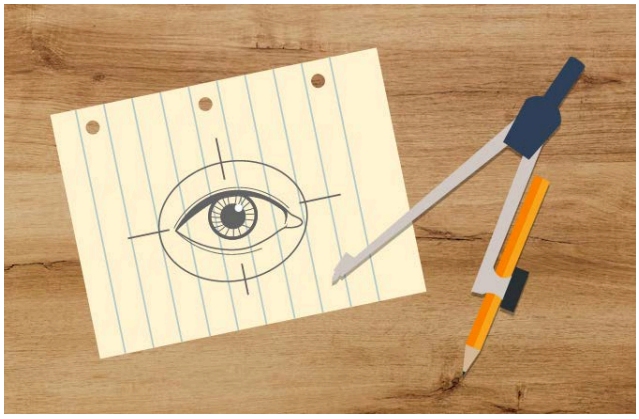
By Ella Eberhardt

Topic

A short excerpt about the importance of communication in science accompanied by a hand-drawn diagram of light pathways through the human eye.

Abstract

Let us imagine the system behind scientific illustration, understanding the creation process for scientific visuals is extremely valuable for those who aim to create or have their research illustrated as well as people who want to learn more about how they are built. Science communication plays a significant role in the knowledge-making process with visuals often having a key role. Identifying the audience and moving toward scientific accuracy are two of the many important elements. Explored here, is an overarching view of the creation process behind the production of a science diagram depicting the “Light Pathway through the Eye” by Ella Eberhardt.



Have you ever thought about how beautiful illustrations in textbooks and scholarly journals come to be? Or how the research you are passionate about could be more easily illustrated to family and friends using formats other than just text?

Science communication is a large aspect of the scientific field where the audience's understanding is heavily dependent on an author's ability to communicate effectively. Science and art have gone hand in hand for ages and play a large role in illustrating processes or diagrams of information that would be lost using only words. Captivating an audience with diagrams can drive people to read further about a topic that they may have previously skimmed.

When building science communication pieces for textbooks, Certified Medical Illustrators will be hired to create art that meets set goals. They will use combinations of artistic techniques to create accurate visuals that engage the target audience and teach according to learning objectives. Many researchers hire illustrators to communicate their research in a way that will be aesthetically pleasing, complete in information, and engaging for the audience – whether that be the public or conference attendees. In a lot of cases, words alone are unable to communicate science in a way that is fully understandable and leads to no misinterpretation. One such example is anatomical illustrations in textbooks – can you imagine trying to learn the eye anatomy from a description of all the layers, their size, and function?

As someone in the scientific communication field, I believe there should be an emphasis on the problem-solving that lies behind the works of art seen in academic journals or magazines like National Geographic. It is equally important for the designer to understand the audience that they are gearing the work towards.

To convey this point, I will explore the building process for one of these diagrams. As a Biomedical Communication student, one of our assignments involved the prompt "Show me the Unseeable!." We had a choice between five different topics: the path of urine through the kidney, the path of blood through the heart, the path of blood through the liver, the path of food through the stomach, and the topic I landed on, displaying the light pathway through the human eye. Now that it has been decided, what next?

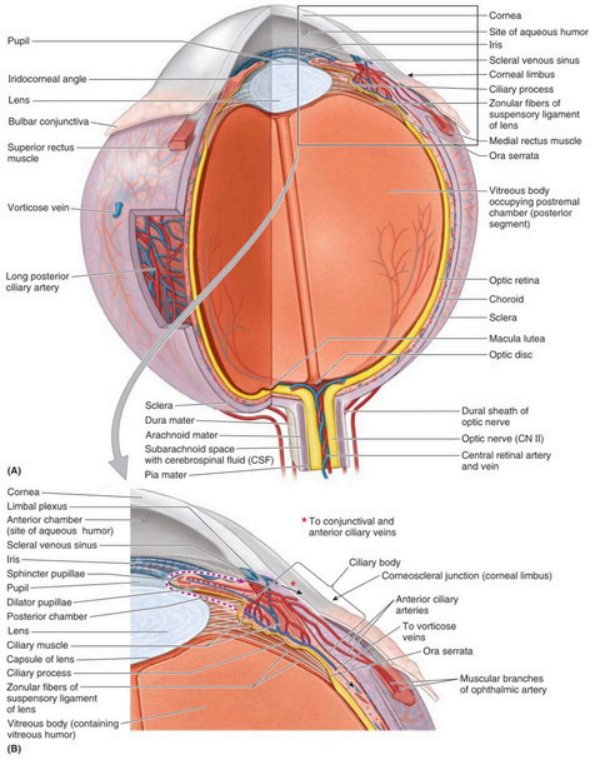


Figure 1. Eyeball in a quarter section removal with major structures (Moore, 2019)

The first phase is the most time-consuming as we search for resources, such as medical textbooks, to build up our understanding and iterate multiple versions. For the eye, I began with overviews of the entire organ such as in *Moore's Essential Clinical Anatomy* (Figure 1) of the human eyeball with a quarter section removal showing major structures (Agur, 2019). Looking at anatomical specimens, such as those found in *Color Atlas of Anatomy* (Figure 2), depict the organization of the human eye from the lateral view (Rohen, 2011).

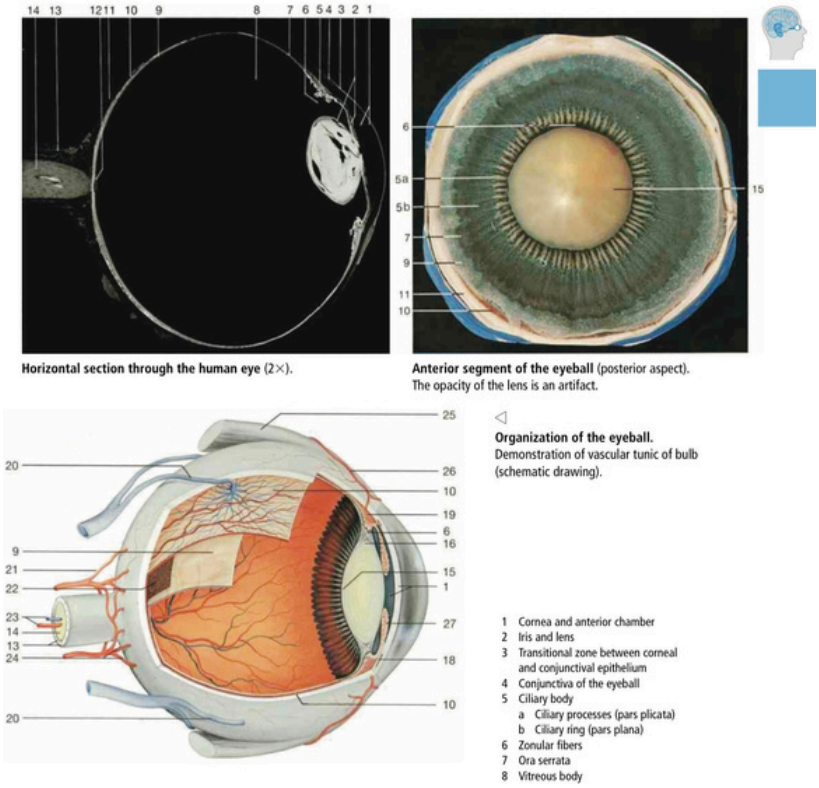


Figure 2. Organization of the human eye from the lateral view (Rohen, 2011)

The first phase is the most time-consuming as we search for resources, such as medical textbooks, to build up our understanding and iterate multiple versions. For the eye, I began with overviews of the entire organ such as in *Moore's Essential Clinical Anatomy* (Figure 1) of the human eyeball with a quarter section removal showing major structures (Agur, 2019). Looking at anatomical specimens, such as those found in *Color Atlas of Anatomy* (Figure 2), depict the organization of the human eye from the lateral view (Rohen, 2011).

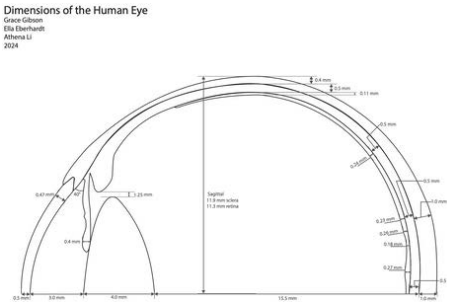


Figure 3. Dimensions of the human eye as compiled by Ella Eberhardt. Athena Li, and Grace Gibson. (Bekerman, 2014; Vurgese, 2012; Wolff, 1933; Spector, 1990; Armstrong, 2014; Doxanas, 1984; Moraes, 2012)

After determining the various measurements, it is greatly beneficial to create 3D models that help illustrators understand how foreshortening affects their model and solve elements prior to creating the final version. Figure 3 shows the measurements I compiled and used to create the model (Bekerman, 2014; Vurgese, 2012; Wolff, 1933; Spector, 1990; Armstrong, 2014; Doxanas, 1984; Moraes, 2012).

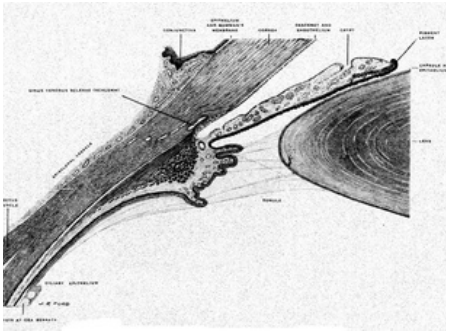


Figure 4. Eye lamella consists of minute connective tissue fibrils which are united by a cement substance (Wolff, 1933)

I then move to understand smaller elements in detail, such as the cellular organization of each lamella, consisting of minute connective tissue fibrils united by a cement substance (Wolff, 1933) (Figure 4), and how the muscles in the iris contract to accurately depict them.

It is also important to find research in primary sources. If illustrators only source existing diagrams, there are chances of perpetuating pathological anatomy. A good example of this phenomenon is the abundance of diagrams with central retinal veins and arteries that twist around each other. Retinal vascular tortuosity (Ghoraba, 2023; Vahedi, 2003; Incorvaia, 2003) is important to understand but should be present only when expressly stated.

The process I underwent to depict light pathways through the human eye (Figure 5) demonstrates that building accurate scientific diagrams takes time and in-depth research, with collaboration between people being essential. Science takes a large number of people working together to perform, decipher and communicate. It is always in our best interest to continue forwards in understanding the various steps throughout the process and imagine the entire systematic process.

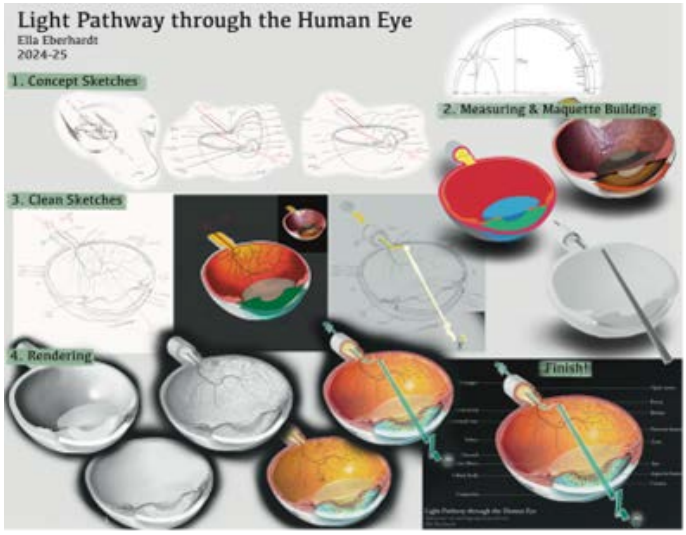


Figure 5. Overview of overarching steps in “Light Pathway through the Human Eye” by Ella Eberhardt (2025)

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About Ella Eberhardt

I completed my BSc in Biology at the University of Ottawa where a coworker at the AAFC Experimental farm told me I could do art & science all in one. It’s been my goal since to create meaningful graphics relating to the biological and medical fields - most specifically when relating to Canadian topics!

BEYOND THE TABOO: MENSTRUATION, SUSTAINABILITY, AND THE SYSTEMS THAT SHAPE IT

By Harleen Kaur

A Tale of Two Worlds

It was a beautiful monsoon evening in Ajrana Khurd, a small rural village in Haryana, India. The air smelled of wet earth, and the rhythmic drumming of raindrops on the tin roof added to the warmth of the moment. Noor sat outside on the porch, surrounded by her parents, grandparents, and siblings, all sharing a steaming cup of chai. Laughter filled the air as they chatted about the day's happenings. Suddenly, the mood shifted. Jess, Noor's friend visiting from Canada, came running onto the porch, slightly out of breath. "Noor," she whispered urgently, "I just got my period. Can you give me a pad or tampon?" The once lively conversation came to a halt. Noor's mother shot her a sharp glare, her father shifted uncomfortably in his seat, and her grandmother pursed her lips, eyes lowered to the ground. The once-welcoming porch suddenly felt like a place where Jess did not belong. Noor quickly grabbed her friend's hand leading her away from the group, the unspoken discomfort lingering in the air behind them. As they stepped inside, Jess finally broke the silence. "What just happened?" Noor sighed. "Here, we don't talk about periods. Not in front of men. Not in

the open." She reached into her cupboard and handed Jess a pad, as if passing along something forbidden. Just then, Meena, the teenage daughter of the house helper, walked into the room. She looked curiously at the packet in Jess's hand. "What is this?" she asked. Noor hesitated for a second but then answered, "A sanitary pad, for periods." Meena's eyes widened, then she nodded in recognition. "Oh, like the cloth I use?" Jess's head snapped up. "Cloth?" repeated, confused. Noor nodded. Many women here still cannot afford sanitary pads. Some do not even know they exist. They use old cloth pieces, wash and reuse them, sometimes drying them in the dark where no one can see. It is just… the way things have always been. Jess felt a wave of realization wash over her. In Canada, she had always viewed periods as an issue of accessibility, advocating for free menstrual products in public spaces. She never imagined that, in another part of the world, the very act of speaking about menstruation could be considered taboo.

Red and Everything In Between

Menstruation holds vastly different meanings across cultures, revered as a symbol of life and renewal in some, yet burdened with shame and silence in others. In Nepal, the outlawed yet persistent practice of 'Chhaupadi' forces menstruating women into remote, unhygienic huts, sometimes leading to serious health conditions or even death (Ratcliffe, 2019). In countries like Japan, often praised for progressive workplace policies, stigma persists. A 2022 survey conducted by the Nikkei Business Publications Intelligence Group found that fewer than 10% of women make use of legally permitted menstrual leave, often deterred by the discomfort of requesting it from male supervisors. Social attitudes, more than laws, continue to dictate behavior, and casual dismissals like "Are you on your period?" still silence and invalidate women in schools and workplaces alike.

At the heart of the global menstrual divide lie three key challenges known as the 3A's: Awareness, Accessibility, and Affordability. Despite growing advocacy, menstrual education remains limited, especially in low-income communities. Only 39% of schools worldwide provide menstrual health education, leaving millions uninformed until their first period (United Nations Children's Fund [UNICEF], 2024). This lack of awareness affects self-esteem and school attendance, reinforcing cycles of silence and exclusion (United Nations Educational, Scientific and Cultural Organization, 2014). Furthermore, access to menstrual hygiene facilities remains a major barrier. In at least 12 countries, one in ten women and girls in rural areas lacked a private space to wash and change during their last period (UNICEF, 2022). Even in developed nations like Canada, a Northern Communities Assessment found that 74% of respondents in remote Indigenous communities and 55% in non-remote ones struggled to access menstrual products

(Lane, 2024). These challenges are compounded by affordability, which continues to prevent many from accessing essential menstrual supplies. In 2021, two-thirds of the 16.9 million low-income women in the U.S. reported difficulty affording period products, with nearly half forced to choose between menstrual supplies and food (Michel et al., 2022). If this is the reality in developed countries, the situation is even more dire in places where people survive on daily wages, making menstrual products a luxury rather than a necessity.

The Overlooked Crisis

While the 3A's remain central to menstrual health discussions, one critical issue often goes unnoticed: the significant environmental impact of menstrual waste. Unlike other forms of plastic pollution that receive broader public attention, menstrual waste quietly accumulates in landfills, sewage systems, and water bodies. Single-use menstrual products and their packaging are now among the most found plastic waste items on beaches and in oceans (Harrison & Tyson, 2022). Each year, plastic-based menstrual products generate over 200,000 tons of waste (California State University San Marcos, n.d.). These products are composed of non-biodegradable materials such as superabsorbent polymers, rayon, and plastics, and can take between 500 to 800 years to decompose, further exacerbating the global plastic crisis (United Nations Environment Programme, 2021). Beyond the sheer volume of waste, the improper disposal of menstrual products exacerbates environmental hazards and public health risks. In many African and South Asian regions, menstrual waste is commonly burned, releasing toxic chemicals into the air (Elledge et al., 2018). A significant portion is also flushed down toilets, causing sewage blockages and contaminating water sources (Peberdy et al., 2019). Additionally, the lack of structured waste management systems in many parts of the world results in menstrual waste contaminating rivers and other water sources, creating serious sanitation and health issues (Elledge et al., 2018).

A Silver Lining

Does everything about menstruation carry a negative connotation? While challenges persist, progress is undeniable, and the global menstrual landscape is evolving. Global advocacy movements such as Menstrual Hygiene Day (May 28) and initiatives like #PeriodFriendlyWorld have propelled menstruation into public discourse. Governments are taking legislative action, with Scotland leading the way by passing the Period Products (Free Provision) (Scotland) Act, 2021, making menstrual products free for all citizens. Similarly, in Canada, the Menstrual Equity Fund Pilot, launched by Women and Gender Equality Canada, provides comprehensive access to menstrual products and menstrual health education, ensuring that economic barriers do not prevent people from managing periods with dignity. The fight against period poverty in low-income regions has also seen remarkable progress. Organizations like AFRIpads in Uganda are working to eliminate the exploitative "Sex for Pads" crisis, where young girls are forced into transactional sex to afford menstrual products.

Even the corporate sector is stepping up by integrating menstrual education into their social responsibility initiatives. Brands like Unilever and Always are shifting their marketing narratives to reduce stigma; for example, Always replaced the gendered “blue liquid” ads with realistic depictions of blood to combat period shame. At the same time, sustainable menstrual product innovations are gaining traction, addressing the long-ignored environmental impact of menstruation. Reusable options like menstrual cups and period underwear offer long-term affordability and significantly reduce waste. Biodegradable alternatives are also emerging: Saathi Pads (India), made from bamboo and banana fibers, can decompose within six months and help prevent skin irritation caused by synthetic products. These eco-conscious solutions show that menstrual hygiene and environmental responsibility can go hand in hand.

Reimagining Systems

These initiatives have laid a strong foundation, but transforming menstrual health requires moving beyond isolated interventions. It is clear that various systems - policy, economy, healthcare, urban planning, and sustainability influence this complex issue, and piecemeal solutions will not drive real change. A future where menstruation is no longer a barrier, but a well-supported, sustainable aspect of life depends on integrating menstrual health into broader sustainability policies, expanding financial accessibility, fostering innovation, and designing menstruation-friendly environments. It is essential to foster collaboration between governments, businesses, researchers, and advocacy groups, ensuring that each system supports the other. Achieving an inclusive and sustainable future where no one is left behind requires reimagining menstruation not as an individual burden, but as a systemic issue that calls for coordinated, cross-sectoral action.

Noor's story is not just about a pad passed in secret. It is about systems that fail - systems that keep menstruation hidden, inaccessible, or unsustainable. But stories can change. The monsoon will keep raining, but the next generation might just dance in it, Unashamed and Free!

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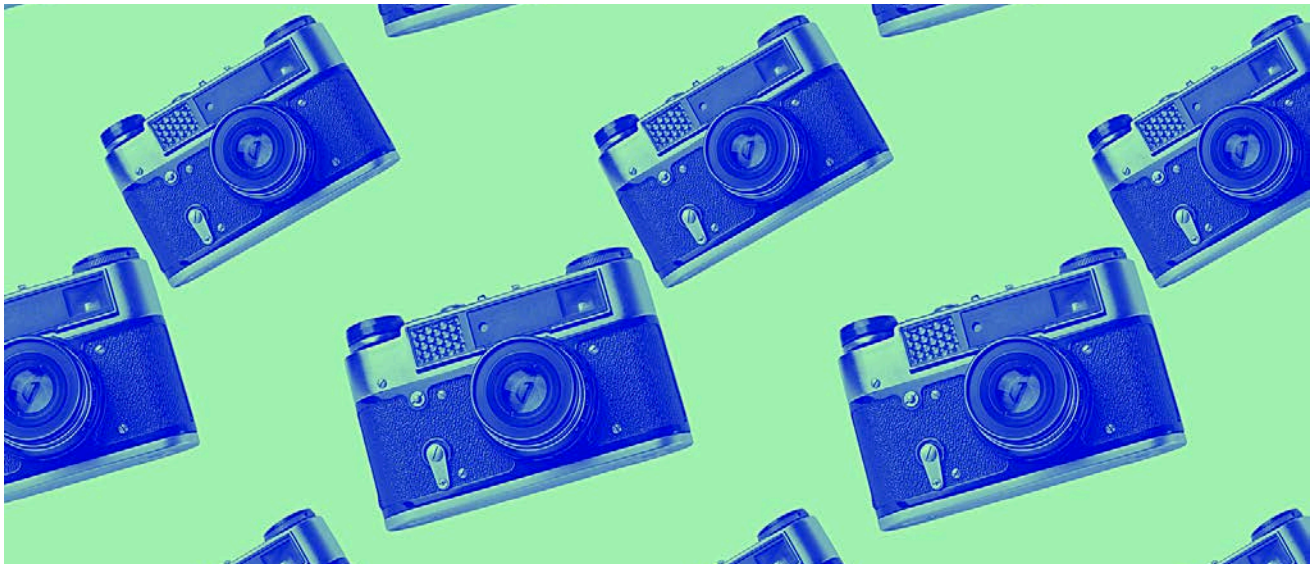
About Harleen Kaur

Hailing from India, I am currently pursuing a master's degree in sustainability management. My professional passion lies in integrating sustainable business practices globally, aiming to redefine business as an ally of the environment rather than an adversary.

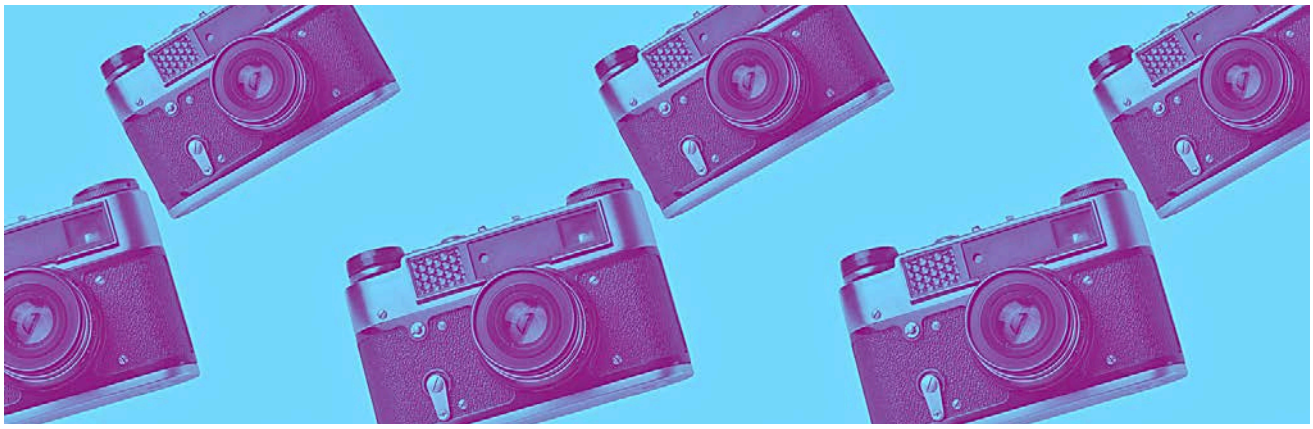


REFRAMING IMPACT: HOW PHOTOVOICE CHALLENGES TRADITIONAL FUNDING MODELS IN YOUTH CLIMATE ORGANIZING

By Chloe Wu

Abstract

Youth-led climate initiatives are instrumental in advancing climate justice but remain significantly underfunded. Conventional funding structures prioritize quantifiable metrics, often overlooking the relational contributions of grassroots movements. This study explores how photovoice, a participatory visual methodology, can challenge traditional impact evaluation models and empower youth organizers to document their contributions in ways funders recognize. Engaging youth climate leaders through a photovoice project, the research identifies key themes including relational organizing, creative resistance, and policy engagement. Findings demonstrate that photovoice not only validates movement-building efforts but also serves as a tool to redefine impact measurement in climate philanthropy. The study calls for funding frameworks that integrate storytelling and participatory assessments, ensuring sustainable support for the youth-led climate movement.



Youth-led climate organizations are at the forefront of environmental justice, yet they remain chronically underfunded. Despite leading mass mobilizations and influencing policy, these groups receive less than 0.76% of climate philanthropy (Youth Climate Justice Study, 2022). Traditional funding mechanisms prioritize quantifiable, emissions-focused metrics, leaving grassroots, relational, and narrative-driven work undervalued. This structural gap reflects broader systemic injustices, where young, often marginalized activists are excluded from decision-making and financial resources. This research explores how photovoice—a participatory, visual method—can challenge conventional impact evaluation models and empower youth organizers to legitimize their contributions in funding and policy spaces.

The impact of youth climate activism is often relational and cultural, making it difficult to capture through conventional evaluation frameworks. Unlike large-scale NGOs, youth-led movements emphasize storytelling, community-building, and intersectional advocacy—work that defies numeric metrics yet drives deep societal shifts. Funders, however, continue to favour data-driven impact reports that prioritize carbon reduction over movement sustainability, reinforcing a cycle where grassroots organizing remains underfunded. Photovoice emerges as an innovative participatory research methodology to disrupt this paradigm by visually and narratively documenting the transformative work of youth climate leaders (Wang & Burris, 1997).

This study engaged youth climate organizers (ages 18-30), collecting visual narratives and conducting reflection sessions. Participants captured images that represented their organizing impact, followed by focus groups where they contextualized their work within themes of visibility, creative resistance, intergenerational knowledge-sharing, and policy engagement.

Key Findings: Making the Invisible Visible

Participants highlighted how photovoice offered a new way to represent their movement-building work to external audience, providing an additional framework for recognizing and valuing the more qualitative sides of grassroots activism. Themes that emerged included:

Relational organizing: Images captured coalition-building, mentorship, and community care—elements often missing from traditional impact reports. This visually demonstrated impact for funders while reducing time needed to draft lengthy written reports.

Creative resistance: Submitted media documented creative storytelling, visual protest, and community arts as tools for movement-building, making advocacy efforts more tangible to supporters and decision-makers. Participants expressed that photovoice allowed them to better articulate their work, leveraging photos already taken for social media.

Policy engagement: Submitted media illustrated youth engagement in coalition-building with policymakers and participatory governance, reinforcing their role in shaping policy discourse beyond mere tokenistic presence. Participants also noted that photovoice provided a valuable opportunity for self-reflection, helping them recognize the impact of their work in ways they hadn't considered.

These findings spotlight a need for philanthropic shifts toward participatory impact assessment. Funders must move beyond quantitative evaluations and adopt approaches that honour storytelling, movement-building, and community resilience. Integrating photovoice into climate philanthropy can elevate youth voices in funding and policy spaces, ensuring that grassroots movements receive the recognition and financial support they deserve while also reducing administrative burdens and freeing up capacity for their impact work. Photovoice is a radical intervention in impact measurement—one that challenges who gets to define value in climate work. For funders, policymakers, and researchers, the path forward is clear: Reimagine systems of evaluation and invest in the future of youth-led climate movements.

Figure 1: A media submission by José Reyeros, co-founder and co-director of Ritmos Climáticos, a youth-led initiative mobilizing culture for climate justice. His reflections included themes of bridging global and local perspectives on environmental justice through art as a climate advocacy tool.

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About Chloe Wu

Born and raised between the buzzing streets of Hong Kong and the vast landscapes of Canada, I've always been drawn to systems—how they shape our world, who they serve, and who they leave behind. Now, as a student in Sustainability Management, I'm weaving together climate finance, impact evaluation, and redistributive justice to challenge financial gatekeeping and reimagine how capital flows. I believe in a world where resources move with intention, where finance serves people and the planet—not the other way around.

A GREENBACK REVOLUTION: HOW YOUTH FINANCE CAN RESHAPE CLIMATE ACTION

By Chloe Wu and Calvin Trottier-Chi

Abstract

Retail investors—everyday people investing their own savings—are a growing force in financial markets. The GameStop rally in 2021 showcased how powerful retail investors can be when mobilized, yet they remain underserved and overlooked. At the same time, the financial system continues to funnel money into industries that contradict many investors' values. Canada's largest banks have directed over $1 trillion to fossil fuels since 2016, far outpacing sustainable investments.

The Greenback Revolution is a youth-led movement empowering individuals to track where their money goes, share personal financial disclosures, and collectively shift toward sustainable investing. By leveraging this data, Greenback advocates for stronger financial transparency, more consumer choice, increased control over investments through banking alternatives, and policies that make sustainable finance more accessible. The climate transition is inevitable—now is the time to ensure capital flows toward investments that support the future young people want to build and will have to live through.

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When you hear the word “investor,” you probably don’t picture a gamer. But in January 2021, retail investors, everyday people investing their own savings, made up nearly half of all trades on the Toronto Stock Exchange (Thomson Reuters 2021). In just a span of a week, those investors drove GameStop’s stock price up by 500%, causing institutions to lose billions and forcing electronic platforms to halt trading. Driven by their sentimental connection to GameStop, gamers were just as much a part of Bay Street as brokers for that month.

The GameStop rally could have been ripped from a movie script (and, sure enough, it became one). But beyond the spectacle, it revealed a bigger shift: retail investors are now a permanent force in capital markets. The fact that Wall Street didn’t see it coming shows how overlooked this growing community is and how powerful it can be when mobilized. With today’s economic shifts threatening to stall sustainable development, retail investors have a crucial role to play in directing capital towards organizations with aligned values.

You’re Already an Investor—Even If You Don’t Realize It

Sustainable investing isn’t just about buying stocks, it’s about where your money sits. Your bank, insurer, or pension fund is investing on your behalf, often in industries that don’t align with your values. Canada’s five largest banks have poured over $1 trillion into fossil fuels since 2016, outpacing sustainable investments by a ratio of 3-to-1 (FinanceMap, 2024). Simply choosing a financial institution that shares your values is a powerful way to shift capital.

Young people are among the most climate-conscious, as the majority recognize the need to align financial markets with these risks. While a large portion of Gen Z directly invest their savings, financial literacy remains a challenge (Ontario Securities Commission, 2022). Others, stretched thin by the rising cost of living, struggle to save or invest at all (Canadian Investment Regulatory Organization, 2024). Even those eager to take climate action through finance often don’t know where to start, so accessibility to sustainable investing remains a key challenge.

Initiatives exist to help youth demand action as voting citizens, such as Climate Action Network or Youth Climate Lab. But there aren't accessible spaces for youth to demand action as investors. That's where Greenback Revolution comes in (Greenback Revolution, 2025). Greenback is a youth-led movement mobilizing young people to track their money, share personal disclosures on their own commitments, and form a collective consensus on how much individuals are willing to shift toward sustainable finance. By gathering this data, Greenback aims to create a tool to advocate for systemic change, pushing for stronger disclosure laws, sustainable banking alternatives, and financial products that meet the needs of values-aligned investors.

Policy & financial tools—making it easier to invest with your values

While individual action matters, the financial system needs to meet people where they are. In Europe, banks must disclose how much of their assets fund sustainable activities through the Green Asset Ratio (GAR) (de Wergifosse, 2023). A similar system in Canada would help consumers see whether their banks and investments align with their values.

Most people don't think of themselves as investors. But if you have a bank account, an insurance policy, or a retirement fund, your money is already shaping the world. The question is: **is it shaping the future you want?**

Consider this: in 2018, just two months after Canada legalized recreational cannabis use, retail investors funneled over $4 billion into cannabis stocks, hoping to cash in on the boom. By 2022, the market had collapsed, wiping out $131 billion. That's about as much as Canada needs to invest per year to build a clean economy (Ontario Securities Commission, 2018; Ghobrial, 2022; Thomas and Smith, 2024).

The climate transition is happening, whether decision-makers plan for it or not. The world's most sustainable companies have historically kept pace with the market, demonstrating that value-driven investing does not necessarily mean sacrificing financial returns (McCarthy, 2025). If billions can flow into cannabis stocks in months, why not into climate solutions, clean energy, and ethical business models?

Want to take a step towards aligning your personal finance with your values? Find more information at: https://greenbackrevolution.ca/

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HOW OUTCOMES-BASED FINANCING CAN SCALE SUSTAINABLE DEVELOPMENT

By Asiyah Choudry

Introduction

In 2024, the UN published the latest edition of its annual Financing for Sustainable Development report, identifying a staggering development finance gap of USD 4.2 trillion annually, which must be addressed to achieve the UN Sustainable Development Goals (SDGs) by the 2030 deadline (UN Department of Economic and Social Affairs, 2024). The report identifies several causes for this financing gap: misaligned policy objectives , minimal private-sector investment, and a lack of incentives (UN Department of Economic and Social Affairs, 2024). Innovative financing mechanisms, such as outcomes-based financing can help bridge this gap by improving access to capital for organizations and governments to pursue sustainable development objectives.

What is outcomes-based financing?

Outcomes-based financing (OBF) is a type of impact investment product, which goes by many names, including outcomes-contracts, social impact bonds, or the pay-for-success model (Raven Indigenous Impact Foundation (RIIF), 2023). Globally, the OBF market is valued at $185 billion and ensures that financial incentives are structured to drive positive social outcomes (RIIF, 2023; World Economic Forum, 2025). In OBF, a funder makes a commitment to dispense payment to a Service Provider (SP) upon delivery of a predetermined outcome, for example sustained employment for homeless youth (GPRBA, 2020). The SP needs upfront capital to deliver an intervention. This financing can come from the SPs own capital, or from funders like financial institutions, philanthropists, governments, or investors (GPRBA, 2020). Repayment is deployed upon verified achievement of the outcome (GPRBA, 2020).

An outcomes-based contract differs from a fee-for-service contract, in that the service provider only gets paid based on results, rather than service delivery (GPRBA, 2020). Funding is tied to the achievement of a development outcome as opposed to intermediary results (Gibson, n.d.). An outcome refers to the change that the user experiences because of the service (Gibson, n.d.). This can include increases in individual well-being, environmental or other social outcomes. The benefit of OBF for governments, is that it allows them to avoid spending on services that aren't effective (RIIF, 2023).

What are the benefits of OBF?

One of the primary benefits associated with OBF is providing the incentive for actors to behave in a socially desirable manner. This occurs as the receipt of payments is dependent on the achievement of outcomes, as a result SPs are incentivized to prioritise positive outcomes to users of their service (Gibson, n.d.). Further, as SPs have full control over service delivery, they will deliver a service in the most efficient way, providing a low-cost mechanism for achieving positive outcomes. A second benefit is the transfer of risk for funders. This model enables governments and other organisations, to implement novel initiatives to advance sustainable development, while reducing the risk of service failure or inefficiency. By linking payment to achievement of outcomes, risk is transferred to the service provider, or private investors (Gibson, n.d.).

How has OBF been deployed to advance sustainable development?

OBF has been deployed to unlock access to capital to support sustainable development initiatives across numerous sectors , including agriculture, cities, and technology.

A. Agriculture: Root Capital's Social Impact Incentives Model for Smallholder Farmers in Latin America

In Latin-America, agricultural small and medium-enterprises (SMEs) lack access to reliable sources of

financing that enable access to technology and tools, to boost agricultural productivity, and build agricultural resilience against weather volatility (Root Capital, 2022). In particular, there is a financing gap for SMEs as they tend to be too large to gain access to capital through microfinance but are considered risky by commercial lenders who hesitate to provide loans (Root Capital, 2022). In partnership with the Swiss Agency for Development and Cooperation, Roots of Impact, and the Inter-American Development Bank Lab, Root Capital received $1 million in outcome-based payments, contingent on the disbursement of loans to agricultural SMEs (Root Capital, 2022). Without access to outcome payments, loans to agri-SMEs would remain unprofitable and would fail to attract investment. This initiative successfully distributed $12 million in loans to 32 agricultural SMEs in Latin-America, generating $41 million in income for more than 9000 smallholder farmers (Root Capital, 2022). The success of this initiative demonstrates the potential of OBF to scale SMEs without access to capital.

C. Technology: Community Driven Outcomes Contract

The Community Driven Outcomes Contract serves as an example of an indigenous outcomes-based finance model, created by Raven Indigenous Impact Foundation (RIIF). This joint initiative between the Raven Indigenous Impact Fund and various outcome partners, trained and certified members of the Peguis First Nation and Fisher Cree River Nation in the installation of geothermal units, windows, doors, and other insulation (RIIF, 2023). The initiative was executed in collaboration with Indigenous social enterprise Aki Energy (RIIF, 2023). Philanthropic foundations supplied $5.1 million in upfront capital for project implementation (RIIF, 2023). This contract led to the installation of 124 geothermal units that supported energy sovereignty on indigenous reserves and enhanced technical knowledge among reserve members (RIIF, 2023). Upon validation of successful implementation, outcomes payments were distributed to investors, who received the principal plus a 4% annualized return from Efficiency Manitoba and the Canada Mortgage Housing Corporation (RIIF, 2023).

Challenges of applying OBF to deliver positive impact

One of the central challenges of OBF, characteristic of many financing mechanisms aimed at delivering a positive impact, is accurately measuring outcomes. To maintain the legitimacy of OBF, outcomes need to be verified. In Canada, there are currently no centralized standard-setting related to outcome assessment (RIIF, 2023). Without proper measurement and verification, there is a risk that SPs misrepresent achievement of outcomes, leading to outcomes not being met. This creates concerns about the effectiveness of using OBF to meet the SDGs. Secondly, there is the challenge of misaligned incentives. This occurs when an SP hyper-focuses on achieving the outcome while failing to address

broader needs of users (Gibson, n.d.). For example, an SP may choose to exclude individuals from receiving access to a service, if they expect that the individual will not contribute to achievement of the outcome (Gibson, n.d.). Misaligned incentives can lead SPs to actively neglect users and reduce the effectiveness of OBF.

Conclusion

OBF is an alternative financing mechanism that links financing to the achievement of predetermined beneficial outcomes. When applied correctly, it has the capacity to deliver positive development outcomes by providing SPs with a financial incentive to supply a service that adequately achieves intended outcomes. OBF has diverse applications and can be backed by private capital or public funds. There are many obstacles that limit uptake of OBF as a financing mechanism including a lack of knowledge about what OBF looks like in the Canadian context (RIIF, 2023). Overall, OBF remains a promising alternate finance mechanism for accelerating sustainable development and meeting the SDGs by the 2030 deadline.

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About Asiyah Choudry

I'm currently pursuing a Masters of Science in Sustainability Management. My professional passion lies in non-profit, community-level sustainability initiatives, focusing on driving positive environmental and social change. I aspire to work with organizations to develop and implement strategies that foster stronger, more sustainable communities.

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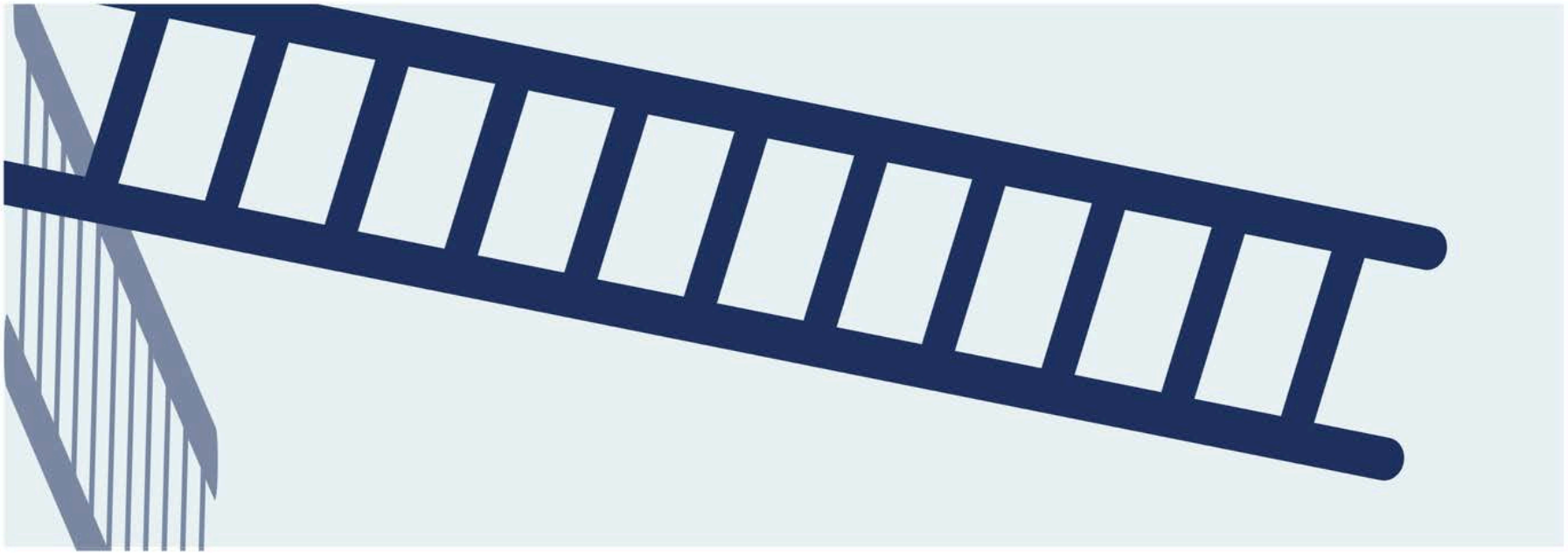

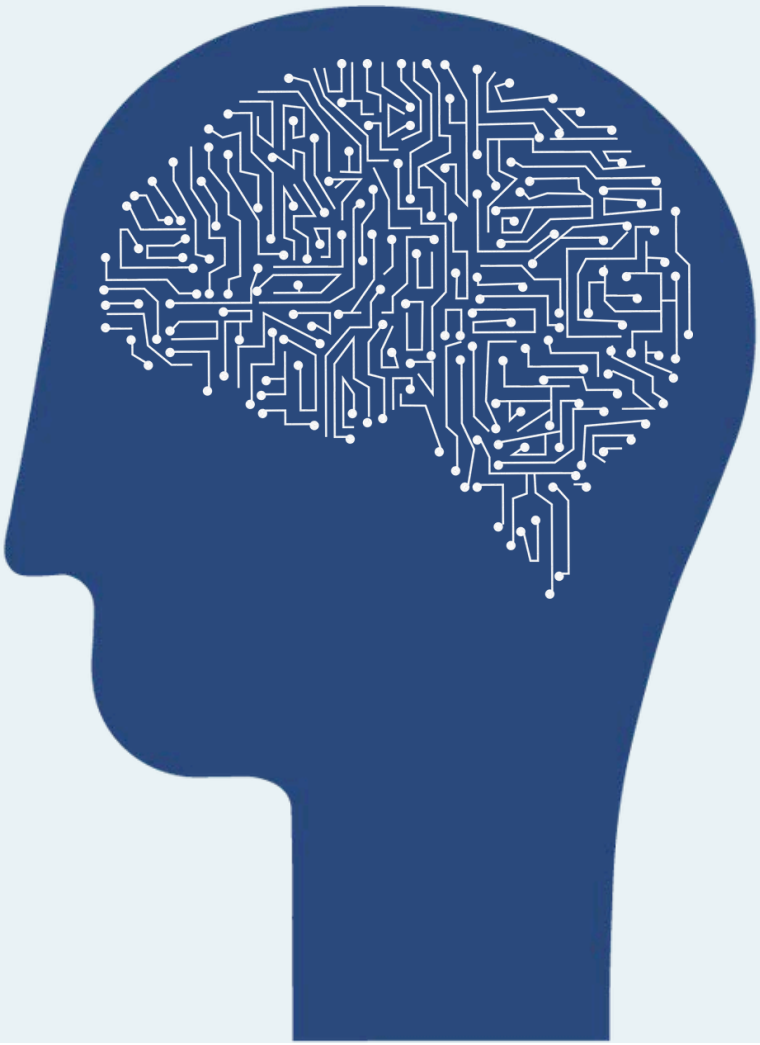

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