

Sustainable Finance

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Karen Wendt *Editors*

# The Fourth Industrial Revolution and Its Impact on Ethics

Solving the Challenges of the Agenda  
2030

 Springer

# **Sustainable Finance**

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Editors

# The Fourth Industrial Revolution and Its Impact on Ethics

Solving the Challenges of the Agenda 2030

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# Foreword

If you want to walk fast, walk alone, but if you want to walk far, walk together.  
Proverb

## Calling for New Forms of Cooperation<sup>1</sup>

The Fourth Industrial Revolution is just one dimension of today's global challenges. It shares its complexity with most other current challenges we are facing and increases our awareness of the interconnectedness in the world we live in today. Climate change, threats to biodiversity, demographic transitions, and migration immediately come to mind. The current disruption caused by the COVID-19 pandemic illustrates the scale of these challenges in most impressive ways. What all of them have in common is that they fundamentally call into question the established paradigm of policy making, namely the sectoral approach that presumes clearly defined interests, roles, and responsibilities. Instead, the discussion shifts to the question of how to collaboratively produce and sustain global common goods.

We understand that complex global challenges will not be met by solutions designed by a single individual, institution, profession, or country. What we need instead is a new paradigm allowing for the inclusion of different perspectives and stressing cooperation beyond sectoral borders. Again, international political, financial, or medical collaboration currently developed to overcome COVID-19 exemplifies the willingness (among some) but also the obstacles to making this paradigm shift. The United Nations and many national governments have expressed the need for more cooperation for quite some time, as reflected in the Agenda 2030, the Paris Declaration, and other resolutions. Sustainable Development Goal 17 in particular is

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<sup>1</sup>The views and opinions expressed in this article are those of the author alone and do not necessarily represent official policy or position of the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH.

calling for “partnerships for the goals” acknowledging that we can only reach them jointly.

But knowing about the “radical interdependence” and expressing the need for a paradigm shift has not been mirrored by adequate changes in structures, instruments, and processes to develop and implement possible solutions in more cooperative ways. In practice, we rather continue to work in sectoral and organizational silos. Experts in politics, economics, academia, and civil society most often act in isolated systems and remain bound to their professional perspectives. What we would need is not only a vital and interconnected system but also new forms of interaction to properly match the complexity and scale of our current global challenges.

Our past guiding principles were professional expertise and efficiency, and they worked well as long as we seemingly knew the solution to specific situations or problems. Yet they already failed in the past, as soon as the unpredictable, the unexpected, or even the disruptive came in. In the face of the Fourth Industrial Revolution and very much so under COVID-19, the unexpected has become the new normal. Instead of applying efficient plans or “best practices,” we have to look for alternative guiding principles to better prepare for unpredictable futures. Experimenting and prototyping gains importance. As much as this is true for technical or scientific solutions, it is also true for partnerships, alliances, and inter-institutional and interpersonal connections. The complexity and scale of today’s challenges, extending beyond geographical, disciplinary, and temporal boundaries, make it quite clear that only joint approaches will produce suitable solutions, combining a broad set of complementary skills and competences.

The field of development aid is a case in point. Over the past few decades, the development community has realized that building networks among diverse stakeholders, as well as the skill to adapt to changing circumstances, would gain importance over rather static planning and implementation processes, which represent the efficiency paradigm of the past.

That is why the Global Leadership Academy came into existence in 2012. Believing that we have to create openness and need spaces to practice new forms of interacting, building trust, and daring to try new ways of collaboration in the field of development cooperation, the Global Leadership Academy<sup>2</sup> was commissioned by the German Federal Ministry for Economic Cooperation and Development in 2012. Implemented in the framework of the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), it added to GIZ’s range of services for international human capacity development. On the micro-level, the Global Leadership Academy aimed at individual change agents across professional and regional borders and designed and conducted international multi-stakeholder dialogues for the Agenda 2030, contributing to 12 of the 17 global goals today.

Addressing global issues such as inclusive insurances, sustainable oceans, economic development and well-being, migration management, human trafficking, etc. and working with a wide range of international partners, the Global Leadership

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<sup>2</sup>Cf. [www.we-do-change.org](http://www.we-do-change.org)

Academy developed new formats for dialogue, while managing their implementation and ensuring their quality. Choosing a systems approach, known as Social Lab Methodology,<sup>3</sup> we based the design of the international and transdisciplinary dialogue processes on the latest methodological findings from multi-stakeholder research and systems analysis, reflected by cooperation partners, such as the Presencing Institute, the Deep Democracy Institute, REOS, and others.<sup>4</sup> Participants networked globally with their peers and developed communities of practice, initiating sustainable transformation at systemic level through projects and change processes in their spheres of influence.

In 2018, it became clear, however, that by purely conducting intensive and extended dialogue processes the scale of change would be rather limited. Even though the approach aimed to produce and enhance change projects and prototypes on local, national, and regional levels and thereby managed to show impact individually and even institutionally, real systemic change was happening beyond a single dialogue process. In other words, it meant moving beyond the time frame of the Global Leadership Academy as a program of international cooperation. Only if the participants of the different dialogue processes would find the courage to leave their thematic “silos” and form a truly global community, they would unleash their full transformative potential of new forms of cooperation. Enabled to connect not only across national and professional but also across thematic borders, they started to form the Global Leadership Community.<sup>5</sup> Its idea is to work together, inspire each other, and survive and sustain, as a vital and interconnected impact-oriented network for facing the global challenges.<sup>6</sup>

Together with the team of the Global Leadership Academy within GIZ, they decided to inquire into ideas and co-create a vision for reshaping into a network, providing for a structure and processes fit to work on the development and implementation of solutions for the global challenges in a sustainable way. Operating as a network of radically interdependent leaders and change agents, they are united in their urge to achieve the global goals of the Agenda 2030 and mitigate risks for future generations.

Members of the Global Leadership Community also feature among the speakers at the conference “The Fourth Industrial Revolutions and its impact in the Ethics” as well as among the authors in this volume. Allen Sophia Asiimwe (Uganda), Joni Baboci (Albania), Katharina Miller (Spain), Natalia Sánchez Herrera (South Africa),

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<sup>3</sup>Cf. Zaid Hassan (2014): *The social labs revolution: a new approach to solving our most complex challenges*. San Francisco: Berrett-Koehler. See also the theory of change by the Global Leadership Academy at [www.we-do-change.org/the-logic](http://www.we-do-change.org/the-logic)

<sup>4</sup>Cf. [www.presencing.org](http://www.presencing.org); [www.deepdemocracyinstitute.org](http://www.deepdemocracyinstitute.org); [www.reospartners.com](http://www.reospartners.com)

<sup>5</sup>Up to spring 2020 the Global Leadership Community includes around 650 individuals from 114 countries of diverse professional background. It is gender balanced with 48% female and 52% male members.

<sup>6</sup>Cf. Peter Vandor et al. (2019): *Addressing grand challenges collectively: a brief introduction to impact-oriented networks*. Vienna University of Economics and Business: Working Paper.



and Kathrin Tietze (Germany) used the opportunity to share their expertise and different perspectives on the topic.

Aiming at systems on national, regional, and global levels, the Global Leadership Community found its common cause, the Agenda 2030. Through new forms of cooperation members aim to set an example for an action network matching the complexity of our current global challenges. The network is in the making, experimenting on its way forward. Change on the macro-level will certainly also have to take place, but members of the Global Leadership Community decided not to wait for that. As for spring 2020 more than two hundred projects and change initiatives have been launched by community members, reaching around 2.4 Mio. people worldwide. Sensitive to power dynamics that often hinder collaboration, the community members aim at making these and their influence visible. Like the Global Leadership Community, some other networks walk this risky path of innovating international cooperation. If they live up to their goals, they will succeed and set examples for more inclusive and symmetric ways of cooperation that are so urgently needed in many fields of global politics.

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Wiebke Koenig

# Foreword<sup>7</sup>

We are witnessing profound shifts across all industries, marked by the emergence of new business models, the disruption of incumbents, and the reshaping of production, consumption, transportation, and delivery systems. On the societal front, a paradigm shift is underway in how we work and communicate, as well as how we express, inform, and entertain ourselves.

Schwab, K., 2016, *The Fourth Industrial Revolution*, World Economic Forum, p. 1–2.

Such paradigm shifts in industries and social systems go hand in hand with shifts in how and what people learn and who is educated. We need to ask in what ways will education, schooling, and learning be shaped by the Fourth Industrial Revolution? What kinds of education, schooling, and learning are appropriate for living in a fourth industrial age?

A review of European history reveals that schooling and individual access to information have changed significantly over time. In ancient Greece and during the Middle Ages, a student's education (in *septem artes liberales*) depended on a family's wealth and status, and access to information was limited by who you were and who you knew.

Schooling increased during the era of industrialization, with concentration on primary skills and catechism. But high levels of illiteracy persisted, and access to knowledge was thus still limited by wealth and privilege as it was available only to those who could purchase and read books, newspapers, and journals.

Over the course of the last century, more and more students in Europe remained in the school system for longer periods. Many also participated in secondary school education, though not all (see figure on the left). From 2000 to 2015, an international effort to ensure universal access to education was pursued under the United Nations Educational, Scientific and Cultural Organization's (UNESCO) focused Education For All (EFA) initiative. Nevertheless, in its final report, UNESCO concluded that a major challenge remains as "tens of millions of children will still not be in school by

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<sup>7</sup>Thanks to Dick Bourgeois-Doyle and Holly McKelvey for their comments on the foreword's draft.

2015”.<sup>8</sup> At the same time, the digital revolution has produced new opportunities and an infrastructure that gives people in all nations greater and easier access to information than ever before.

While education in former times provided information about the world, education today aspires to empower students to handle and judge information in the face of questions: What information is reliable? What information is trustworthy? How can I produce reliable information?

A key characteristic of education in this era of knowledge-based societies is therefore the process of learning about research as a safekeeper for reliable, comprehensible, and transparent information.

With the advent of the Fourth Industrial Revolution, education is again at a turning point. Through the shifting and intertwining of the physical, digital, and biological spheres, education, schooling, and learning will be powerful influences on society. To combat both traditional and new inequalities arising from automation, displacement of workers, and the digital divide, education, schooling, and learning will need to transform. It is imperative that the present shift reach and engage everyone in learning, with emphasis on enabling students to better understand research, to request research integrity from others, and to conduct responsible research.

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Coburg, Germany

Julia Priess-Buchheit

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<sup>8</sup>United Nations Educational Scientific and Cultural Organization. (2015). Education for all global monitoring report. Education for all 2000–2015: Achievements and challenges. Paris, France: Author. Retrieved from <http://en.unesco.org/gem-report/report/2015/education-all-2000-2015-achievements-and-challenges#sthash.Srl5cfP0.dpbs>, p.7

# Foreword

The Fourth Industrial Revolution is already a reality. New technologies, mobile devices, and artificial intelligence condition—and will increasingly condition—our lives. They affect employment and labor relations: robots will assist and replace us in many of the more arduous and repetitive tasks, but also in data analysis and drawing conclusions as well as producing diagnoses and verdicts (in medicine, justice, etc.) where complex algorithms will make complicated decisions, assign resources, and set priorities. Yet, they also affect leisure activities, which are becoming increasingly individual as major platforms allow us to enjoy films and TV series, meet people, or create new relationships at any time and without leaving our homes, in addition to our consumption as we buy products and services wherever, whenever, and however we want.

All this is happening in the middle of the twenty-first century, in a society that lives in what Amelia Valcárcel calls “the mirage of equality.” While it seems as if in many areas equality between women and men has already been achieved, nothing could be further from the truth. We live in a deeply sexist society marked by unequal power relations that still do not grant women and men the same opportunities. Although women have succeeded in the education system and the percentage of girls and young women who obtain a degree is higher than that of men, there is still a significant bias in the choice of training paths, and the percentage of women in scientific and technological disciplines, both in vocational training and in higher education, is very low.

Women are thus absent from the development of the tools, computers, and algorithms that directly affect our lives, with all the risks that this exclusion entails:

- Artificial intelligence does not take women’s perspectives into account. Algorithms can spread and reinforce sexism and gender stereotypes through biased decisions that will negatively affect women.
- Women are not present in the professions that have the greatest demand, the brightest future, and the best work conditions. This will perpetuate inequality between women and men in the labor market, mainly in terms of occupational

segregation, the absence of women in leading positions in the top companies, and, as a result, the gender pay gap.

- Many of the jobs that are mostly performed by women can be automated, which may imply a loss of work opportunities that will be replaced by positions requiring technical skills which many women do not possess.

We are facing a paradigm shift exacting the establishment of ethical frameworks and principles that guarantee human dignity, freedom, effective equality between women and men, tolerance, justice, solidarity, and non-discrimination and that ensure sustainable and inclusive development; however, this will not be achieved without the balanced participation of women and men in all areas.

Fortunately, although there are reasons to worry as well as important challenges to overcome, there are also reasons to be optimistic: *whether it is destiny or coincidence*, this Fourth Industrial Revolution coincides with another fourth wave, that of the feminist movement. During the last few years, millions of women, many of them young, and increasingly more men have been at the forefront of massive mobilizations questioning the patriarchal society and demanding the end of gender gaps as well as their full rights as citizens.

Here at the *Spanish Women's Institute*, we congratulate the *European Women Lawyers Association* for the organization of the conference “The Fourth Industrial Revolution and Its Impact on Ethics” and the publishing of its conclusions and presentations. We are convinced that this will lead to important reflections on how to take advantage of the opportunities of this Fourth Industrial Revolution to create a more inclusive future that is focused on people and in which equal treatment and opportunities for women and men are real and effective.

Madrid, Spain  
December 2019

Director of the Spanish Women's Institute

# Preface

## The Fourth Industrial Revolution: in the Spirit of Immanuel Kant

Revolutions and upheavals are constant and recurring phenomena since human communities have existed. We are currently in the era of the so-called Fourth Industrial Revolution. This expression “The Fourth Industrial Revolution” (4IR) is a neologism coined by Klaus Schwab. In his article in *Foreign Affairs* 2015,<sup>9</sup> he identifies the defining Fourth Era technologies as robotics, artificial intelligence, nanotechnology, quantum computing, biotechnology, the Internet of things, the industrial Internet of things (IIoT), decentralized consensus, fifth-generation wireless technologies (5G), 3D printing, and fully autonomous vehicles. Given the scope and nature of these technological fields, we could not have wished for a better introduction to our discussions than the contribution from the Vice-President, Emerging Technologies, National Research Council Canada, Dr. *Geneviève Tanguay*: “*Addressing the Ethical and Social Challenges of Emerging Technologies: Creating the Conditions to Play a Leadership Role in the Fourth Industrial Revolution.*”

In this atmosphere of new beginnings, it is extremely important to reflect and investigate both the positive and negative effects this coming change can have on the individual and on living together in a democracy.

For this reason, this book examines the effects of the 4IR on human coexistence and ethics, with 29 authors, who come from 14 different countries and four different continents, contributing.

None of the 28 authors nor I are philosophers, but we hold in the spirit of Immanuel Kant<sup>10</sup> that: “*Common sense can just as well hope to get it right as a*

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<sup>9</sup>Schwab, K: What It Means and How to Respond, in: *Foreign Affairs*, December 12, 2015 (<https://www.foreignaffairs.com/articles/2015-12-12/fourth-industrial-revolution>)

<sup>10</sup>Kant, I: *Grundlegung zur Metaphysik der Sitten*, 1785, reprint in: Immanuel Kant, *Gesamtausgabe in zehn Bänden*, Leipzig 1838, Modes und Baumann, page 23.

*philosopher can always hope to get it right; indeed, it is almost more certain of it than even the latter, because the latter, however, has no other principle than the former, but can easily confuse his (or her) judgment by a multitude of strange, irrelevant considerations and make it deviate from the straight direction (. . .). There is something splendid about innocence; but what is bad about it, in turn, is that it cannot protect itself very well and is easily seduced. That is why even wisdom—which otherwise probably consists more in doing things than in knowledge—also requires science, not in order to learn from it, but to give its prescriptions entrance and permanence.”*

Kant thus assumes that the layperson, i.e., a person who is not explicitly philosophically educated, is more reliable than the philosopher in finding the right thing to do. We are not interested in being a “bicycle brake on an intercontinental airplane.”<sup>11</sup> Our aim is to place questions of distribution and justice in and for our society at the center of our considerations.

This is why Agenda 2030 offers an ideal framework for our book: For the 17 sustainability goals, which were agreed by 193 countries on September 25, 2015, aim to establish equal rights between people, protect our earth, and guarantee prosperity. Those who want to learn more about Agenda 2030 can do so in reading the contribution of *Larisa B. Miller: “How Businesses Can Impact Agenda 2030.”*

The sustainability goals 5 and 10 were especially important to us when we organized the congress in November 2019 and started to edit this book. Because we still live in a system that was largely developed by white men for white men and, in this system, it is not always easy for women to postulate and pursue our own innovative projects, longings, and desires with vigor.

Nicola Crowden already described this difficulty impressively in 2003<sup>12</sup>: “*Innovation studies do not generally take into account or explicitly seek out the views of women about innovation processes or their roles in innovation, and they do not consider the possibility that women’s and men’s contributions to innovation may differ.*”

You may notice that we do not have a separate chapter on intersectionality and we are aware that we have not succeeded in “*being complete*” either.<sup>13</sup> On the other hand, our author *Kathrin Tietze* deals with intersectionality in “*Beyond gender.*” At this point I would like to note that it is becoming more and more evident to me that many men also feel forced into a corset within this system. The *kairos* is therefore there to venture to new shores, to develop, and above all to implement a new project of coexistence. A new social contract must therefore be negotiated.

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<sup>11</sup>Beck, U: Die Ethik wird zur Fahrradbremse am Interkontinental-Flugzeug. Legitimationskrise durch Demokratisierung venden. In: Das Parlament, June 4, 1999, page 6.

<sup>12</sup>Crowden, N: A report for the women’s advisory group on innovation studies, August 2003 (<http://www.sfu.ca/sfublogs-archive/departments/cprost/uploads/2012/06/0310.pdf>) (latest check on May 23, 2020)

<sup>13</sup>Butler, J: *Gender Trouble: Feminism and the Subversion of Identity*, 1990, p. 210.

That is why it is so important, especially now, to sit down at a (virtual or real) table with as many people as possible and question the status quo and reflect on how our living together should and can look more ideal. This thoughtfulness is made all the more urgent by COVID-19. We now all understand that we live in a VUCA<sup>14</sup> world and that its limits, possibilities, and risks are no longer as easy to assess as we might have thought 30 years ago. Perhaps, this is precisely why it is so important and significant that my South Korean colleague *Angela Joo-Hyun Kang* writes about “*Essential Change Factors to Enhance Integrity Competitiveness*.” Right now, compliance and ethics are in greater demand than ever before.

Alfred Cyril Ewing wrote in his Introduction to *Ethics*<sup>15</sup> that “*today there is a strong tendency to equate knowledge with science. But science, as two world wars in the last century made painfully clear, can only teach us about the means—not about how these means should be used.*”

This text from 1953 could also be from the year 2020 because even in the twenty-first-century natural science cannot protect us from a new type of virus and she is at her wits’ end when it comes to conflicting interests and open conflicts between neighbors, EU member states, or even more so at the global level; nor can it protect us from the conspiracy theories and disinformation that have already captivated many people.

For this reason, I am very grateful to all the authors who write about education in our volume.

First of all, I would like to thank Prof. Dr. *Julia Priess-Buchheit*, who writes in her concise preface about the importance of integrity in research. I would also like to thank Prof. Dr. *Montserrat Cabré Pairet* and her colleagues, as their contribution on “*Gender in engineering: assessing women’s performance in university education*” shows how important sex-disaggregated data are to get more women students and researchers in STEAM.<sup>16</sup> My wonderful friend and colleague in the W20, *Cheryl Miller*, explains clearly in “*Digital equity and the Fourth Industrial Revolution*” the serious impact that the lack of women in STEAM subjects has on our economy and democracy.

The ethicist Peter Singer, who is very controversial at least in Germany, wrote in one of his essays<sup>17</sup>: “*Perhaps we are more ready to accept that the biological differences between men and Women are relevant to the roles they play in society. There are such differences, and they are not purely physical. So we should not leap to the conclusion that if most engineers are men, there must be discrimination against Women. It may be that more men than Women want to be engineers.*”

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<sup>14</sup>VUCA is an acronym to describe or to reflect on the [volatility](#), [uncertainty](#), [complexity](#), and [ambiguity](#) of general conditions and situations.

<sup>15</sup>Ewing, A. C.: *Ethik. Eine Einführung*, Felix Meiner Verlag, Hamburg 2014, Preface.

<sup>16</sup>Explainer: what’s the difference between STEM and STEAM? <https://theconversation.com/explainer-whats-the-difference-between-stem-and-steam-95713> (latest check on May 24, 2020)

<sup>17</sup>Singer, P.: *God and woman in Iran*, in *Ethics in the real world*, Princeton University Press, Princeton and Oxford, 2016, p. 156.



At the latest after reading the contributions of the former Spanish Secretary of State Prof. Dr. *Angeles Heras Caballero's* “*Women and ethics during the Fourth Industrial Revolution,*” of my Spanish-Italian colleague *Andrea Accuosto's* “*4IR's ethical impact and the role of women,*” of *Jorgelina Albano* on “*Meritocracy vs gender equality,*” and of my Argentinean-Italian colleague *Cecilia Danesi* on “*The impact of artificial intelligence on women's rights: a legal point of view*” and the contribution of EWLA's Secretary General *Dace Luters-Thümmel* on “*We all have to lean in. . .*” it becomes clear why Mr. Singer's conclusion cannot be so consistent.

I would like to come back to the aspect of education, to which we give much space in our book. First, I would like to highlight *Katharina Schüller's* “*How can FinTechs contribute to financial literacy?*” Her contribution shows us how important it is for all of us to acquire data competence also in the area of finance. My Indian W20 colleague *Vidisha Mishra* and *Gergana Vladova's* contribution “*It's personal: 4IR and the future of learning*” describes from an Indian and German perspective the need to establish e-learning and make it accessible for all, not least because of COVID-19.

As European lawyers, we have the following goals with this book:

- It is important to us as we female lawyers have to deal with the topics of the 4IR and implement this from different perspectives.
- We need to learn to look beyond our legal texts, leave our comfort zones, and interact with engineers, investors, startup managers, and others.
- Our society needs proactive women lawyers who propose regulations or who set up a startup or invest funds themselves.

I am therefore very grateful to the former Advocate General at the European Court of Justice (CJEU), Prof. Dr. *Verica Trstenjak*, for addressing the topic “*Human rights in the digital era: From digital practice to digital law and case law.*”

Prof. Dr. *María de la Concepción Chamorro Domínguez* explains to us “*Financing of start-ups via Initial Coin Offerings (ICOs) and gender equality.*”

To find your way in the world of Bitcoin and startups, networks are important. *Gloria Lorenzo*, *Yolanda Díaz Villarrubia*, and *Regina Llopis* tell us about it in “*4IR and ethical impacts: Startups ecosystems and gender equality.*”

Prof. Dr. *Magdalena Suarez Ojeda* deals with the topic smart cities: “*Sustainability and non-discrimination: the only possible path for the proper development of smart cities and smart territories,*” and my French colleague and member of the EWLA Board, *Claire Poirson*, writes about “*The legal regulation of facial recognition.*”

Cybercrime is a major problem, especially for women and children. My Spanish colleague *Cruz Sanchez de Lara Sorzano* deals with this in “*The Fourth Industrial Revolution and sophistication in gender crimes*” and researcher Dr. *Ana Vidu* shows how important the support of bystanders is and how they themselves can be in danger: “*Addressing second order of sexual harassment to overcome gender-based violence in times of the Fourth Industrial Revolution.*”

Though we all knew it, COVID-19 has shown it to us once again that our work has changed and will change even more. Her Highness Queen *Zaynab O. Obanor*

from Nigeria deals with this topic from a historical perspective in “*The New Luddites*,” whereas my German colleague *Maria Dimartino* does it legally: “*The future of work—opportunities and challenges under German legislation*.”

Necessary changes can only bear fruit and really work if the leaders of an organization are one hundred percent committed to them. The same applies to heads of government, and my Argentinean W20 colleagues *Susana Balbo* and *Victoria Marensi* write about it: “*How can leaders face 4RI challenges? The importance of gender sensitive lenses in leadership*.”

My thanks go to our coeditor *Karen Wendt*, who made the book project possible. Furthermore, I would like to thank all authors for participating in this important experiment and very special thanks to our EWLA board members Prof. Dr. *Laura Carlson*, *Maeve Delargy*, and EWLA-Vice President *Susanne Hirschberg* and our loyal Irish friend and supporter *Sharon M. Morrissey*, who helped us to polish our English. Many thanks!

We wish you, dear reader, a good read and food for thought that may inspire you to take action.

Yours

Brussels, Belgium

Katharina Miller

# Preface

## Merging IQ and EQ

The digitized Sustainable Development landscape, which we define as digitalization and technology projects, initiatives, and ecosystems across any of the Sustainable Development Goals, has changed dramatically in the past 2 years since digitalization has received global attention for its potential implications on the economy, business, sustainability, and government at the World Economic Forum in 2017.

A 20-year vision of adoption was optimistically delineated across all facets of the real economy wherein businesses and governments would be able to achieve unprecedented efficiency, with global operations and supply chains fundamentally reorganized, enabled by new business and service models, ecosystems, and relationships. Digitalization promises to offer approaches and solutions that were not possible using other technologies or systems and a unique opportunity to simultaneously create accountability, transparency, and security of systems alongside the decoupling of growth and resource usage. Digitalization for sure has a huge benefit in tracking supply chains and weeding out corruption and facility payments and therefore provides indication for good.

The societal innovation behind digitalization is based on the theory that it enables transparent decision-making procedures and decentralized incentive systems for collaboration and cooperation. It allows for modular structures, linked in an ecosystem of providers, producers, supporters, and clients, which is orchestrated by a key “value proposition” that is shared by all participants in the ecosystems. Ecosystems are seen as the answer to a number of profitability problems. Enhancing profitability will not work within companies or silos; rather the intelligent orchestration of the digitized ecosystem is required to deliver productivity gains and connecting digital infrastructure across multiple industries, from supply chains, to energy markets and utilities, to the public sector, intellectual property management, payment systems, and more. Open banking and open finance are the most recent examples for the “ecosystemification” of the industry.

Digitalization is more than intelligent business engineering or change management: it entails IQ and EQ. It will breathe a new era of leadership, as leaders need to be able to synthesize all the information and developments (what is happening and what will it lead to), contextualize (what is relevant, what does it mean for us, what is in for our business), create new narratives and customer satisfaction, and cut through the industries and solve cross-cutting issues.

The day after tomorrow challenges with digitalization for companies will be:

An ecosystem value proposition will need to entail and engage different industries, foster an allocentric view rather than an idiosyncratic one in order to allow for orchestration of the ecosystem, respect and solicit customers' consent to data collection, respect privacy, and deliver better integral returns in a measurable way including economic, environment, and social outcomes. Digitalization is meant to save time, enhance time, decouple growth from resource usage, and allow for smart risk management; the real benefit for people, planet, and prosperity however is a better value proposition provided in a collaborative ecosystems approach. Whereas productivity gains and profitability have been falling across industries and so have subsequently interest rates, we now have to face the reality that the future fitness of business models requires ecosystems, sustainability, and diversity.

Digitalization allows all economic players to create new opportunities:

Decoupling growth from resource Usage enhances innovation through ecosystem approaches; see compliance as a business opportunity. Compliance can be an early warning indicator for transition risks. One marvellous example is the EU Action Plan for Sustainable Growth. Whereas in former times it has been sufficient to understand physical risks and inside-in risks, investors now are adding transition risk (to a climate-aligned investment universe), regulatory risk (for instance, the need to create a taxonomy-compatible investment universes), and compliance to the risk management menu. Those who are sensitive to reputation add sustainable supply chains, human rights respect, and business conduct in alignment with OECD Guidelines for Multinational Companies—at least at their policy level.

When we look at due diligence, legal due diligence has been extended to technical, market, environmental, and social due diligence very much so with the help of digitalization. Impact investors are adding team due diligence and leadership due diligence. Impact can only be achieved with the right team and the right leadership, so any shortcomings should be detected prior to investing by adding team due diligence and leadership due diligence to the gap report. Diversity and an open corporate culture are important drivers for innovation and successful cooperation. Mixed teams achieve better results in this regard. Also in crisis situations diversity of perspectives matters in order to find the best solutions. Impact investors know that. Digitalization is more than intelligent business engineering or change management: it entails merging IQ and EQ.

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# Addressing the Ethical and Social Challenges of Emerging Technologies: Creating the Conditions to Play a Leadership Role in the Fourth Industrial Revolution



**Geneviève Tanguay**

The Fourth Industrial Revolution is upon us, driven by the convergence of a wide range of digital, biological and physical innovations. These include advanced manufacturing, neuroscience, 3D printing, digital communications, blockchain, biotechnology and the Internet of Things. As with each of the previous three industrial revolutions, the Fourth Revolution will profoundly transform institutions, industries and individuals—and ultimately our society. It is already changing the way we create, exchange and distribute value, and how we communicate, learn, entertain ourselves and relate to one another. It is reshaping human identities, communities and even political structures. It is also making us question our values and our ethics. Its new technologies offer immense opportunities for individuals, business leaders and broader society. However, they also pose major social and ethical challenges, such as potential labour market disruption; threats to data privacy, security and reliability; and exacerbated inequalities.

The National Research Council (NRC) is Canada's largest federal research and development organization. The NRC advances knowledge through science, supports business innovation and finds technical solutions to pressing public policy challenges. We are a global leader in a number of emerging and disruptive technologies such as nanotechnology, advanced materials, printed electronics, photonics and digital technologies. In this role, we must play our part in addressing the challenges of the Fourth Industrial Revolution, as well as in realizing the burgeoning opportunities for all Canadians.

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## The Promise of Emerging Technologies

The potential to improve the quality of life and generate economic benefits is one of the main promises of the Fourth Industrial Revolution. Some of the most significant opportunities can be found in nanotechnology, quantum technologies and artificial intelligence (AI).

### *Nanotechnology*

The global nanotechnology market is expected to exceed US\$125 billion by 2024.<sup>1</sup> Nanotechnology R&D, which engages disciplines in chemistry, physics, biology and engineering, involves modelling, synthesizing, imaging, measuring and exploiting materials with features between 1 and 100 nm (1 nm is 1 billionth of a metre). Nanoparticles, for example, make excellent coatings due to their incredibly high surface area to volume ratio, allowing a large area to be covered by a small amount of material. In addition, quantum dots used for medical imaging exploit certain nanoparticles' size-dependent light emission properties. Nanotechnology applications include drug delivery, solar cells for renewable energy, and nano-filtration technologies for water treatment.

### *Quantum Technologies*

We are now fully engaged in the second quantum revolution. The first, which occurred at the turn of the last century, produced new laws that govern physical reality, primarily based on the idea that matter particles sometimes behave like waves, and that light waves sometimes act like particles. The second quantum revolution is using these rules to develop new advanced technologies. Over the next 20 years, the market for quantum technologies is expected to grow to more than US\$65 billion,<sup>2</sup> with potential advances improving every facet of our daily lives:

- **Sensing:** Quantum sensors will enable quick and accurate gravity mapping, allowing detection of very small differences in gravity to reveal underground features such as different soil types, tunnels, sewers and utilities.
- **Imaging:** Quantum simulation of complicated chemical reactions will allow for the development of new drug therapies.

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<sup>1</sup><https://www.marketwatch.com/press-release/nanotechnology-market-2019-global-industry%2D-key-players-size-trends-opportunities-growth-analysis-and-forecast-to-2024-2019-04-08>

<sup>2</sup><https://qutech.nl/wp-content/uploads/2019/09/NAQT-2019-EN.pdf>

- **Communications:** Quantum communications will provide high security for transmitting sensitive data. In the near term, it could be used to supply the secret keys and random numbers that are an essential resource for cryptography; eventually, it could be used in a secure global communication network operating over long distance fibre and satellite links.
- **Computing:** Quantum computers will be useful in analyzing large quantities of data, running faster simulations, or optimizing processes. The race to build the first quantum computer is on.

## *Artificial Intelligence*

The International Organization for Standardization (ISO) defines AI as “an interdisciplinary field, usually regarded as a branch of computer science, dealing with models and systems for the performance of functions generally associated with human intelligence, such as reasoning and learning”.<sup>3</sup> In 2030 AI is expected to contribute up to US\$15.7 trillion to the global economy.<sup>4</sup> Recent advances in AI-related technologies are driving market disruptions in a number of economic sectors such as automotive, health, finance, insurance, manufacturing, agriculture and consumer products. For example:

- **Sensors:** Sensors are enabling the development of the Internet of Things, allowing devices that normally would not be connected to the internet to become part of a network, collecting and sharing information without human intervention. The sensors can be as simple as a tag on a package that allows a manufacturer to track delivery, to smart cities projects that are filling entire regions with sensors to help us understand and control the environment. These sensors are collecting huge amounts of data that must be processed by AI to be useful.
- **Machine learning algorithms:** Machine learning is an AI application that enables systems to learn and improve from data and experience, rather than through explicit programming. Machine learning algorithms are being used to build mathematical models that automatically make predictions or decisions. Automating routine processes and mundane tasks lets individuals focus on more challenging and complex tasks. Businesses are also using sophisticated algorithms to optimize processes, leading to increased operational efficiency.
- **AI and robotics:** Self-driving cars are the most obvious example, with potential benefits including fewer accidents, less traffic congestion and fuel savings.

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<sup>3</sup><https://www.iso.org/obp/ui/#iso:std:iso-iec:2382:ed-1:v1:en>

<sup>4</sup><https://www.pwc.com/gx/en/news-room/docs/report-pwc-ai-analysis-sizing-the-prize.pdf>

## **Ethical and Social Challenges**

The development and adoption of Fourth Industrial Revolution technologies is producing a range of ethical and social issues around the world. These include potential disruption in the labour market; unfair biases embedded in the technologies themselves; the rise of new moral dilemmas and questions; societies fractured by a fall in trust; widening inequality due to a new digital divide; and mounting threats to data privacy, security and reliability.

### ***Labour Market Disruption***

As in previous industrial revolutions, the potential for labour market disruption in the Fourth Industrial Revolution is significant. In the past 20 years, the use of new technology has eliminated some jobs while creating new, previously unheard of job roles and titles. For example, the rise of online flight comparison sites has drastically reduced the number of physical travel agents, and advancements in mobile technology have made switchboard operators obsolete. On the other hand, brand new occupations have appeared such as app developers, social media marketers and data scientists.

The World Economic Forum reports that 38% of businesses believe that AI and automation technology will allow employees to carry out new productivity-enhancing jobs, and 25% think that automation will result in the emergence of new roles.<sup>5</sup> In Canada, technology is expected to heavily disrupt more than one-quarter of jobs in the coming decade, and one-half of occupations will undergo a significant skills overhaul.<sup>6</sup>

A recent Royal Bank of Canada study found that the strongest demand in an age of rapid change is for foundational skills such as communications, emotional intelligence, problem-solving and critical thinking.<sup>7</sup> Workers also need to work effectively with an increasingly diverse range of business partners around the world as well as with co-workers of all ages, genders, languages and cultures.

### ***Biases Embedded in Technologies***

Evidence shows that machine learning algorithms, although designed to help in problem-solving and decision-making, are vulnerable to biases and errors. These

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<sup>5</sup>[http://www3.weforum.org/docs/WEF\\_Future\\_of\\_Jobs\\_2018.pdf](http://www3.weforum.org/docs/WEF_Future_of_Jobs_2018.pdf)

<sup>6</sup>[https://www.rbc.com/dms/enterprise/futurelaunch/\\_assets-custom/pdf/RBC-Future-Skills-Report-FINAL-Singles.pdf?\\_ga=2.260168462.2055440367.1582743350-1960725214.1582743350](https://www.rbc.com/dms/enterprise/futurelaunch/_assets-custom/pdf/RBC-Future-Skills-Report-FINAL-Singles.pdf?_ga=2.260168462.2055440367.1582743350-1960725214.1582743350)

<sup>7</sup>Ibid.

biases could be introduced either by their creators or by the dataset used to train the systems themselves. One widely publicized example is Amazon's time- and resource-intensive effort to build an AI recruitment tool. Upon implementation, however, the system showed a considerable bias against women. Engineers reportedly attributed this bias to the AI combing through resumes submitted to the company over a 10-year period, most of which were submitted by men. Amazon ultimately scrapped the system because, despite making edits to it, there was no guarantee that it no longer discriminated against female candidates.

This example illustrates that new technologies cannot correct 10 years' worth of biased data reflecting the male dominance of the technology industry. Transparency and accountability are critical as we develop and implement new technologies.

### ***Moral Dilemmas***

New technologies are also raising perplexing moral questions that most of us have never contemplated. Should your driverless car value your life over that of a pedestrian? Should we legalize predictive policing based on AI? Should gene editing be made legal to create "designer babies"? If you could undertake a little gene editing to increase your child's IQ, would you do it? What if it was possible to patent a human *gene*?

In the past, these questions were the domain of ethicists and philosophers only. Today, they are examined and discussed through broader interdisciplinary expertise, in public consultations, and even in mainstream media. In a recent commentary on ethical research, Sarah Franklin, Chair of Sociology and Director of the Reproductive Sociology Research Group at the University of Cambridge in the United Kingdom, observed: "There is now more emphasis on continuous communication and outreach, and on long-term strategies to ensure collective participation and feedback at all stages of scientific inquiry. The result is less reliance on specialized ethical expertise and more attention to diversity of representation."<sup>8</sup>

### ***Fractured Social Cohesion***

While technology helps people connect more, it has also meaningfully altered the ways in which we interact. Overall, this has created polarization, uncertainty and a decrease in trust. The growth of social media platforms facilitates connection and engagement at an individual level. Peer trust is replacing institutional trust, the

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<sup>8</sup><https://media.nature.com/original/magazine-assets/d41586-019-03270-4/d41586-019-03270-4.pdf>, p. 627.

confidence in the relationship between individuals and institutions. Peer trust is now built on bottom-up, decentralized, flowing and personal relationships.

According to the 2019 Edelman Trust Barometer, which measures the levels of trust globally, 73% of those surveyed worry about the use of false information or fake news as a weapon.<sup>9</sup> At the same time, interest in fact-finding has increased by 22 points in the last year, with 72% of respondents now consuming news at least once a week. Trust in traditional media is at an all-time high, with roughly two-thirds of respondents rating it favourably compared with 44% trusting social media.

## ***Widening Inequality***

Those with access to new technologies in the past have benefitted from economic opportunities, higher levels of education and better health. Similarly, access to the applications of emerging technologies of the Fourth Industrial Revolution will likely drive increased wealth and well-being, but creation of a new digital divide will also yield greater inequality.

The *Digital Economy Report 2019*, released by the UN Conference on Trade and Development, found that concerted global efforts are required to better distribute gains from the digital economy and minimize the digital divide.<sup>10</sup> It highlighted the disproportionate concentration of the digital economy in the United States and China, with the rest of the world trailing considerably, especially countries in Africa and Latin America. The United States and China account for 90% of the market capitalization value of the world's 70 largest digital platforms, over 75% of the cloud computing market, 75% of all patents related to blockchain technologies, and 50% of global spending on the Internet of Things. The report predicts that, under current regulations and policies, this trajectory is likely to continue, contributing to increasing inequality.

So how can we bridge the gap? The report outlines a number of recommendations aimed at policy makers, including ensuring affordable and reliable connectivity, boosting entrepreneurship, encouraging small businesses to adopt technologies, and, at a more macro level, updating competition and taxation policies to promote greater access. Key policy questions raised include how to assign ownership and control over data and how to build consumer trust and protect data privacy.

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<sup>9</sup>[https://www.edelman.com/sites/g/files/aatuss191/files/2019-02/2019\\_Edelman\\_Trust\\_Barometer\\_Global\\_Report.pdf](https://www.edelman.com/sites/g/files/aatuss191/files/2019-02/2019_Edelman_Trust_Barometer_Global_Report.pdf)

<sup>10</sup>[https://unctad.org/en/PublicationsLibrary/der2019\\_en.pdf](https://unctad.org/en/PublicationsLibrary/der2019_en.pdf)

## ***Data Privacy, Security and Reliability***

Individuals are becoming more aware of the value of their personal information and the need for its secure storage and protection. At the same time, data have also become strategically important to business: the ability to collect, store, analyze and transform data brings tremendous competitive advantages. Facebook’s purchase of Instagram in 2012 for a reported US\$1 billion suggests just how much data are worth. So how much does it cost to protect organizations and individuals from data breaches? While the answer ultimately depends upon the industry and country, in general it can range from US\$1.25 million to US\$8.19 million, according to IBM’s 2019 *Cost of Data Breach Report*.<sup>11</sup> This estimate includes costs associated with detection and escalation, post-breach response, notification and lost business.

Data protection is fast becoming an issue of national security, especially in relation to the development of large-scale quantum computing. Although many years from reality, quantum computing will render obsolete many of the tools that currently form the basis of current digital cryptography. Cryptography technologies keep sensitive personal information, confidential corporate data, and even state secrets safe. They also maintain the operation of banking services, commerce and email communications. The fear is that those with access to the new technology will be able to protect their secrets, reaping substantial financial benefits.

## **Embedding Values and Ethics into Technology Development**

Although we may think that we are ahead of the game in recognizing and confronting the social and ethical challenges of the Fourth Industrial Revolution technologies, we are actually lagging behind in many areas. For example, AI research started in the 1960s. The “cloud” as a means of distributed computing started to gain traction in the early 1990s. The good news is that we are taking action now as we, in particular, engage in the second quantum revolution and, in general, move towards the Fifth Industrial Revolution. The aim is to embed values and ethics into technology development. At the NRC, as we develop our research and technology programs, we are committed to not only looking at *what* we choose to do, but also at *how* we actually do it. That means integrating values such as equity, diversity and inclusion into program design and implementation.

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<sup>11</sup><https://www.ibm.com/security/data-breach>