Future of Business and Finance

Tamás Landesz
Sangeeth Varghese
Karine Sargsyan *Editors*

Future Intelligence

The World in 2050 - Enabling Governments, Innovators, and Businesses to Create a Better Future

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Karine Sargsyan
Editors

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Foreword

We cannot predict the future, but we can try to anticipate it to shape a better present.

Although we cannot know exactly how the future will unfold, we can explore the forms it might take because these originate in current trends and patterns, exploratory research, and ongoing discussions and solutions happening today. These anticipations can help shape a better present by allowing us to consider the potential impacts on our lives as human beings, our relationships with each other, and our relationship with the environment.

Historically, we have assumed that understanding the past is necessary to anticipate the future. Historian Yuval Noah Harari says the purpose of learning history is not to predict the future but to widen our horizons, and to understand that our present situation is neither natural nor inevitable and that we have many more possibilities before us than we can imagine.

As such, the practice of anticipation, or the ability to imagine and plan for potential future scenarios, is crucial. This requires both the capacity to use the future to guide our actions in the present and the ability to make the present a time in which we actively consider and work towards desired futures. This is not a new idea. Governments from Finland to Chile have long-established parliamentary committees for the future. The United Nations Secretary General Our Common Agenda and associated 2024 Summit of the Future aim to accelerate progress towards the 2030 Sustainable Development Goals by including future generations as stakeholders. The Geneva Science and Diplomacy Anticipator in Switzerland, where I work, brings the expected scientific breakthroughs of the next 25 years to the attention of the global diplomatic community to promote the inclusive and multilateral governance of emerging technologies. Building the capacity to *use the future to build the present*, and strengthening our collective 'futures literacy' are two central aims of this book.

Anticipation can help shape a better present by allowing us to consider the potential impacts on our lives as human beings, our relationships with each other, and our relationship with the environment. The book's ambition is to help us visualize the contours of how the world will look like in 2050 and what transformations we can expect to lead us there. Instead of looking at history to inform the future, this book takes the pulse of the changes, trends, and patterns as

anticipated by experts in all domains and shares them widely with the global community to better inform leaders and decision-makers of the present to accelerate desired futures.

Through the crowdsourced views and perspectives from global leaders, futurists, practitioners, and students from five continents, including a large cohort recognized as World Economic Forum Young Global Leaders—one of the most prestigious leadership awards in the world—the authors collected glimpses and snippets about plausible futures. Views came from business, government, media, non-profits, intergovernmental organizations, artists, and academia, and each chapter covers one sector of human activity and society: from business, politics, work, healthcare, and technology to education, law, entertainment, religion, or families.

Too often the prioritization of current issues leads to a lack of attention towards anticipation, leaving us unprepared when the future arrives. Even if we know what may be coming, achieving global consensus on anticipatory actions can be difficult, particularly in a time of low global cooperation. The cost of not anticipating—and most importantly, not acting on it—can be significant, as illustrated by the Covid-19 pandemic. It is therefore necessary to create new platforms for exchange and collaboration in order to effectively anticipate and plan for the future.

So, this book is not just a book—it is a foundation for a global movement to address this need for new leadership and empower the future generations to guide us into a better future. One of the premises of the book is that the world is short of true global leaders, and a new leadership model is necessary to meet our interconnected economic, social, environmental, and political challenges facing us. Looking ahead to the year 2050, a visionary shift in leadership becomes apparent. I distill from this book three essential characteristics for future-intelligent leaders.

Planetary conscious: First, leaders will recognize the interconnectedness of all life on Earth. While deeply honoring their countries, histories, cultures, languages, and traditions, they will rise above boundaries to embrace the idea of a shared human civilization. They will comprehend that our very existence hinges on the delicate balance of this planet we call home. To safeguard our future, they will understand that collaboration is the only way forward, as the challenges we face transcend borders and silos, and can only be overcome through joint efforts and multilateral action. They will embrace our common humanity as the only foundation upon which enduring solutions can be built.

Scientifically literate: The leaders of the future will reject science denialism and the distortion of truth, upholding facts and evidence as guiding beacons in decision-making. They will abandon linear thinking and adopt the power of exponential thought, realizing the profound impact of rapid change on our world. They will be able to anticipate, discern weak signals, and act preemptively to shape potential futures.

Boundary-spanning: Breaking free from silo thinking and echo chambers, the leaders of the future will become polymaths in their own right. They will seek diverse knowledge and skills, connecting seemingly unrelated disciplines to foster innovation and progress, and dismantling barriers to collaboration and mutual understanding.

Many institutions are setting up future-oriented programs and policy initiatives to correct short-term biases to achieve a better balance between the legitimate concerns of the present and the potential interests of the future. But strengthening our collective 'futures literacy' starts with the individual, and this book will help each and every one of us to get started. Through a self-administered questionnaire, readers will be able to explore their Future Intelligence or Future Quotient (FQ)—a measure of future readiness to positively cope with and overcome the various complexities as a result of foreseeable and unforeseeable future changes in the economy, society, and the environment.

In the coming years, the World 50.0 initiative to improve our collective future's literacy will materialize in different training and outreach initiatives around the world, including a university curriculum.

A new Future Center in the Gagarin Valley in Armenia will become a place for exchange and bringing together and training future leaders in government, academia, business, and other sectors to be equipped with the knowledge and skills to lead us into the future in a responsible and inclusive way. Because global agreements, for the moment, are not reached by video calls. Collaboration, diplomacy, negotiation, and compromise are reached by looking each other in the eye, by talking side by side, and by understanding each other. That is why we need physical locations to come together and foster this new mindset. It should not escape us the symbolism of naming the World@50 Center after Yuri Gagarin, the first human to orbit the Earth and the first to experience the 'overview effect' of witnessing the planet's interconnectedness, vulnerability, and urgency to care for it collectively.

In these times of global fragmentation, this book takes us to 2050 to expand our vision of how we can arrive to the future together, as a planetary civilization, leaving no one behind. Despite the urgencies and challenges of today, we need both information and inspiration to bridge our understanding and actions between our desired futures and the present moment, so we can make the right choices today. I hope this book helps initiate that conversation.

Enjoy the journey!

Dr. Marga Gual Soler is the Head of Science Diplomacy Capacity Building at the Geneva Science and Diplomacy Anticipator (GESDA) in Switzerland. She has been one of the pioneers in developing science diplomacy as a field of research, policy, and education worldwide, helping governments, universities, international organizations, and scientific institutions across five continents strengthen the role of science in global policy to address common challenges, bridge diplomatic relations, and navigate global transformations. In 2019 she participated in the largest women in STEM expedition to Antarctica in history, and in 2020 was selected as a Young Global Leader of the World Economic Forum.

As science increasingly takes centre stage in diplomatic negotiations—from pandemics to climate action—her journey from the laboratory to international diplomacy demonstrates and inspires the potential for scientific collaboration as an essential tool for peace, global governance, and sustainable development.

Watch her TEDx talk at the Geneva Graduate Institute: https://www.ted.com/talks/marga_gual_soler_from_the_lab_bench_to_the_united_nations

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Acknowledgements

Writing this book has been a challenging process, but beyond rewarding. It not only offers novel insights and thought-provoking ideas about the future but also brings the three editors on a journey which reinforced their friendship and joint commitment towards creating a better future together. The book is only the first stage of a longer journey with the aim of improving future literacy globally through research, teaching, collaboration, and sharing.

Thanks to everyone on the editing team who helped bring this book to completion. Special thanks to Christine Ann Mitchell from Medical University Graz, who has been absolutely indispensable in formatting and editing the final versions of the manuscript, and organizing our editorial board meetings. We would also like to thank Astghik Kyurumyan, a design and architecture student, who allowed us to illustrate our invisioned ideas with powerful artwork.

Medical University Graz deserves special acknowledgment for supporting the World 50.0 project from the start, organizing TEDx events, allowing us to advocate for the World 50.0 movement in general, and funding the open access fees of the book in order to make it available to a wide audience through the global commons.

Furthermore, we would like to thank Land Steiermark—Department 12 for Economy, Tourism, Science and Research for partially funding this project (Project Number: ABT12-1317055/2022).

Springer Publishing saw the value of this book from the outset, working closely with the editorial team to bring the book to life, advising on structure, content, and format.

All our interviewees with special mention of those named above have our deepest gratitude for taking the time to share their most personal and original perspectives of the future in 17 different domains. They range from Young Global Leaders to futurists, academics, and university students. Thanks to their crowdsourced perspectives this book is as diverse and rich as it is.

The World Economic Forum's Young Global Leaders community as well as Professor Klaus Schwab have been extremely generous and encouraging throughout the editorial process. We share values and a mission to improve the state of the world.

Not least, special thanks to our families who helped us complete this book with their support and encouragement, to our friends who were there for us when we needed them most, and to everyone who reads this book and decides to help our planet, help future generations, and contribute in their own way, no matter how big or small, to our shared quest, creating a better future.

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About the Editors

Tamás Landesz is a senior executive at the World Health Organization (WHO) International Agency for Research on Cancer (IARC). He is a pioneering leader with exceptional track record in designing, setting up, and operating complex intergovernmental missions, among others in conflict and post-conflict environments across four continents. Advised prime ministers, governments, national institutions, intergovernmental organizations, and non-governmental organizations to overcome major diplomatic, political, military, economic, health, scientific, education, human rights, democratization, and electoral challenges.

He is equally comfortable waltzing through the ballrooms of the Hofburg in Vienna, and taking the floor in the Human Rights and Alliance of Civilizations Chamber at the Palais des Nations in Geneva, as participating in a traditional buzkashi game riding on horseback with local elders in the Hindu Kush mountains of Afghanistan. He contributed to major historic shifts and global transformation in the past three decades while devising unique innovations in support of peaceful transition and development in hotspots such as the Balkans, Caucasus, Central Asia, Eastern Europe, Horn of Africa, Latin America, and the Middle East.

Born in Budapest during the Cold War and raised by diplomatic parents in Buenos Aires during the last military junta, Dr. Landesz developed highly sophisticated adaptive, intercultural, and language skills from an early age. He trained as economist (BBA) and business administrator (MBA) in Vienna; international lawyer and diplomat (MALD) at Tufts University, Fletcher School of Law and Diplomacy, Medford; public administrator (MPA) at Harvard University, Kennedy School

of Government, Cambridge; and leadership expert (PhD) in Paris. He has been recognized as Harvard University Mason Fellow and Vali Scholar. Dr. Landesz also served as faculty member at Corvinus University Budapest, and International School of Management in Paris. He lectured on adaptive leadership, health diplomacy, and economic competitiveness at universities across the world, including Harvard University and Cambridge University.

A high-profile speaker, analyst, and author, Dr. Landesz' research interests focus on the future of our world, and how to improve it, *inter alia* through stronger leadership, better education, and building new multidisciplinary capacities in future literacy. He received various honours and awards, but he is most proud of having been recognized as Young Global Leader of the World Economic Forum. As an active member of the community, he mentors Global Shapers around the globe. He has two exceptionally gifted children, a son (Tamás, 12) and a daughter (Tiffany, 10).

Watch his TEDx talks at MedUniGraz:

Tamás Landesz: Future Of The World 50.0

Karine Sargsyan, Tamás Landesz, Sangeeth Varghese: OUR WORLD IN 2050

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Sangeeth Varghese is a globally acknowledged leadership thinker, ranked among the top 10 in 2011, from the Harvard and London School of Economics. He is a personal advisor to 3 prime ministers of the world on matters of leadership and youth development. Varghese is an ambassador of Harvard and listed in the Who's Who in the World, 2012–13. He has consulted for nations from Africa and Asia, institutions like the UNO, World Bank, and ADB and Fortune 500 corporations like Microsoft, Intel, Unilever, and Coca-Cola. He was nominated as the Young Global Leader 2010 by the World Economic Forum.

Varghese is the author of global bestsellers *Open Source Leader* and *Decide to Lead* and the forthcoming *Hidden Links*. He was honoured as the first Asian Youth Ambassador by the government of Libya. Varghese is a member of the Global Agenda Council and board member of the Global Business Oath of Harvard University.

He was a member of the Karnataka Knowledge Commission, India, and the Chair of their data secretariat. He is also a co-founder of Bangalore Biz Lit Fest and Future 2050. He was a contributing editor for *Forbes* and the *Economic Times*. He was chosen as the face of the 2010-11 annual report of the Centre for Creative Leadership, USA, considering his unique contributions to the world of leadership development. Varghese was chosen to guest-edit the New Year edition of the *Times of India* as a 'Young Achiever Making a Difference to India's Future'.

Varghese has the unique distinction of being part of the core teams that helped India's telecom penetration grow from 1 to 50% and the personal computer spread from the metros to tier 2 and 3 towns. He researched leadership at Harvard and the London School of Economics with scholarships. He has also done his MBA and Bachelor's in Economics with gold medals.

Watch his TEDx talks at MedUniGraz:

Karine Sargsyan, Tamás Landesz, Sangeeth Varghese: OUR WORLD IN 2050

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Karine Sargsyan is life sciences and research enthusiast who does not think outside of the box because the box does not exist! Experienced Managing Director with a demonstrated history of working in the research industry. Skilled in Interdisciplinary Research, International Research, Research Policy, Clinical Research, Life Sciences, quality and risk management (particularly in a grant-driven environment), and digitalization (including AI and ML) in life sciences, particularly in medicine. Strong business development professional with a Doctor of Medicine, focused on development projects, biomarkers, and biobanking. TEDx Speaker and Organizer. She is the Scientific Director of the Onco Biobank at the Cedars-Sinai Health Center, Los Angeles, USA. She also holds the positions of Managing Director for International Biobanking and Education, Vice Scientific Leader, and Lecturer of the Master's university programs Biobanking and Human-Centered Artificial Intelligence in Medicine at the Medical University of

Graz as well as Professor of Digital Medicine and Medical Genetics at Yerevan State Medical University.

She built the Biobank Graz from the first moment of institutionalization into the most automatized, most divers and most used clinical biobank in Europe and was granted several academic awards for the efforts. She pioneered in biobanking education and implemented the first Bologna convention conform Master of Sciences Cours in Biobanking.

She provides scientific expertise and experience as a reviewer, editor or consultant to several sites worldwide and is focused on innovation, specifically on innovative technology in several international projects.

She published more than 100 papers in scientific journals and is the author of several books and book chapters with Springer and the Cambridge Publishing house. Her key-notes and other speeches reached over 60.000 professionals.

She is married and has a highly talented daughter (22).

In her free time, she enjoys painting and playing the piano and happily commits to various voluntary activities.

Watch her TEDx talks:

Karine Sargsyan, Tamás Landesz, Sangeeth Varghese: OUR WORLD IN 2050

Don't Give Up - If You Love It | Karine Sargsyan | TEDxMedUniGraz

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List of Interviewees (in Alphabetical Order)

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Muna ABUSULAYMAN
David AIKMAN
Wadia AIT HAMZA
Malak AL AKIELY
Samuel ALEMAYEHU
Thomas ARNOLDNER
Yalda AOUKAR
Fatoumata BA
Gina BADENOCH
Eli BEER
Chris BEHRENBRUCH
Georgie Giner BENARDETE
Yobie BENJAMIN
Diane BINDER
Jesmane BOGGENPOEL
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Jane BURSTON
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Sarah CHEN
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Silvia CONSOLE BATTILANA
Thomas CRAMPTON
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Stephan DE SPIEGELEIRE
Rajeeb DEY
Carola FERSTL
Rossana FIGUERA
Lars FLOTTRONG
Svetlana FLOTTRONG
Facundo GARETON
Sadiq GILLANI
Soulaima GOURANI

Christine GRAEFF
Marga GUAL SOLER
Eyal GURA
David HANLEY
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Sandrine JOSEPH
Nik KAFKA
Verena KASSAR
Tariq KRIM
Robert KROTZER
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Lily LAPENNA
Tristan LECOMTE
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Elisha LONDON
Bob MACMAHON
Mokena MAKEKA
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Martin MÜLLER
Carolina MÜLLER MÖHL
Siegfried NAGL
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Bjarte REVE
David RODIN
Kate ROBERTS
Nilmini RUBIN
Caroline SCHOBER
Stav SHAFFIR
Tobby SIMON
Elaine SMITH GENSER
Moran SOL BROZA
Ian SOLOMON
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Serj TANKIAN
Lucian TARNOWSKI

Siri TRANG KHALSA
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Freija VAN DUIJNE
Alexis VON HOENSBROECH
Ivan VATCHKOV
Arnaud VENTURA
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Stefan VERRA
Mark VLASIC
Felicitas VON PETER
Lisa WITTER
Michele WUCKER
Yan YANOVSKIY
Patrick YOUSSEF

List of Abbreviations

3D	Three-dimensional space
ALQ	Authentic Leadership Questionnaire
AI	Artificial intelligence
AR	Artificial reality
APM	Atomically precise manufacturing
BBC	British Broadcasting Corporation
BCE	Before the Christian Era
BSc	Bachelor of Science
CEO	Chief executive officer
CFO	Chief financial officer
CO_2	Carbon dioxide
DAO	Decentralized autonomous organization
DIY	Do-it-yourself
DNA	Desoxyribonucleic acid
ECTS	European Credit Transfer and Accumulation System
EIU	Economist Intelligence Unit
EQ	Emotional intelligence
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FQ	Future Intelligence Quotient
GESDA	Geneva Science and Diplomacy Anticipator
GDP	Gross domestic product
HBO	Home Box Office
HCI	Human–computer interaction
HD	High definition
HRV	Heart rate variability
HSBC	International banking group based in the UK
HQ	Headquarters
IARC	International Agency for Research on Cancer
ICRC	International Committee of the Red Cross
IEA	International Energy Agency
IIASA	International Institute for Applied Systems Analysis
ILO	International Labour Organization

IPCC	The Intergovernmental Panel on Climate Change
IQ	Intelligence coefficient
ISN	Idea Studio Nepal
IT	Information technology
IVF	In vitro fertilization
LDES	Long duration energy systems
LGBT	Lesbian, gay, bisexual, and transgender
LMIC	Low- and middle-income countries
MACH IV	Machiavellianism Questionnaire
MBA	Master of Business Administration
MD	Medical Doctor
MR	Mixed reality
NGO	Non-governmental organization
OECD	Organisation for Economic Co-operation and Development
OHC	Offline-human-communication
PC	Personal computer
PGD	Preimplantation genetic diagnosis
SDG	Sustainable Development Goal
SMS	Short Message Service
TEDx	Technology, Education, and Design conference
TV	Television
UK	United Kingdom
UN	United Nations
UNICEF	United Nations Children's Fund
UP	United Planet
US	United States
VR	Virtual reality
VUCA	Volatile, uncertain, complex, and ambiguity
WEF	World Economic Forum
WHO	World Health Organization
YGL	Young Global Leaders

Introduction to the World 50.0 Movement

Tamás Landesz, Sangeeth Varghese, and Karine Sargsyan

Abstract

This book delves into the future of the world in 2050, covering various sectors such as healthcare, energy, transportation, communication, entertainment, and climate change from the perspectives of global leaders and visionaries from diverse backgrounds. It draws on open crowdsourced research and incorporates insights from the Covid-19 pandemic, appealing to not only businesses and governments but also the general public. The book includes 19 chapters, with 17 addressing the future of specific sectors and the last discussing the World 50.0 movement and how to participate. The topics of Artificial Intelligence, machine learning, and singularity are integrated throughout the book, considering the potential benefits and risks of new technologies. The authors acknowledge that predicting the future is impossible for any single expert but propose that practical conclusions can be drawn by correlating opinions from various experts (noting that contributions from interviewees reflect their own views). The book seeks to

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engage and inspire a diverse audience and is designed to be accessible across generations.

"I've learned that everyone wants to live on top of the mountain, but all the happiness and growth occurs while you're climbing it."—Andy Rooney

1 Towards a Better Future: World 50.0

In 2020, the Medical University of Graz organized a virtual Countdown TEDx event titled: "Think once! Think twice! Think future!" The Countdown is a global initiative to champion and accelerate solutions to the climate crisis, turning ideas into action. Karine Sargsyan gave a talk on the environmental (and not only) effects of a war. Tamás Landesz was invited to deliver a talk about the World 50.0 movement, which he launched a few years ago with fellow World Economic Forum Young Global Leader Sangeeth Varghese.

His virtual talk started something like this:

"I grew up in the beautiful city of Buenos Aires, Argentina in the seventies, where the skies are always blue. As a kid I was fascinated by two things: surfing and computers. I often set on the beach, staring at the ocean, fantasizing about the future, imagining how the world would look like 50 or 100 years later. Today, about 50 years later, we find ourselves at a crucible moment in human history in which leadership will define whether we can meet critical economic, social, political or environmental challenges. . . But we seem to be short of true global leaders."

We often talk about how to create a more inclusive and sustainable future, which contributes towards the 2030 agenda and the Fourth Industrial Revolution. With members of World Economic Forum's Young Global Leaders community, Landesz and Varguese conducted an open crowdsourced research project, titled World 50.0. In this open-access book which builds on their initial research, they partnered with Karine Sargsyan to further expand it and enrich the concept with a fresh perspective. As a consequence, the three authors decided to include new insights also about "how the Covid-19 pandemic changed the way we think about our future."

"While we know that no person can predict the future, individuals can see snippets. Our aim was to collect many of these snippets and piece them together to answer the question: How will the world look like in 2050? Using a variety of social media tools, we invited selected global leaders from business, government, media, non-profits, intergovernmental organizations, artists and academia, as well as university students of all ages, to share their glimpse of the future." (Sargsyan et al., 2022)

Initially, in the "Pre-Corona World," the majority of our respondents were cautiously optimistic, while now, since the Covid-19 pandemic, we are seeing a slightly different picture of the world emerging and within that the future of

humanity. We have closely examined and recorded these perspectives. Personal experiences and compassionate stories have been added to better portrait the changes triggered by the global pandemic, making the book appealing not only to businesses and governments, but also to the public.

Through this open-access book, we hope to reach a wider audience, crowdsource ideas, and mobilize people to build a better world together.

This book is organized into 19 chapters of which 17 chapters address the future of a particular sector, such as leadership; governments, politics and democracy; geopolitics; healthcare; energy; climate change; transportation; communication and interactions; sex and gender; consumption; food; families; homes; work and business; learning and education; religion; and entertainment. The last chapter discusses the World 50.0 movement and how to get involved, aiming to encourage governments, businesses, and societal stakeholders to think differently about the future.

Artificial Intelligence, machine learning, and the subject of singularity will be interweaved into all relevant chapters. By 2050 singularity may be possible and it is imperative to reflect on this already today from multiple perspectives—from the use and development for humankind to ethical and legal considerations and misuse. We will cover the benefits of new technologies in general but will also show possible risks and offer some solutions to minimize these.

Recently, there has been a growing interest in books aiming to describe the future. These include Yuval Noah Harari's books "21 Lessons for the Twenty-First Century" and "Homo Deus," primarily based on extrapolating from human history. In their book, "The Future is Faster than You," Diamandis et al. write about how modern technologies like 5G, Artificial Intelligence, and Virtual Reality will transform the future. In similar vein, Ray Kurzweil in his book "The Singularity is Near" outlines the future of technology and makes predictions about singularity post-2045.

This book is entirely different in its scope and approach. The basic underlying assumption of World 50.0 is that no matter how credible one expert is, nobody on their own is able to predict the future, since the future is way too staggered, complex, and disruptive. While individual experts would be able to see snippets of the future and be able to make marginal rather than exponential forecasting leaps within their field of expertise, when the opinions of several such experts are considered and correlated, we are able to draw practical conclusions. World 50.0 will deep dive into various domains such as healthcare, technology, transportation, governance, geopolitics, education, and employment, rather than looking at the future as a single monolith. The underlying assumption being: though the future of domains is ultimately interrelated, they also undertake their own different trajectories.

World 50.0 draws from domain expertise and uses statistical tools to interpret and extrapolate the future, simplifying complex messages using a variety of tools, including modelling, sketching, storytelling, and quotations. World 50.0 targets a broader audience, making it an interesting and inspiring read across generations.

The following chapters will describe inter alia how we are entering a "human age" or the "age of empathy" where Moore's law can be applied to the human potential curve. Humans will lose their natural biological identities—and become

"homo nano-technus," meaning that "it's just a matter of time before we can 'download' ourselves fully into the digital domain and in doing so, pull the plug on our biological identities." The future will be about "the use of technology and science to connect us with nature, instead of thinking that we can control it." The book includes quotes from expert interviews, relevant essays, artwork, and a self-administered Future Intelligence or Future Quotient (FQ) questionnaire.

How best to prepare and thrive in the future? Here is some privileged advice from World 50.0 (Landesz, 2016, 2020, 2022; Sargsyan, Landesz & Varghese, 2022; TEDxTalks, 2020, 2022):

- Follow your passion; hustle, hustle.
- Exercise compassion and resilience and adapt.
- Spread and scale stuff.
- Do new things every day.
- Practice mindfulness, presence, and being kind.

The aim of the World 50.0 movement is to build our future together and faster—a better future that we want our children and their children to inherit.

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Future of Leadership

Tamás Landesz

Abstract

The current pandemic and the accelerating future require a new type of leadership to emerge. The Young Global Leaders of the World Economic Forum (WEF) interviewed in this book envision an emerging era of humanity and empathy as we transition towards a more digital existence where global institutions will be significantly redesigned. Future leaders shall be role models, representing a new set of values that inspire new generations to lead with heart, compassion, emotional intelligence, care, education and kindness. Authentic leadership traits such as adaptability, collaboration, creativity, emotional intelligence, entrepreneurship, ethics, resilience, self-awareness and social awareness will be crucial for future-generation leaders. Eight traits responsible for the development of early leadership abilities of Young Global Leaders included evolutionary traits, early exposure to significant responsibility, high expectations, enabling environments, important crucible moments and the pursuit of passion. The concept of leadership is changing, and the right mix of authenticity and Machiavellianism is necessary to make an impact in an increasingly complex world.

Interviewees
David Aikman
Wadia Ait Hamza
Chris Behrenbruch
Yobie Benjamin
Marga Gual Soler

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André Loesekrug-Pietri
Martin Müller
Seán Ó Héigeartaigh
Lucian Tarnowski
Mark Turrell
Felicitas Von Peter

"It is easier to fight for one's principles than to live up to them".—Alfred Adler

Now, we lack true global leaders. An accelerating future will require a new type of leadership to appear. Below is a summary of the most interesting ideas in this domain, provided by our interviewees.

While current leadership styles are typically:

- Trying to figure out how to transform top-down hierarchical organizations and answer the question: how to lead in a period of change (like during the Covid-19 pandemic)?
- Relying on best practices and latest research in cognitive and social sciences trying to figure out how to influence and persuade others.
- Craving for innovation, while still being bugged down by the old routines.

Leadership styles likely to emerge in the future will:

- Rely on neuroscience to integrate mindfulness strategies enhancing performance and resilience
- Be more aware of methods of manipulation, ensuring that next-generation leaders are responsible, ethical and driven to do 'good'
- Try to move their organizations towards flat organic structures and 'connected autonomy', improving their ability to scale (Table 1)

Young Global Leaders (YGLs) of the World Economic Forum (WEF) interviewed for this book seem to converge towards a shared view regarding a new type of leadership to emerge. They envision an emerging era of humanity and empathy, as we transition towards a more digital existence where the role of global institutions will be significantly redesigned (Landesz, 2016):

- 'Technology will become an enabler for people to use themselves more effectively, maximizing their potential . . . Reputation will be so much more important because everyone will be aware of it'. (Lucian Tarnowski)
- 'Change requires leadership in complex systems'. (Mark Turrell)
- 'Using technology and science to connect us with nature, instead of thinking that we can control it'. (Tristan Lecomte)

Table 1 Emerging leadership styles (Landesz, 2016)

Current Context 'Old World'	Emerging Leadership Styles 'New World'
• Inundated by 'feel good leadership' literature that sounds good, but reinforces our belief in a just world fallacy, causing us to fail; • Employees claim that they want to receive negative feedback, but don't take it well when given; • Best practices based from latest research in cognitive and social sciences on how to influence and persuade others; • Transformation of top-down hierarchical organizations – how to lead in a period of transition? • People are longing for the 'New World', but are raised, educated and still very used to the 'Old World'	• Latest neuroscience research to integrate mindfulness strategies to enhance performance and resilience; • Evaluate engagement and behaviour change strategies in one's personal and professional lives; • Being aware of methods of manipulation, it is important for responsible leaders to remain ethical and use their talents for good; • Transition towards flat organic network organizations based on 'connected autonomy', providing new and gigantic opportunity to improve our ability to scale; • High performance and outstanding leadership by nurturing lifelong performance and resilience; • Protecting one's main asset: oneself

- 'It's just a matter of time before we can "download" ourselves fully into the digital domain and in doing so, pull the plug on our biological identities'. (Chris Behrenbruch)

The vast majority of YGLs envision the world as a better place with 'equality, opportunities and humanity, requiring lower levels of Machiavellianism and higher levels of authentic leadership in future generations'. YGLs are to step up as role models, representing a new set of values to inspire next-generation leaders (Landesz, 2016).

According to research conducted by Landesz, YGLs identified mostly with the authentic leadership value 'leading with heart', which refers to compassion, emotional intelligence and learning, care, education and kindness. Interestingly, this was followed closely by the Machiavellian leadership value 'self-love, money, power, and competition', more specifically referring to decentralization, computational processing power, enhanced human mind, as well as empowered women.

YGLs shared their vision with Landesz about the skills needed to lead in an increasingly VUCA (volatile, uncertain, complex and ambigous) world. Most

common visions include the increased importance of traits such as adaptability, collaboration, consciousness, creativity, embracing change, discipline, diversity, emotional intelligence, empathy, entrepreneurship, ethical, grounding oneself, in harmony with nature, having fun, honesty, humanism, meditation, mindfulness, networked thinking and learning, passion, reputation, resilience, respect, self-awareness, social awareness, multilingualism and tolerance. These attributes are similar to the elements described in recent leadership literature and foreshadow the importance of authentic leadership traits in future-generation leaders.

The concept of leadership is changing. Understanding an individual's unique DNA of talent will become important. Dealing with emerging challenges will require new approaches and a different leadership style.

The world would be a far better, more humane place, if we were always authentic, modest, truthful and consistently concerned about the welfare of others instead of pursuing our own interests. However, such a world does not exist. Hence, Landesz asked what is the right mix of authenticity and Machiavellianism in a leader to be able to make an impact in an increasingly complex world?

Varghese and Ferose (2014) identified eight traits responsible for the development of YGLs' early leadership abilities:

1. Evolutionary traits that helped our predecessors, like fear more than confidence, a sense of insecurity more than security, and the awareness of those feelings, and struggle to cope. These traits aided YGLs in achieving early accomplishments.
2. Many who succeeded early were exposed to or trusted with significant responsibility by the age of 10 years, either by design or destiny, e.g. being sent to boarding school, feeling responsible for a sibling after parents divorced or moving from a village to a city for studies. Several YGLs assumed responsibility at an early age.
3. It is not uncommon for individuals to reach a certain level of success and freeze. This is the time for role models—parents, teachers—to help setting high expectations, building enabling environments and helping them break psychological roadblocks. Several YGLs were encouraged from an early age to find their ways through self-fulfilling prophesies.
4. All YGLs who succeeded early in life experienced important crucible moments in their lives, like meeting people impacting them deeply, allowing them to define who they are.
5. Several early success stories show the commonality of striving to stand out, a desire for freedom, flexibility and a creative space. This intense desire gives them the strength to assume more risks and to embark on their own journey.
6. The majority of YGLs had 'no choice' in making many of their key decisions. They were just lucky. Knowing oneself and taking advantage of smaller opportunities kept many YGLs on the ascent.
7. Interestingly, several successful YGLs are not motivated by a larger than life vision but driven by a general ambition to succeed. This ambitious greed for success seemed to be more accentuated than any other talent in the path to

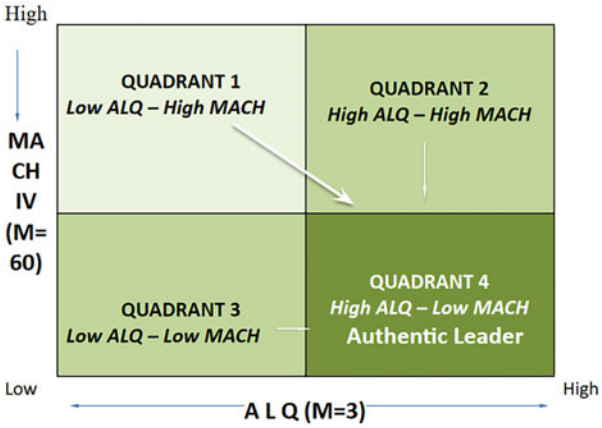

Fig. 1 Authentic leadership quadrant (Landesz, 2016)

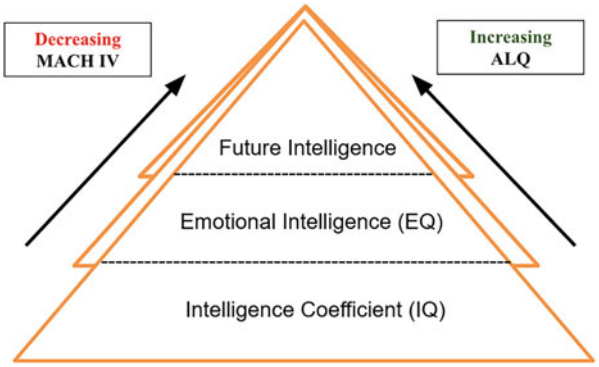

Fig. 2 Authentic leadership pyramid

success. Many of them had no problem to give up on a failed mission to move on to the next.

8. Many YGLs who experienced early success seemed to be introverted, but learned to be extroverted for carrying out their duties. This allowed them to switch between drawing energy from the world and drawing energy from within.

Landesz (2016) compared the results of the Authentic Leadership Questionnaire (ALQ) against the Machiavellianism Test (MACH IV) (Fig. 1).

The findings confirmed that a combination of low Mach—high ALQ scores are ideal for new age leaders, who are able to lead change in complex organizations, easily adapting to the new realities and promoting a caring style of leadership. This book goes a step further, offering a self-administered questionnaire to measure an individual's Future Intelligence, or FQ (Fig. 2).

According to Petrie (2014), senior faculty at the Centre for Creative Leadership, similarly to neural networks, organizations should become 'smarter' by connecting

Table 2 Developing global firms and leadership cadre (adapted by Landesz from George, 2016)

Shift from:	Exporter	to: Multinational	to: Global
Decision-Making	At HQ	HQ & Regional	Dispersed
Organizational Form	Functional	Matrix of SBUs & Geographies	Integrated Global Network
Style	Tops down	Power struggles	Collaborative
Measurement	Firm-wide	Transfer prices	Shared credit
Geographic Diversity	HQ nationals dominant	HQ nationals & local nationals	Global cadre from multiple cultures
Leadership Cadre	*from: Machiavellian Leadership (controlling)*		*to: Authentic Leadership (caring)*

'more parts of their social system to each other and build a culture of shared leadership, achieve greater adaptability and collective capacity'. People should better understand their role within organizations and the nature of leadership which is reflected in the process of connecting people as a network, continuously clarifying 'direction', establishing 'alignment' and garnering 'commitment'. Leadership is gradually moving from an individual to the group level, with various people's contributions influencing the collective. Concurrently, the differentiation between leaders and followers becomes less accentuated, as everyone can be both.

George (2015: 255–256) posits that Machiavellianism is not a crucial leadership trait of the future and that future leaders must thrive to 'serve people equitably contributing to their societies'. Leaders should thrive to transition away from a Machiavellian (controlling) leadership to a more authentic (caring) leadership style in order to better adapt to a VUCA world, as shown in Table 2.

Succeeding in the new global context will require organizations to develop managers with high Future Intelligence or Future Quotient (FQ). FQ consists of seven elements, all of which are essential for global leaders (adapted by Landesz from George's Global Intelligence, 2016; Heifetz, 2002 and Heifetz et al., 2009):

1. Adaptability
2. Awareness
3. Curiosity
4. Empathy
5. Alignment
6. Collaboration
7. Integration

According to Mark Turrell, leaders will be held more accountable in the future: 'If they do weird things, they will be easier caught. . . this may bring more humanity in leaders and encourage more honest conversations'. This will potentially limit the playing field for authoritarian dictators and put more pressure on leaders to create real value for their people.

1 Input from Interviewees

David Aikman
Co-founder and chief executive officer of ESG DAO

Leadership in 2050 and beyond will be more southern, more eastern, more empathetic, more holistic and more sustainable. We see the trends already with the younger generations who are rejecting the current system of leadership. They seek a more distributed form of leadership, favouring collective empowerment over the 'cult of the CEO' through structures like DAOs and Coops. They reject the 'hustle culture' and an economic system which is based on exploitation and extraction of value. They seek value- and mission-driven companies and organizations to work for. They embrace diversity, of all forms, with sincerity. They are interconnected in ways that my generation could never imagine, shifting fluidly between online and offline, between the digital and physical worlds. . . I am filled with hope when I see young leaders and aspiring leaders from this generation.

Wadia Ait Hamza
Head of the Forum of Young Global Leaders, World Economic Forum

Technology has made our world more connected than ever before and will continue to revolutionize the way we communicate and interact as a global society. As we explore the frontiers of this hybrid human experience, it is essential that we remember to emphasize the human in human interaction. In order to build a connected world where all members of our society are valued as essential stakeholders in our collective future, trust must form the foundation of our collective dialogue, empowering all of humanity to have a voice in our global conversation.

Chris Behrenbruch
Biomedical engineer; co-founder and CEO of Telix Pharmaceuticals

It's just a matter of time before we can 'download' ourselves fully into the digital domain and in doing so, pull the plug on our biological identities.

Yobie Benjamin
Entrepreneur, futurist and speaker

I believe we will find a much more egalitarian world by 2050 where women, men and machine will be treated equally by all. National boundaries will disappear and travel will be open. Prosperity will be possible because by then the world will be energy independent and running on fusion, nuclear, solar and wind.

Marga Gual Soler
Head of Science Diplomacy Capacity Building, GESDA

The leaders of the future will embody three remarkable characteristics. First, they will possess a profound planetary consciousness, recognizing the interconnectedness of all life on Earth. While deeply honoring their countries, histories, cultures, languages, and traditions, they will rise above boundaries to embrace the idea of a shared human civilization. They will finally comprehend that our very existence as a species hinges on the delicate balance of this planet we call home. To safeguard our future, they will understand that collaboration and solidarity are the only way forward, as the challenges we face transcend borders and silos, and can only be overcome through joint efforts and multilateral action. They will embrace our common humanity as the only foundation upon which enduring solutions can be built. Second, future leaders will reject ignorance, science denialism and the distortion of truth, upholding facts and evidence as guiding beacons in decision-making. They will abandon linear thinking and adopt the power of exponential thought, realizing the profound impact of rapid change on our world. The outbreak of the Covid-19 pandemic serves as a poignant reminder of the need for anticipation, the ability to discern weak signals, and act preemptively to shape potential futures. Third, breaking free from silo thinking and echo chambers, the leaders of the future will become polymaths in their own right. They will seek diverse knowledge and skills, connecting seemingly unrelated disciplines to foster innovation and progress, and dismantling barriers to collaboration and mutual understanding. Looking ahead to the year 2050, a visionary shift in leadership becomes apparent in this book. I hope the 2024 UN Summit of the Future begins to chart this path. See you there!

Tristan Lecomte
Chief executive officer, Pur Projet

Using technology and science to connect us with nature, instead of thinking that we can control it.

André Loeskrug-Pietri
Chairman and scientific director, Joint European Distruptive Initiative (JEDI)

Science and technology will be increasingly central to all facets of human life in the twenty-first century. It depends on us to make it a force for good and equity. Let us always anticipate and shape the future and not be shaped by it.

Martin Müller
Executive director, Science Anticipator, GEneva Science and Diplomacy Anticipator (GESDA)

How technology will reshape the nature of leadership? We have witnessed huge technological disruptions in recent years. Future leaders should develop the ability to harness future technologies, share information and exploit the power relationships. Power is more and more distributed, as well as increasingly competitive. New technologies have the potential to democratize the way people have access to and

use power. So, I think future leaders will need to understand these technologies and how best they can be used.

Seán Ó Héigeartaigh
Programme director, AI: Futures and Responsibility Programme at the Centre for the Future of Intelligence, University of Cambridge

We are likely to see advances in artificial intelligence in the coming decades that will reshape the world we live in, revolutionizing scientific progress and changing the nature of work. We are beginning to see this already, with the progress DeepMind's AI systems have made in the key scientific problem of protein folding, for example. We are also, unfortunately, seeing the potential for AI to be used for military or surveillance purposes, or to be used in ways that further disenfranchise the most disempowered in society. Concerns have been raised that further in the future it may be extremely difficult to ensure that advanced AI systems remain under meaningful human control. Such a loss of control could pose catastrophic consequences. Ensuring that these developments go well—ensuring that the benefits are distributed across society, that risks are avoided, and that existing inequalities are not perpetuated—will be the challenge for our time, requiring insights and cooperation across disciplines and across society. It is a tremendously exciting time to be alive.

Lucian Tarnowski
Hindsight futurist; founding curator of United Planet Game

Technology will become an enabler for people to use themselves more effectively, maximizing their potential. Reputation will be so much more important because everyone will be aware of it.

Mark Turrell
Strategist, educator and entrepreneur; founder and CEO of Orasci

Change requires leadership in complex systems. Leaders will be much more accountable in the future. If they do weird things, they will be easier caught. Ultimately, this may bring more humanity in leaders and encourage more honest conversations.

Felicitas Von Peter
Managing partner, Active Philanthropy

Will leaders in 2050 look differently than today? Undoubtedly. My hope is that the leaders of 2050 will lead in collaboration, integrate perspectives from *all* sectors of society and judge their decisions by their impacts on the planet, as well as its inhabitants. Profitability will be defined holistically and take into account the perspective of future generations—and their ability to live a fulfilling, healthy life in harmony with nature. And if you think this is naive, ask yourself whether this isn't a kind of leadership to strive for?

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Future of Governments, Politics and Democracy

Tamás Landesz

Abstract

This chapter discusses the decline of democracy and trust in political institutions worldwide, as well as the role of technology and AI in improving infrastructure, public services and policymaking. The Economist Intelligence Unit's Democracy Index has measured the quality of political processes, civil liberties, the functioning of government, public participation and political culture every year since 2006, providing a ranking of nearly every country in the world on a 10-point scale. In 2020, the global average score fell to its lowest point since 2006, with the pandemic contributing to this decline. The Edelman Trust Barometer shows that people have fears about the future and how it may impact them, leading to a lack of trust in governmental institutions, businesses, NGOs and media. The European Union launched a project to explore the future of government beyond 2030, combining citizen engagement, foresight and design. Four scenarios emerged: DIY Democracy, Private Algocracy, Super Collaborative Government and Over Regulatocracy. The chapter concludes with predictions for democracy's future in the new digital age and how technology can both weaken and strengthen democracy.

Interviewees
Asanga Abeyagoonasekera
Özlem Denizmen
Florian Hoffmann
Robert Krotzer

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Olivier Oullier
David Rodin
Nilmini Rubin
Stav Shaffir
Elaine Smith Genser
Moran Sol Broza
Ian Solomon
Lucian Tarnowski
Mark Turrell
Arnaud Ventura
Lisa Witter

> "Government exists to protect us from each other. Where government has gone beyond its limits is in deciding to protect us from ourselves"—Ronald Reagan

How should governments best employ future technologies and AI for improving infrastructure and public services and devise effective policies to reap their benefits by 2050? Will the world still have refugee crises and poverty levels as today in 2050, and what can businesses and governments do to help them? These are just some of the questions we discuss in this chapter.

According to a recent British Broadcasting Corporation (BBC) Future series article (Heaven, 2017), trust in political institutions—including the electoral process itself—are at an all-time low. The global tide of democracy seems to be slowly eroding. New converts to democracy in Europe and the Middle East are sliding back into authoritarian rule. And populist leaders are winning votes. Societies around the world are experiencing a strong backlash to democracy, the hallmark of developed nations since World War Two.

The decline of democracy has been measured (Economist, 2021). Every year since 2006, Joan Hoey and her colleagues at the Economist Intelligence Unit (EIU) have produced a report called the Democracy Index, which provides a comprehensive ranking of nearly every country in the world on a 10-point scale. It combines regional data and multiple surveys conducted in 167 countries to measure the quality of political processes, civil liberties, the functioning of government, public participation and political culture. Each country is then classed as a full democracy, flawed democracy, hybrid regime or authoritarian regime.

Overall, in 2020, the global average score fell from 5.44 in 2019 to 5.37 in 2020. This is the lowest score since 2006, when the index started. The coronavirus pandemic was a key driver in this decline. Government measures taken to address the emergency contributed greatly. Sub-Saharan Africa, the Middle East and North Africa saw the most pronounced democratic decline. Almost all the world's democracies were penalised for curbing their citizen's freedom, even if their goal was to save lives. Sixty-five out of 72 democracies had their scores downgraded. Only 8.4% of the world's population live in a full democracy while over a third live under authoritarian rule.

Concurrently, the Edelman Trust Barometer (2020) reveals that 'despite a strong global economy and near full employment, none of the four societal institutions that the study measures—government, business, Non-Governmental Organizations (NGOs) and media—is trusted'. The reason for this paradox has to do with people's fears about the future and how it may impact them. As a result, these institutions should find new ways to building trust, in other words combine competence with ethical behaviour.

The European Union (EU) launched a project asking citizens what they thought about the future of government beyond 2030 (Vesnic-Alujevic et al., 2019). Their project adopted a novel approach that combined citizen engagement, foresight and design. The central question they posed was 'how will citizens, together with other actors, shape governments, policies and democracy in 2030 and beyond?' Four scenarios emerged:

- *Do-It-Yourself (DIY) Democracy*, characterized by decentralization of power and self-organized communities
- *Private Algocracy*, large digital organizations enforce their power over citizens and governments
- *Super Collaborative Government*, high level of collaboration and co-creation between citizens, governments and other stakeholders
- *Over Regulatocracy*, characterized by over-protection by the government by overregulating with the aid of technology

The project demonstrated that technology is seen as a powerful driver. Future literacy, together with cyber and data literacy and the promotion of creative and critical thinking, are needed to withstand future challenges in society.

In this context, the Knight Foundation announced in 2019 a 50 million US dollars investment to 'develop new field of research around technology's impact on democracy, cross-disciplinary research centers and projects to fill knowledge gaps on how society is informed in the digital age'.

In 2020, the Pew Research Centre (Anderson & Raine, 2020) published a report, covering many predictive comments from technology experts and futurists as they were asked about the possible future of democracy in the new digital age. About half of the respondents think that humans' use of technology will weaken democracy between now and 2030 as a result of the speed and scope of reality distortion, the depreciation of journalism and the impact of surveillance capitalism. A third of the respondents hope for technology to strengthen democracy as reformers find ways to fight back against info-warriors and chaos. The main concerns for democracy's future included power imbalance and trust issues. The former refers to the risk of those in power seeking to maintain it by building systems that serve them and not the public. Not enough people in the general public have the knowledge required to counter this assertion of power in a meaningful way. However, the latter refers to the rise of misinformation that erodes public trust in many institutions. Experts suggest solutions around innovation and technology. Change is inevitable; we can see innovation happening at the level of individuals and social systems. Human

evolutionary adaptation pays off. Some of the tech tools now antagonizing democracy may come to its aid with time. Leadership and activist agitation will create the required change.

In a World Economic Forum article, Joseph S. Nye Jr. (2014), a Harvard University professor, referred to Ambrogio Lorenzetti's painting *Allegory of Good and Bad Government* (1337–1339) covering three walls of the Sala dei Nove in the Palazzo Pubblico in Siena. The painting shows a dignified ruler sitting among the virtues of courage, justice, magnanimity, peace, prudence and temperance. The image of the city is one of stability, prosperity and happiness. If Lorenzetti was given the same space on the walls to cover 2050, what would his painting depict? Technology is evolving exponentially, often destabilizing, but also empowering. Leaders ought to develop a long-term strategic vision to identify the right tools and approaches required to shape the future of good government in their respective societies.

The Future of Government Smart Toolbox report (2014) by the Global Agenda Council on the Future of Government asks how governance could look in 2050. By analysing future trends, leaders can envision the future that they want for their countries and map out how to get there in a context of uncertainty. For instance, governments may choose to invest in improving the digital literacy of the population, or in infrastructure such as e-service kiosks in rural locations.

Public sector leaders around the world are held accountable to deliver good government, fit to address the challenges of the twenty-first century. They are under increased scrutiny to deliver to a growing urbanized population, while addressing complex issues, such as macroeconomic uncertainty or international conflicts, while trust in government is decreasing, and bureaucratic complexity is increasing.

The World Economic Forum's Strategic Foresight team explored the different ways in which major forces of change could play out in the future by 2050 and developed three distinct scenarios:

- *e1984*, a world in which big data has taken over everything, economic, geopolitical and cyber surveillance and threats are all around us, and collective solidarity is a central value of society.
- *Gated Community*, a world in which Big Government is gone, political power is exercised by individuals and private sector organizations; individual responsibility and choice are central values in the society, while the private sector has become the main provider of collective services.
- *CityState*, a world in which authority is transferred to the city level and pragmatism wins over idealism in addressing collective issues.

Joseph S. Nye Jr. (2014) warns us that 'today's trends left unattended could lead to dystopian futures'. Smart policymaking in the present would be required to ensure a positive future with gains for society at large.

1 Input from Interviewees

Asanga Abeyagoonasekera
Foreign policy specialist; founding director general of the Institute of National Security Studies Sri Lanka

Inequality is one of the biggest issues to tackle. Democracy and liberal thinking would still be most widespread organizational constructs. Conscious capitalism is rising, with elements of socialism brought into the practice of capitalism.

There would be less power at the centre with more devolution of power towards people, giving people more say and influence. This will inevitably lead to the redesign of global institutions as we know them.

Özlem Denizmen
Opinion leader in women empowerment; founder of Para Durum

I feel women are going to be really ruling the world. I am expecting more women to come up to leadership positions, not just company Chief Executive Officer (CEO). The world needs more caring and nurturing, and nurturing comes from women mostly. So women will be taking up a lot of social positions, sort of like I am, but on a bigger scale. And they will feel increasingly stronger.

In a world where everybody can learn everything and can live up to any age, it becomes very important to have a regime that keeps things under control. Democracy may be less widespread than authoritarianism, because all things available through technology will have to be controlled somehow. There also may be a revolution of some sort.

Florian Hoffmann
Social innovator and serial entrepreneur; founder of The DO

Our challenge is not one of understanding the problems we face but taking collective action with speed. We live in a time where too many people believe that their contribution won't matter anyways, that they have no part in tackling the big problems of our time. But our future is not that glum actually. There are millions of people who are taking positive action already—large and small. So my work and hope for the future is that we tell each other the stories of what is working and empower more and more diverse people to take action too.

Robert Krotzer
City councilor of Graz, Austria, for Health and Care

Thanks to democratization and participation, the divided society has grown together again.

Siegfried Nagl
Former mayor of the city of Graz

What does the ideal future of humanity look like? 'Forecasts are difficult, especially when they concern the future'. This bon mot has been trotted out so often by now that it would probably be trivial at this point to leave it at the mere

quotation. But this sentence has another punchline that is often overlooked: its authorship. After all, it is attributed to Karl Valentin, Kurt Tucholsky, Mark Twain, Winston Churchill and Niels Bohr—and this list is still incomplete. You see, history is (equally) difficult, especially when it concerns the past!

It is not only a widespread misconception that the future happens in the future; it also applies vice versa to the past. Alexander Kluge came up with the great formulation of the 'attack of the present on the rest of time' as early as the 1980s.

In other words, our images of the future are inextricably linked to our interpretive sovereignty over the past and the present. Strictly speaking, the question of an 'ideal future' for humanity therefore insinuates nothing more—but also nothing less—than the optimization of the present. Surplus progress is always also the result of the unpredictable; it is not continuity but the disruptive that usually creates dynamism.

The 'ideal future of humanity', as formulated in the question, is above all an 'open society' that promotes innovation, that keeps freedom and responsibility in a productive balance, that knows that in the long run there can be no rights without duties. This society will hopefully be able to accept the world as a place where easy answers are distrusted: discourse instead of dictation, participation instead of populism!

How do I envision the year 2050? First of all, I am convinced that in 2050 many people will think about how they can imagine the year 2080. And in 2050 we will remember that then, almost exactly 100 years ago, a clever person by the name of Bertrand Russell spoke of the most important question being to persuade humanity to consent to its own survival. This is probably the decisive point of departure: as an optimist, I assume that we will achieve the necessary turnaround, and that we will have practically implemented much of what we already know theoretically today. Specifically, I mean the recalibration of the three great freedom promises of modernity: individualisation, mobility and consumption.

The ME AGs (i.e., public enterprise driven by self interest) will no longer be a successful model in 2050. The expected profound reorganization of work and leisure—in view of developments in digitalization and demographics alone, but also in the 'science enterprise' as well as in medical care provision and likewise in urban housing—will lead to a far greater importance of social interaction than is the case today. The willingness to take responsibility for the community must and will be one of the key resources of the future.

We will still be consumers in 2050, unless we want to organize politics as an 'educational institution' again, despite all historical experiences. The task of politics will rather be to demand more ecological and social cost truth. Above all, this will also raise awareness for quality.

What should humanity do to achieve all of the above? Graz has been a human rights city for 20 years: incidentally, the first and thus the oldest in Europe. We have learned in the meantime that human rights are more than a fight against all forms of discrimination. We have realized that we must proactively shape them as a mandate for every human being. In concrete terms, every person deserves full respect, has a right to an environment that strengthens his or her resilience and opens up opportunities for free self-empowerment. However, this also includes an

understanding that, as already mentioned at the beginning, there can be no rights without duties in the long run and that a balance is needed between the should and the may that is suitable for the common good.

Olivier Oullier
Professor of behavioural and brain sciences; co-founder and chairman of the Board of Inclusive Brains

We will be able to mind-control everything and that will radically change the way people interact with other humans and with machines.

I think one of the major impacts on society will be a change of the legal system, totally rethinking the mere notion of responsibility and free will in light of the findings in neuroscience. Neuroscience will be changing the way we legally define and comprehend the notion of responsibility. We are talking about basically leveraging neuroscience in our everyday lives.

Another aspect is in understanding the brain. The big thing will be the merging between tech and the brain to help with neuro-degenerative diseases that we can't cure now.

My country, France, is complex. Resilient as it has survived many crises, but it is in dire need of change.

But if you want to reform this country, whenever a government moves the needle and people don't like it, there is a chance you end up with a million people down on the streets. Say that you want people to work one additional year to allow the country to fund its pension system, the great majority of people would not accept it. My country is very hard to reform. One could also argue this is a good thing because people don't accept everything blindly and have the right to voice their disagreement, which is not the case in all countries.

On the science and innovation front, France must make profound systemic changes: starting with the way it combines finance, innovation, science, technology and industry. These still feel to me like separate buckets instead of being efficiently coordinated to truly benefit society and the economy.

David Rodin
Moral and political philosopher; founder and CEO of Principia Advisory

What I see looking ahead is what I would describe as real megatrends. The first megatrend is the way we think about ethics, which over the past four to five decades has become progressively more focused on individuals, obligations that we owe both to ourselves, to our communities and to others. This is one big megatrend that I see continuing quite a way into the future. So what do I mean by that? The way societies and ethical constructs were structured around collective group of entities, coming out of the late medieval and into the early modern period. They were structured around entities like the state, like the church, like the community. Starting with the Renaissance really, we began to see an idea which placed the individual conceived as being a free rational agent bearing certain rights at the centre of that moral world. So the claims of collective entities like states had to be fundamentally recast. The way we understand the state today, I would argue, is very much one that derives its moral

status and its value from its relationship to individuals rather than the other way around which is the way that people would have thought about it, coming into the early modern period. Now this kind of change, putting the individual at the centre of these systems, has profound effects. One of the biggest vectors of this change has been the rise of the idea of individual human rights that were really codified after the second World War with the Universal Declaration. This has brought enormous transformational change in politics and society. This megatrend will continue and will accelerate over the next number of decades.

I think we will see the further empowerment of individual actors. Individuals acting in domains that previously were really monopolized by states, large corporations or other large collective entities in terms of seizing the authority to make claims about what is and is not appropriate forms of action. A kind of individualization of authority on the one hand, but also an individualization of action on the other. When individuals will see that things are not right in the world, where there is injustice or inequality, individuals I think increasingly will take action. Now, when I say individuals that obviously doesn't mean purely isolated individuals acting alone, but it means citizens, individual people often acting in concert using new technologies to take things into their hands to seize power in order to address things on their own.

The second big megatrend is that while ethics and our ideas about ethics are becoming individualized they're also in a sense becoming global. We are moving towards a global conversation about many issues rather than one that is necessarily structured around particular nationalities, states, or even regions. There are a large number of significant issues that the world is facing now which cannot be addressed on a local, national or regional level. They are truly global problems, like global warming, cybersecurity, nuclear weapons, management of pandemics and diseases, and management of the food system. These are global problems that just can't be addressed by individual communities, compelling us to think about values, principles and governance mechanisms that are really global in scope. The idea of a human right, for example, is something which is completely general in scope. It is possessed by human beings simply in virtue of being human, it is not associated to a particular religion, context or culture, so it really pushes us to think in terms of a global community of all mankind in a way that previous ethical frameworks did not.

Technological improvements and new gadgets will come and go with some having very profound impacts on our society and our lives. But what really matters the most is how human beings will relate to each other, whether we live well, we live badly or we thrive or fall into anarchy and war and genocide and all those things which cannot be solved by technology. While technology facilitates, what makes things really work is the relationships and structures between human beings. The most important transformative thing for how the world will be is not a tech gadget, but the institutions, structures and values we create together.

Nilmini Rubin
Chief of staff and head of Global Policy at Hedera, senior associate at the Center for Strategic and International Studies

An increasing number of citizens worldwide are dissatisfied with democracy.

Stav Shaffir
Social entrepreneur; former member of Parliament, Leaders of the Green Movement; and founder of the Shira Special University

In the future democracy will be much more than voting: it will be a source of power, to use the creativity and dreams of every citizen in the world in order to improve our lives. Democracy will be integrated in city planning, in education and schools, in state budgets; it will be based on facts and knowledge that is constantly moderated and improved; and it will involve citizens not just passively, but actively, in creating solutions, taking responsibility over their communities, on climate, society and the future. It is a democracy to be proud of, to learn from, to constantly shape to become better.

Elaine Smith Genser
Adviser, United Nations, Joint SDG Fund

Technology is a tool that is increasing polarization, but it is also shedding light on people across the world demanding the authority to govern or choose their representatives. True democracy is an undeniable trend where we are witnessing the demand for voting protections and election participation.

Moran Sol Broza
Sustainable impact entrepreneur; founder of Be. and Sol Food

Transparent democracy will be introduced, making it easier for people to influence local and regional policies and self-organize accordingly. People may relocate to regions of the globe based on values and principles, rather than observing an increase in 'nationalism'.

Ian Solomon
Professor of practice of public policy; dean, Batten School of Leadership and Public Policy

Geography will still matter; people will still care about their home. I believe that we will not recognize the world 30 years from now the same way people 30 years ago would hardly recognize our world today. I would expect that the pace of technological change will actually increase so the degree of change will be even greater in the future. What worries me is that even though we'll have this great capacity, it's not clear to me that our skills and tools and institutions for collaboration and cooperation and problem-solving will keep up with the pace of technological change.

You would expect that technology for voicing your political position by casting a ballot would advance dramatically. Our ability to cast votes, audit, validate and verify our vote will grow. That will change how we think about our democratic process. You can imagine that democracies will be far more interactive. You will be able to give feedback much more regularly than it is currently the case. Why not just click the 'like button' on a particular legislation? This would make governments

more accountable, transparent and engaged with their people, giving them more voice. But due process of debate may be harmed. Having a healthy debate is an important aspect of governance in a true democracy. That goes beyond just having your voice heard. It is the ability to have your voice and your opinion changed and to change others in the process.

I do think that it will get much harder for authoritarian regimes to maintain power. That trend will continue. But it won't necessarily mean that all non-authoritarian regimes will be always genuinely democratic in the sense of being participatory and raising the standards of their people. Democracy needs checks and balances, which will vary in degree from country to country.

Lucian Tarnowski
Hindsight futurist; founding curator of United Planet Game

Most importantly, we're entering the human age or the age of empathy.

I think we will see a crisis of the financial system at the same time as a crisis of the nation state. I basically, don't think the nation state is fit for purpose anymore. They are nineteenth-century creations.

The problem is that all nation states are independent. What happens when you get 192 sovereign nation states together, to vote on something that has global importance, do their duty and try to act in the best interest of their electorates of their nation state, rather than the best interest of the world? You get as a zero sum game where everybody will want to give as little as possible and take as much as possible. That's why we can't get any agreement on major global issues facing our planet, such as globalization, population growth, climate change, nuclear proliferation, disease control, etc. All major threats to humanity are global in nature. We are basically completely terrible at acting as a global, united world. Like we just don't have any true global leaders. No such a thing. People are still leaders of their countries, and they try and act on a global level, but often, they're just acting in the best interests of their electorate. We can see this in the failure of COP 15 or Kyoto.

Benjamin Barber, one of my mentors, who wrote 'Jihad versus Macworld' (1995) and 'If Mayors Ruled the World' (2013), thinks that cities are more efficient systems. Cities have more in common with each other than nation states. Rio, London, Shanghai, Paris, LA and New York have more in common with each other than Brazil, China, UK, United States (US) or India. City mayors could become really powerful in the future. Like, it's back to the future. In the past, we had city states like Florence, Venice and Athens. And if we went back, what worked was that it was hyperlocal, in that nobody wanted pollution in their own city. Everybody is aligned to reducing pollution in their own backyard. Today, 75% of the world's wealth sits in 40 cities. Therefore, if we could somehow create a governance model for those 40 city mayors to have decent power, what might happen is that we get hyperlocal governance, technology enabled, returning to true democracy. So rather than electing your representatives, you're actually voting on what you think should happen in your city. And as we move to a human age or an age of empathy, more and more people become educated about what needs to happen, they'll vote both with their wallets and technology, in what will be a lot more integrated democracy.

I think technology will radically change how governments are elected and how they operate. It's going to be a lot more participatory. I don't even know if there will be countries in the future, given that I expect a major crisis. Part of the trigger of this crisis will be a tipping point where a huge number of people is going to suffer if not die from something that's going to happen. And it's either going to be a major disease, nuclear war of some sort or similar major meltdown crisis. It's going to get pretty bad before we can completely reboot. What we have is not sustainable.

My father used to say that 'we are one missed meal from anarchy'. There will be a catalyst that makes people wake up; it is not going to be a slow-boiling frog. It is a very popular belief that we are going to innovate our way out of the world's problems. This is hyper dangerous as it makes us complacent. When we will look back, we will likely say about today, 'amazing innovation, bad leadership'. Davos shows the lack of global leadership around the world.

Mark Turrell
Strategist, educator and entrepreneur; founder and CEO of Orasci

The ability of people to rise up at scale is exponentially increasing. Democracy will dramatically change in the next 30–50 years. What is missing is the organizational model. So, I believe it is entirely plausible that our notion of democracy will be radically different in 2050. The voting cycle will likely be much more frequent. It would not be impossible to imagine votes taking place every week through mobile devices, instead of every five years. Probably we will still have party structures because they have got benefits, but parties may get formed around causes for shorter periods of time, given that the electoral system would allow for more frequent voting.

Most people's votes don't count, most democratic governments elected over recent decades have been elected with 15–30% of the voting population. Because of the party system, parliamentary seats are often subject to coalition agreements. This means that you can rule without any majority support for five years. New more participatory forms of democracy will have to necessarily replace this.

There should be nothing profound happening with the nation states, largely because most systems are fairly rigid. To change fundamental pieces of systems is pretty bloody hard. So, I don't see any huge change taking place to nation states by 2050. I do see, though, that the current sort of power balance between nation states will change.

Arnaud Ventura
Financial inclusion specialist; co-founder and vice president of Positive Planet Group

Poverty will disappear as we know it. In the next 50 years, at the latest in the next century, one of the most radical change on the planet will be that poverty and underdevelopment as we knew it 50 years to 100 years ago would have disappeared. Nobody will be dying from hunger, infant mortality would have been dramatically reduced and only a few countries will be considered as poor by international standards. But from a population of 9 to 10 billion people, less than 10% will be

considered as poor. Asia will be well developed and Africa would be following with only some spots of poverty remaining.

If most countries would have been able to escape poverty, inequality would still exist and be strong in most countries and obviously most countries will have rich and poor, but the poorest citizen of those developed countries will benefit from a number of safety nets (minimum wages, basic health coverage, etc.) that will allow them to escape from radical poverty.

Lisa Witter
Award-winning executive, serial entrepreneur, writer and public speaker; co-founder and executive chair of Apolitical

The world will be much more collaborative and interconnected. I am seeing a reorganization of the ideas around interconnectedness. If you extrapolate that into the future, we are going to hear a lot more voices and a lot more input into how things really happen. There will be a need for trusted advisers or curators to say whose voices are right and whose voices are wrong. This role may be offered by institutions, governments or otherwise. People will look for nodes of influence in a much larger way. That has fantastic implications for the world in terms of solving problems.

Another thing we are going to see a lot more going forward is power sharing versus power grabbing. I predict that the world will become much less violent which makes me super happy. I am also excited about what looks like a rush of political entrepreneurship happening. I see new models for organizing people emerging, new models for thinking about democracy in different ways, party structures redefined or broken down entirely and the role of them changing greatly. This could be the beginnings of a real revolution around political entrepreneurship. People around the world are fed up with how politics works now and they are looking for new models. It is nascent right now, so the next 30 years may see the complete disruption of politics as we know it. Whenever these shifts happen, they can be good, bad and ugly, all at once, but I am positive about it.

Democracy will continue to be an important notion of direct representation and of the people's voices being heard. But there will be a radical makeover of it, less focused on the process of governance and more on the outcome of governance. I realized this in Myanmar when conducting a training for young political leaders. They kept saying that they want democracy, but could not really articulate why is democracy important for them. There wasn't a sense that they have rights as individuals and I actually think the whole concept of human rights will go through a major shakeup. There will be really interesting discussions in 30 years, between what's my right as an individual and how I live as an individual, versus how I live in a community and a collective. I am not saying that we're going to go to communism, but we can't all have individual rights to do whatever we want; we have to think about how we fit into the tribe within our community. Democracy will be seen not just as who I directly elect, but how my direct election impacts how we fit into the world.

At one point the caveman woke up and he's like, I'm alone, and then he realized that he will have to work together with others. The world will be much more collaborative in 30 years; it will just have to be. Democracy will feel more collaborative; politics will feel more collaborative; governance will feel much more collaborative; gender relations will feel much more collaborative; the notion of an individual will be less highly valued.

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Future of Geopolitics

Tamás Landesz

Abstract

This chapter discusses the potential transformation of geopolitics over the next 30 years and the global challenges humanity may face. The world is undergoing a historical transition, with economic and political power rebalancing, and as a result future politics will be moving towards more openness or resistance to change. China is predicted to become the world's largest economy and a more significant political actor, and the proportion of economies with a high degree of state ownership and control is expected to increase sharply. Emerging power hubs by 2050 may include Brazil, Colombia, Egypt, Indonesia, Iran, Kenya, Mexico, Nigeria, the Philippines, Turkey and Vietnam. Furthermore, future conflicts will likely be more about spheres of influence, water, resources and supply lines and less about territory. The chapter concludes with a discussion on how international trade impacts global poverty and the potential impact of policy decisions on globalization and climate change on a global scale.

Interviewees
Asanga Abeyagoonasekera
Gina Badenoch
Eli Beer
Chris Behrenbruch
Rajeeb Dey
Tariq Krim

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Martin Müller
Olivier Oullier
David Rodin
Tobby Simon
Ian Solomon
Mark Turrell
Arnaud Ventura
Mark Vlasic
Lisa Witter

> 'The national interest is predetermined by geopolitcs or the history of a country. Important political leaders never just followed their interests—they were concerned about the interests of their people'.—Joseph Nye

How will geopolitics transform over the next 30 years? What type of global challenges will humanity be facing? Will we find better ways to live in harmony with nature? How will we deal with the future collapse of borders or with the intensification of sharing economy and disruptive entrepreneurship, as well as the emergence of cities with global influence? This chapter will be looking at these questions and more.

A world with new opportunities is emerging for businesses, investors and policymakers. Everything seems to indicate that the world is in the midst of another period of historical and messy transition, a rebalancing of economic and political power; in the next 30 years we may see:

- Future politics will move away from right and left towards more openness or resistance to change—a sort of worldview struggle.
- China will become the world's largest economy and a more significant political actor.
- The proportion of 'less free' economies with a high degree of state ownership and control is predicted to increase sharply.
- In addition to traditional powers like China, India, USA and possibly Europe and Russia, emerging power hubs by 2050 will possibly be Brazil, Colombia, Egypt, Indonesia, Iran, Kenya, Mexico, Nigeria, Philippines, Turkey and Vietnam, all with large populations and economies.
- Warfare is transitioning from regular armies to freelance contractors, militias, special, robotic and cyber forces, making nations' traditional military less relevant. Future conflicts will be more about spheres of influence, water, resources and supply lines and less about territory.
- Technological, ecological, social and cultural soft power will most probably become more important than economic and military hard power.

As we have seen during the Covid-19 pandemic, global black swan or great rhino events can radically impact the world. Tom Orlik and Bjorn Van Roye from Bloomberg Economics (2020) predict four possible scenarios:

1. The current Western-dominated paradigm succeeds to address its current weaknesses and fragmentation, resulting in a renewed democratic revolution. Contributing to an environment in which the challenging powers would be successfully convinced to integrate. Coined as 'liberal internationalism renewed'—a reloaded version of the paradigm prevailing since the end of the World War II.
2. Those who oppose the Western-led paradigm—Russia, China and others—take advantage of the situation and move relatively peacefully towards a multi-polar world. Labelled as 'twenty-first-century concert', in reference to the nineteenth-century Concert of Nations.
3. A version of the second, but with one important difference. The transition to multi-polarists turns violent, armed conflict spreading to ever more regions of the world. Let us refer to this as 'geostrategic meltdown', a renewed period of global conflict.
4. Finally, the possibility of a military breakthrough that would be sufficiently convincing for challengers to step down. Similar to submarines in World War I and nuclear weapons in World War II.

1 Nation States, Population and Global Trade

International trade is rarely looked at with a humanitarian lens. However, China's rapid trade-driven growth in the past 30 years helped 680 million people move out of poverty.

Throughout much of the last century, strong trade restrictions, including agricultural barriers and subsidies in Europe and the USA, as well as import duties almost everywhere, seriously slowed growth. Research published by the Copenhagen Consensus reveals that more than half the cost to developing countries comes from their own policies. This would concurrently mean that unilateral action could result in half the potential benefits, not having to wait for others to act.

Bloomberg Economics forecast that a remarkable period of stability, from the end of World War II through to the early twenty-first century, is coming to a halt. Economic influence and power is transitioning from West to East, 'from advanced economies to emerging markets, from free markets to state controls and from established democracies to authoritarian and populist rulers'. We can already witness this shift happening (Orlik and Van Roye, 2020).

Of course, these projections could be easily derailed by such complex events of global impact as the Covid-19 crisis with major consequences to the global economy. Armed conflicts, natural disasters and financial collapse can have a similar impact. Policy decisions on globalization and climate change can have global repercussions as well.

China's annual Gross Domestic Product (GDP) growth is expected to slow down to around 3% by the 2040s, resulting from an aging workforce and slowing development. India will likely develop at a faster pace given its younger population and significant gap to make up for. We will likely see more tensions between China and India as they continue to position themselves as the main centres of gravity in Asia.

Based on Bloomberg Economics' GDP forecasts and the Heritage Foundation's classification system, the share of global output from 'free' or 'mostly free' economies is to slide from 57% in 2000 to 33% in 2050. The share from economies classed as 'mostly unfree'—with a high degree of state ownership and control—is set to rise from 12% to 43% (Orlik and Van Roye, 2020).

Looking back, the end of the Cold War—referred to as the end of history by Fukuyama (1992)—was just a turn of chapters. We are seeing an unorderly transition of the balance of power from West to East, from free markets to the state and from democracies to authoritarianism and populism. For governments, businesses and innovators, history is far from over. It is just getting wind up.

According to Lindsey Galloway (2020) in a BBC article, in 30 years current superpowers such as the USA, Japan and Germany will be overtaken by emerging nations as the world's largest economies. The top ten economies in 2050 listed by PWC's 'The World in 2050 report' (2015) will be (1) China, (2) India, (3) USA, (4) Indonesia, (5) Brazil, (6) Russia, (7) Mexico, (8) Japan, (9) Germany, and (10) UK.

2 Global Alliances and Conflict

The World Economic Forum predicts a shift in the balance of power. Among its expert networks the Global Future Council is the world's foremost multistakeholder and interdisciplinary knowledge network dedicating to promoting innovative thinking to shape a more resilient, inclusive and sustainable future. It is likely that we are witnessing the world entering another period of major historical shift.

War always has a heavy economic and human toll. According to the Copenhagen Consensus Centre, the twentieth-century military cost about 5% of GDP per year. Yet, since the Korean war peak of 7%, global costs have declined steadily through 3.4% in 1980 to about 1.7% now. Even for a pessimistic outlook till 2050, this might only go up to about 1.8%—and with a more optimistic outlook, it could decline further to 1.6%. Have the heavy military costs of the twentieth century been turned into a permanent peace dividend?

3 Normative and Ideological Environment

We can observe a tech-driven cultural mindset shift emerging in the 2020s, driven by a completely new value system represented by Millenials, based on circular economy and an increased emphasis on artificial intelligence. Nations, governments and institutions not meeting expectations are increasingly bypassed by megacities,

private corporations, NGOs and citizen groups, in a major transition of political power. Networks of pooled interests are emerging, aiming to address pressing global issues by introducing innovative, pragmatic and affordable crowd-sourced solutions. These flexible new structures form the backbone of an emerging global order. The masses increasingly believe in these new structures as they deliver in ways that nations failed to do.

Stephen Walt (2015), international relations professor at Harvard University, writes the following in a Foreign Policy article titled 'What Will 2050 Look Like?':

> 'If one is trying to envision the world of 2050, it is the technological frontier where our crystal ball is cloudiest. And let's not forget the "black swans": those seemingly random natural or man-made events that could shift the course of world politics in unexpected directions. A mass pandemic, a nuclear terrorist incident, an even bigger financial panic, or a catastrophic drought might have profound effects in many places, alter global discourse in key ways, and make many of our other forecasts look silly. And by their very nature, such events are hard to anticipate even if we know what their baseline probabilities might be'.

If we want to work towards creating a better future, we need to promote a transition that is less competitive and more cooperative at a global level. This would require a suppression of our short-term self-interest mindset in favour of longer-term human and environmental priorities. Current events and our evolutionary urge to survive and adapt will hopefully help steer the current transition in a positive direction.

4 Input from Interviewees

Asanga Abeyagoonasekera
Foreign policy specialist; founding director general of the Institute of National Security Studies, Sri Lanka

I expect a universal declaration against terrorism.

The world will go through a difficult time in the next decades, because of terrorism and the increasing role of non-state actors. Global institutions will need to be redesigned to tackle the issue of terrorism and the role of non-state actors. There will be a point in the future where we will all be fighting terrorism together because it disturbs world peace. Another world war, states fighting other states is less likely, but overall tension and chaos may increase in the next two decades due to non-state actors.

Humanity will come to a threshold whereby we would not be able to tolerate our situation any more, leading to the redesign of the United Nations (UN) and other global institutions, enabling them to intervene. Joseph Nye's 'positive sum game' is more likely to become a reality, instead of a 'zero sum game'.

More digital inventions, computational thinking and skills will be part of every discipline and absorbed by everyone. Sri Lanka is well located to become a major trade hub in South Asia. Chinese are helping develop Sri Lanka as a trade hub of the

future. Two hundred years ago Sri Lanka was a trade hub; hence, this is like going back to the future.

New tech will have a dramatic impact on international relations. I am optimistic about the impact of nanotech and quantum computing on development. Populations will undergo lots of changes, no more rural, and growing standards of living. In Sri Lanka from a population of 21 million, 18 million has a mobile phone and over 90% literacy rate. This will further increase; thus, Sri Lanka could grow into a developed nation in about 30 years.

There will be less power at the centre, with devolution towards the people. I don't see the rise of one country, but everyone at the same time. The Security Council will be enlarged, priority being the peace of the world.

Gina Badenoch
Social entrepreneur and photographer; founder, Ojos Que Sienten AC and Capaxia, UK

I don't believe in a world war in the next 50 years.

Nature is paying back. We are a bit late, and sadly I believe that we will see worst. What I love about London is that it is very diverse. And when the Olympics happened, it is how I picture the world in the future. There was diversity in all the senses, people with disabilities, without disabilities, of all nationalities.

I see huge potential for Mexico's development. Unfortunately, there is a huge amount of corruption going on. The top third billionaire lives in Mexico, while there are so many poor people. There is big inequality with many people lacking education and opportunities. I hope that a better education system will shoot the country up in the future.

Eli Beer
Social innovator and first responder; founder of United Hatzalah of Israel

We will have a lot of wars going on in the next 50 years.

I am very pessimistic about geopolitics. We will have a lot of wars going on in the next 50 years. Religious radicals will enforce many wars. Terrorism will continue for another 200 years or so. It will take so long because young generation especially in middle east learn to be radicals for a cause. One hundred years of hatred and another 100 years to clean up the hatred.

People today make money of being leaders of hatred and will take time until people will be sick and tired of it. History repeats itself. In 200 years there will be a renaissance and people will realize that they will have to find a way to live together, but before that millions of people will die.

Chris Behrenbruch
Biomedical engineer; co-founder and CEO of Telix Pharmaceuticals

Nuclear terrorism will be a certainty. This, combined with mass urbanization, will change the way we look at borders and frontiers—the protectionist policies and legal frameworks of the world's existing megacities will further grow and expand to the point where the world's politics will be dominated by city states. This will have the effect of hyperlocalizing environmental, economic and racial issues—in the long

term it will create better global governance and decentralize power in countries like the USA. In the short–medium term it will cause major conflict.

Rajeeb Dey
Founder and chief executive officer, Learnerbly.

Which nation will be the first to colonize outer space?

Tariq Krim
Writer, tech entrepreneur and inventor; founder Slow Web Initiative

For the last 40 years, goal of technology has escaped externalities. We didn't care about consequences in the real world. Now the global internet will be profoundly shaped by geopolitics and is at risk of splintering into regional subnetworks.

Tristan Lecomte
Chief executive officer, Pur Projet

We are not the happiest now. Those who are richest are not the happiest, but rather those who are closest to nature (see happiness world surveys). We need to act or risk being more and more unhappy. For instance, China has a lot of these big cities with factories where people go working every day, totally unhappy and depressed.

Bob Macmahon
International affairs journalist, managing editor, Foreign Affairs Magazine, Council on Foreign Relations

The United States will not be the unipolar power it used to be, as it does not want to be the dominant world power any longer. USA defence establishment does not want to spend as much budget as until now in the future. The world will be organized based on coalitions of the powerful. The Security Council will be expanded to tackle together issues like global governance of Internet, climate change, etc. Space may be governed by international norms. The United Nations will include not only nation states. The ability of global leadership in terms of coordination and resilience against national disasters (virus like covid, or asteroid event) will evolve continuously.

Martin Müller
Executive director, Science Anticipator, Geneva Science and Diplomacy Anticipator (GESDA)

Three key drivers of the future will be (i) information technologies and the underlying usage of data, (ii) access to next generation resources and who controls them and (iii) geopolitics with new alignments emerging, affecting every other driver.

Olivier Oullier
Professor of behavioural and brain sciences; co-founder and chairman of Inclusive Brains

Ultimately, global institutions might end up running countries as opposed to the opposite. The mayors of big cities will have increasing power over centralized governments.

Next, wars will be very different using robots, drones and cyber warfare. Even today one could theoretically destroy a city sitting giving orders remotely to drones without any human soldiers being required. How this will change in 30 to 50 years is unpredictable.

The power of leaderless revolutions to bring down regimes is a reality. But we have not seen yet any such revolution being followed by a leaderless creation of new and improved regimes. Leaders are still needed . . . so far.

David Rodin
Moral and political philosopher; founder and CEO of Principia Advisory

We have commemorated the 100 years anniversary of the first World War not too long ago, and I see much parallel between today and that time.

Global governance structures are under increasing strain, set up 60 years ago. Despite multiple reform efforts not much change. The UN will not disappear but diminish in relevance. There will be an increase in spreading the EU model, basic idea of interrelated sovereigns or super sovereign structures. Process of enlargement shall continue and act as an example for other regions (Asian, African states, Russian trade initiative, etc.).

Tobby Simon
Founder and president of Synergia Foundation

World will be fragmented and fractured in 30 years. Competition for economic resources; deceases will increase in complexity; new strains will emerge. In an interconnected world everyone will be more affected; countries would close their border. Cybersecurity challenges are also becoming more prevalent. India will become more resilient; standard of living will increase and will be among the top 5 in the world. Country will acquire more character.

All continents will reengineer themselves. For instance, Europe will still remain among top 5 regions in the world. I don't see global war, but 4–5 man-made disasters; conflicts will be of economic nature, e.g. South China Sea. Australia will be the largest producer of natural gas in the world. Middle East power balance will majorly change.

Ian Solomon
Professor of practice of public policy; dean, Batten School of Leadership and Public Policy

New ways will need to be invented to organize ourselves. Leaders will have to step up and adapt, shape, create value in the changing context. I am optimistic but a bit overwhelmed.

The USA will be still important. It will still be most probably a major and most powerful state, but how it will interact with technological, trade and other interest blocks and alliances will be very different than today. Facebook versus Myspace versus outer space.

Geography will still be important but less than today, or in other ways. We will still see armies. How to build national identity in the future, building support for

social movements? How will mobs use new tools? USA versus China may not be so relevant anymore, but rather what about workers and so on. USA values of innovation, tolerance will still be important, and institutions will need to be developed to maintain USA' competitive edge.

Mark Turrell
Strategist, educator and entrepreneur; founder and CEO of Orasci

Good and bad people can equally emerge, while bad people are usually more motivated.

China will evidently rise, similar to USA, growing in influence and military power without wanting to participate in any war. Chinese military is also expanding to protect their trade interests (for the moment).

I am relatively positive, optimistic about the next 30 years. Wars of the future will be on the Internet, on voicing and sharing opinions and data. Enough traffic and demand flowing through the Internet that this is inevitable—no turning back. Systems are more unstable, prone for revolutions. Nationalistic rhetoric lets governments turn people's rights off. Everyone can be (is) a terrorist these days. . . .

Arnaud Ventura
Financial inclusion specialist; co-founder and vice president of Positive Planet Group

The current barriers will progressively dislocate, transforming our world into an open world. In the next 30 years, France, as well as most of Europe, will continue their move to become one of the oldest continents, in terms of average population age, on Earth, moving definitively from an industrial economy towards an economy of leisure and tourism. France will not be able to pretend anymore to be one of the world's leading powers, and as Argentina in the beginning of the twentieth century will move from being one of the world's great powers to being a charming country with an interesting culture.

One of the main events that will change the world in the next 30 years, or possibly the next century, is the collapse of our borders. My grandchildren will certainly live in a world where our current definition of nation and citizenship does not apply anymore, because of major innovations in travel and energy, most citizens will be in connection not only thanks to telecommunication means but also through physical means. The current barriers will progressively dislocate, transforming our world into an open world.

Mark Vlasic
Professor, lawyer, Hollywood producer and former international war crimes prosecutor; principal, Madison Law and Strategy Group; and senior fellow and adjunct professor of Law, Georgetown University

Expect a lot more complexity and unlikely alliances in a resource-stretched world.

Lisa Witter
Executive, serial entrepreneur, writer and public speaker; co-founder and executive chair of Apolitical

The world will completely change. Privatization versus public good will be important, e.g., who will own the air—a government or a company?

The world will be less power-centred. USA and EU will still be significant; Latin America will improve; Africa needs catchup. There will be less conflicts, less resource dependency, less religious disputes. People will be more satisfied.

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Future of Healthcare

Karine Sargsyan

Abstract

Future medicine will focus on preventing new diseases and monitoring a person's pre-nosological state, which is perfectly evidenced by the current situation with the coronavirus epidemic. The medicine of the future is not about treating the sick, but making sure that you do not get sick in principle. The boom of innovations, gadgets, and technological solutions cannot but affect medicine. The traditional healthcare system is a highly fragmented structure. Technology can offer an interconnected solution to the individual. Sensory wearable technologies will likely become the basis for future disease prevention, diagnosis, and treatment. The new generation of doctors is interested in innovation and making better decisions rather than in traditions and centuries-long working SOPs.

Interviewees
Gina Badenoch
Eli Beer
Chris Behrenbruch
Thomas Crampton
Özlem Denizmen
Facundo Gareton
Soulaima Gourani
Christoph Holz
Robert Krotzer

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Image 1 Future of healthcare. Original Photo: LKH-Univ. Klinikum Graz, Austria. Illustrated by: Astghik Kyurumyan, used with permission

Tristan Lecomte
Elisha London
Bob Macmahon
Martin Müller
Tolullah Oni
Bjarte Reve
Caroline Schober
Ivan Vatchkov

> "The doctor of the future will no longer treat the human frame with drugs, but rather will cure and prevent disease with nutrition."—Thomas Edison

To guide us through our world's unpredictability, we have relied on focused sets of experts until now, whether in healthcare, education, or any other field. However, it is even more complex to predict the future of healthcare, as medicine and healthcare are very diverse and complex initially. Events like the Covid-19 pandemic shook even the foundations of the future of healthcare built on expert plans (Image 1).

I am happy for this opportunity to write about the future of healthcare, not only as a medical doctor and researcher but also because I was not sure of my own future several years ago. I started to have hemiparesis during migraine attacks in 2018. What it exactly meant was that the left part of my body began to hang like a dead

flash and was not reacting to my brain's orders. Do you know what a human (especially a doctor) does in this situation?—Panic! But to my fortune, I got one of the best neurosurgeons in the world, who spent a very long time explaining the exact procedure to me—a doctor. If I had been born half of a century earlier—I would not be alive or would be disabled, but now, although I run through a months-lasting short-time memory loss period, which was horrible at that time, funny—if I look back to that. I have the same brain capacity—thinking and logic—and I am extremely happy about it. This type of surgery is available only in the developed world. Today, I am one of the lucky humans with the availability of an incredibly secure but innovative and research-prone health system, like the one in Austria. Being a doctor, researcher, research manager, and patient, I see the future of medicine and healthcare in an integrative approach.

What do we expect from the medicine of the future: prevention, gadgets, technologies. . . . Suppose the twentieth century mainly directed the scientific interest of man outward and continued to push for discoveries related to space and the depths of the sea. In that case, the twenty-first century can be safely called the era of searching within ourselves. Humanity has discovered high technologies for itself. Of course, the boom of innovations, gadgets, and technological solutions cannot but affect medicine, turning the idea of what will underlie it in the future by 180°.

The traditional healthcare system is a highly fragmented structure, while technology can offer an interconnected solution to the individual. Suppose now the collision of a person with medicine occurs when the disease has manifested itself, then in the future. In that case, treatment will become an ongoing process of preventive healthcare and will move from treating conditions to preventing them. The central concept of the transformation of future medicine is the 4Ps: predictive, personalized, participatory, and preventive.

The medicine of the future is not about "treating the sick" but making sure that you do not get sick in principle.

Considering a person's pre-nosological state, monitoring and finding this stage is the main task of future medicine, which is perfectly evidenced by the current situation with the coronavirus epidemic. Right now, we see that all public health efforts aim to assess risks and prevent new diseases.

Do you want to live in harmony with your body and not feel like an owl in the world of larks? That future will come soon.

Personalized medicine: Even 30–40 years ago, scientists could not even imagine that one day they would be able to decipher the genetic code—this was considered impossible. DNA makes it possible to determine a person's predisposition to breast cancer, type 2 diabetes, intestinal inflammation, and heart disease nowadays. Furthermore, although this is only the beginning of the journey—scientists have a long search for links between specific parts of the genome and diseases—in a few years, an individual fully sequenced DNA profile will likely become an indispensable part of every patient's medical record.

"Precision" or "personalized" medicine is already a genuine field of modern health science. The essence of this approach is to find the best treatments for a particular person based on his own unique biochemical characteristics. Thus, by

reading the DNA of a patient's cancer cells, one can identify specific mutations and see which of hundreds of drugs and millions of combinations of treatments will be most productive, or to determine which of the patient's own lymphocytes are capable of attacking cancer cells. After growing "good" cells in the laboratory, they are introduced into the patient's body, where the restored immune system begins a targeted fight against a cancerous tumor. There have already been successful precedents for curing cancer in this way, but these are only the first rays of hope—it is too early to talk about mass healing.

Or, for example, tissue analogs of the affected organs are already being grown from the cells of patients, thereby creating "living" models for testing. Subsequently, they are used to analyze how the organ of this particular patient will behave if one or another drug, including an experimental one, is applied to it. This approach allows them not to waste time and not aggravate the patient's condition with non-working therapy but with his desire to ensure the monitoring of everything in the world. Now, smart fitness bracelets, which have long become a familiar attribute of everyday life, can count many indicators of health and physical condition or activity: number of steps per day, HRV, pressure, quality of sleep and training, calories consumed, frequency of meals and meal times, weight, body composition, etc.

Sensory wearable technologies will likely become the basis for future disease prevention, diagnosis, and treatment.

1 What Other Critical Medical Technologies, Gadgets, and Devices Are Already in Place, and What Can We Look Forward to in the Future?

Bionic eye: Even though movie characters have been flaunting functional bionic eyes almost since the late 1980s, creating such a functional prosthesis is a challenging task, and it is unlikely that it will be solved quickly. Nevertheless, scientists are already taking the first steps in this direction and, for example, have already learned how to print working light receptors. So far, their structure is too rigid, the receptors themselves are bulky, and photoids convert sunlight into electricity with an efficiency of 25%.

Smart lenses: As mentioned above, various sensory health monitoring systems will become the primary tool for monitoring health. Already, scientists are working on a smart contact lens that can read glucose levels in tears. These lenses can eventually become a great alternative to regular blood collection and make life easier for people with diabetes.

Pressure sensor: Another mobile body monitoring device is an elastic touch "patch" that, using ultrasonic waves sent into the body, reads blood pressure and transmits data directly to the doctor's monitor. The device is smaller than a postage stamp, and the patient does not feel its impact.

Surgeon robots: The boom of talk about nano-robots has long passed, but the idea itself has not gone away. True, so far, scientists are testing the technology on larger counterparts of nanorobots. The first tests are already being carried out by a robot

placed in a capsule, which unfolds in the intestine like a clamshell and can remove a foreign body from it or help restore damaged tissues.

Three-dimensional (3D) prostheses: Over the past ten years, 3D printing as a technology has finally moved into the field of mass consumption. Anyone can now buy a 3D printer, which means that objects produced using 3D printing are gradually becoming more affordable. Yes, the production of a 3D prosthesis is still a costly process, and yet this field of medicine has been multiplying in recent years. A person with an ergonomic prosthesis made on a printer is no longer a rarity.

AI diagnostics: Over time, artificial intelligence will likely make most of the primary diagnoses, while the work of doctors will expand to the most complex and ambiguous cases. Most recently, using the principles of machine learning, Google experts analyzed more than 250,000 images of the retina. The AI's task was to identify patterns in the images that correlate with high blood pressure, the risk of cardiovascular disease, and strokes. Furthermore, although full-fledged robot diagnostics is still far away, in some cases, AI determines the presence of the disease more accurately than doctors.

Virtual reality (VR) for education: Of course, we cannot ignore digital technologies for training a new generation of doctors. You will not surprise anyone with online education, but there is not only one way to connect. Using virtual and augmented reality technologies, it will be possible, for example, to "take a tour" of a person's internal organs or look at an accurate operation through the eyes of a famous surgeon.

The main task of the medicine of the future, all this gene analysis, cellular programming, and tissue engineering, is to give a person control over their own health, which was simply unthinkable before. Very soon, the refrigerator will monitor our diet and advise us to eat a particular product at a specific moment or throw away an extra package of ice cream. The phone will determine the degree of depression, and toothbrushes will analyze saliva composition daily to notice the first deviations from the norm.

The future changes will be in two different areas—acting healthcare and forming healthcare.

The acting triad includes the following:

1. **Healthcare workers**—doctors, nurses, therapists, etc. The question is, who will devote their lives to this very challenging profession? Just some numbers. In the USA, between 300 and 400 doctors commit suicide annually—it is a doctor a day on average. Here are some more statistics for the plasticity of the message: in developed countries—for every hour spent with patients, doctors spend one and even 1.5 hours with paperwork (mainly for the insurance companies). On the other hand, the new generation of doctors is interested in innovation and making better decisions rather than in traditions and centuries-long working SOPs. Parallel to researching doctors, we will also have business-trained doctors (medical doctor [MD], master of business administration [MBA]), and politics-trained doctors to make the right laws and fitting models for healthcare and medicine.

2. **Future diseases and new challenges**. The future conditions and hotspots will be affected first by an aging society: sedentary lifestyle-related diseases—obesity and co and psychiatric states—due to an overload of information and sharper life competition. Second, it will be affected by new infectious diseases and agents that are consequences of "not recycling"—which is not only about infections but also about heavy metal drainage in drinking water, soil corrosion, and other effects that we do not know yet. We research to explore which diseases are most likely to cause the next global pandemic, racing to keep that from happening. Still, more resistant bacteria, viruses, or prions may cause another pandemic that we cannot even imagine today.
3. **Future diagnostic and therapeutic technology** is developing with enormous speed. There is no doubt that our society is developing much faster than before. This also applies to medical technology, which has reached an incredible level today. However, what is ahead of us? We mention some technologies, like:
   - Portable health monitoring tools or indicators—like my e-Watch
   - Mobile applications providing medical support
   - Artificial intelligence in medicine, which becomes precisely accurate, especially in picture-based diagnostics
   - Genome editing technology—which may once be the trend for xenotransplantation
   - Biohacking—against expectations, the main goal of biohacking is noble: to bring the human body to a new qualitative level, improving well-being and refining vital processes

The forming triad of future healthcare and medicine is about:

1. **Healthcare trends—**In 2004, we spoke about personalized medicine, and several years ago, the term precision medicine came out and started to, even more, tend healthcare to a single person. The preventive enhancing approach, digital healthcare, integrated (into daily life) medicine, etc. will become usual. The future is not about how we treat diseases but how we prevent them from occurring.
2. **Health system challenges—**We must fight the idea of seeing a hospital as a business. We need to enhance affordability. In the future, we will overcome the problem of payability and affordability. The system will change in favor of health accessibility, system and best quality sustainability, integrative health patient experience, and simply better health.
3. **The enablers like** regulatory enhancements, researching and curing medicine symbiosis, new integrative organizational and business models, and healthcare platforms (technological) will make future medicine more accessible if politics keep the speed of technological and curative development.

In the future, we will be able to heal wounds in minutes; grow full-fledged organs, bones, and cells; create human-powered equipment; repair damaged brains; and much more.

Integrative healthcare infused with a human approach, holistic well-being, and comfort supported by high-end diagnostic and therapeutic technology will become a reality. In the future, not the virus or any other infective agent will be contagious, but the health itself.[1]

I want to finish with the words of Antoine de Saint-Exupery.

"It is only with the heart that one can see rightly; what is essential is invisible to the eye."

2 Input from Interviewees

Gina Badenoch
Social entrepreneur and photographer; founder, Ojos que Sienten AC and Capaxia, UK

In medicine world acceleration will increase due to technology, impacting directly blind people and paralyzed ones, significantly changing their lives.

Eli Beer
Social innovator and first responder; founder, United Hatzalah of Israel

The medical world is my world. . . In New York City if you want a taxi, you put out your hand and you get a taxi. In 50 years from now people will continue dying from the same things, choking, car accidents, terrorism, etc.. . . but when people call for help, it will be there immediately, because so many people will be well trained, within less than 1 minute, medical response will arrive.

Even in Africa where today no response is available, through education (via new technology), they will learn how to save someone.

Everyone who is able to respond will be connected through a digital network like Facebook and organize themselves to respond to accidents. My company is trying to reduce response time to 90 minutes across the world. In 50 years if someone would die from heart attack on the street, it will be in the news next day, will not be considered normal. Israel puts a lot of money into research and medicine.

Even enemy countries will come to Israel and learn about healthcare.

The real invention will be how to prevent death—protect people from dying suddenly, not from deceases because they always renew themselves, but biggest cause of death is cardiac rest or stroke/but in future all this will be taken care of, which will save so many people.

People's life could be saved from their phone, for example (giving an electric shock).

[1] A previous version of this text has appeared in the author's speech at Digital Davos 2022, World 2050, Jan 17, 2022, online, also available for students at https://youtu.be/eTtjqpAMO_k.

I don't know about flying cars, and other technology, but I am talking about life.

In future less people will die; hence, less people will be able be donors for others; hence, artificial heart will be probably invented/you will be able to buy yourself a heart in the future.

Technology should also be invented that protects people by monitoring their body functions.

Chris Behrenbruch
Biomedical engineer; co-founder and CEO of Telix Pharmaceuticals

Humans will lose their natural biological identity—we will move to homo nano-technus. There will be a price/performance/risk equation applied to healthcare and medicine, which will become deregulated because it has no choice. If we don't remove the regulatory barriers for medicine and the almost arbitrary nature of drug development as mandated by our government authorities, the gulf in care between rich and poor will be too great. The quality of medicine will depend on what you can afford, as will the lifetime of replacement organs.

Within 50 years we will see bio-replacement strategies that are started from birth.

Thomas Crampton
SVP and head of Corporate Affairs at GreenLight Biosciences

I look forward to the eradication of illnesses and ailments that plagued previous generations as well as treatments that serve populations formerly unable to access the best that medical advancement offers.

Özlem Denizmen
Opinion leader in women empowerment; founder, Para Durum

There is going to be the recreation of the human body, cloning ourselves, replacing body parts, look younger; in other words there will be a biological revolution, I feel.

The whole Botox and so on will be much more advanced. We could be looking just the way we would want to be looking at any given time and at any age.

I believe that because of this there is going to be a bit too much emphasis on the physical part of things; people will possibly lose their souls, leading to an increasing gap between body and soul.

Different types of illnesses will come about of psychological nature.

Chip under our ears, no phones, no credit cards.

As a body, we will almost be as numbers, and taking, receiving, handling; we will be like a transaction point.

Healthcare will revolutionize. Even today we can care a woman in India through a cell phone from the USA.

Facundo Gareton
Serial entrepreneur, CEO of Terraflos, chairman of Blueberries Medical Corp.

It is difficult to predict with certainty what the future of plant medicine will be in 2050 and beyond, as it will depend on many factors such as advances in technology,

changes in societal attitudes, and the discovery of new plant species. But I'm convinced that the future is in nature, my thesis is that we are on a new revolution that will transform prevailing production methods for food, medicine, and materials based on nature, built on foundational advancements in biochemistry, computing, AI, ecology, synthetic biology, cellular agriculture. I see three core "ecobiotechnologies" (biotechnologies designed to promote environmental goals and circular systems) emerging that could lead to radical socio-economic shifts.

These core "ecobiotechnologies" are:

- Cellular agriculture—production of biomolecules (like proteins) and whole cells (animal and microbial) through fermentation and cell-culture processes
- Biofabrication—manufacturing of materials with biodesign principles (like biomimicry) and leveraging self-assembling qualities of living organisms (like fungal mycelium)
- Bioagronomics—applications of biotechnology (like genetic engineering) and systems-based approaches (like soil microbiome) to agriculture, includes crop optimization for novel applications and plant molecular farming

The result of this revolution will be (1) no longer using animals to produce food, materials, and medicines, (2) decoupling economic growth from carbon emissions, and (3) commercial models built on principles of industrial ecology. In this context, the use of AI can help speed up the development in different areas related to the drug development process and reduce the costs associated with identifying and developing new plant-based drugs.

There are several ways that AI can assist in the development of plant-based drugs:

Data analysis: AI can be used to analyze large datasets of plant chemical compositions and biological activities, which can help identify potential plant-based drugs and predict their effects on the human body.

Lead compound identification: AI can be used to identify the most promising plant-derived compounds for further development as drugs, based on their chemical structure and biological activity.

Drug development: AI can be used to optimize the chemical structure of plant-derived compounds to improve their effectiveness and reduce their toxicity.

Clinical trial design: AI can be used to identify the most appropriate patient populations and dosage regimens for clinical trials of plant-based drugs.

In this context, it is possible that plant medicine will continue to play a significant role in healthcare, particularly in the areas of traditional and complementary medicine. Many plant-derived substances have been used for medicinal purposes for centuries and continue to be researched for their potential health benefits.

It is also likely that advances in technology and research will lead to the development of new plant-derived medications and treatments. Overall, the intersection of technology and nature is really promissory.

Soulaima Gourani
Entrepreneur, author, and keynote speaker; CEO and co-founder of Happioh

I believe it to be a certainty that people in Western countries will live much longer in the next 50 years. In the last 50 years, we have already been able to significantly prolong life as well as cure many life-threatening diseases. We will have found a cure for cancer (but dangerous new diseases will have developed).

In Western countries, we put a lot of focus on public expenditures on healthcare, and therefore, we will invest a lot of resources on the development of products and services that will allow people to check their own health.

In the next 50 years, your home will be able to check your health. Fever scanners will be installed in the front door, and every time you go to the lavatory, your excrement will be scanned for diseases—this way, you will be alerted of any sudden development before your doctor. Also, your toilet will warn you to be careful not to consume too much unhealthy food because you are at risk of developing diabetes.

Some researchers claim that in 2025–2030 life expectancy will increase faster than we age. This is primarily because biotechnology can significantly slow down the aging process, deactivate harmful genes, and activate positive ones.

Christoph Holz
Keynote speaker, Digitalization

Can you imagine a most dangerous place in the western world than a hospital? The concept was invented by Florence Nightingale in the middle of the nineteenth century as a surveillance system, decades before the concept of privacy was even conceived. In 2050, the stern eye of a nurse is no longer responsible for surveillance, but dozens of sensors on and in the body.

Mobile operating rooms on trucks have long been reality in war zones. In a few years, they will be deployed in rural areas by successors like Toyota's autonomous e-Palette vehicles. After all, cities will hardly exist anymore. These vehicles have enough space for a small version of the Da Vinci surgical robot, which has long since learned to perform operations itself. It parks at the family doctor's, who observes my prostate surgery, and then sends me home with a nursing robot. Aging in dignity is inconceivable without care robots anyway. In 2050 research will have moved on to quantum computers. The old centralized health factories of the industrial age will not only be too expensive to sustain, but also ethically questionable.

Robert Krotzer
City councilor of Graz, Austria, for Health and Care

Health and care facilities are public and free for everybody.

Tristan Lecomte
Chief executive officer, Pur Projet

More and more we will use natural remedies by using science to observe nature. We will be using more natural plants to cure diseases, instead of chemical drugs.

We will also go back to nature in health, education, energy, etc. If not as a species we will destroy ourselves by destroying our ecosystem. It is just the law of nature.

We have started to see this (environmental degradation, pollution, etc.), and if in 50 years from now no change happens, our life on Earth as humans will not be viable anymore.

We need to use technology to understand this and make a change in all the sectors or otherwise we will not be there. Game-changing future innovations in health will include toilettes analyzing what we ate and advising us on our health, telling us to go back to eating natural products.

Elisha London
Founder, United for Global Mental Health, and founder and CEO, Prospira Global

We know that money can be a key source of stress for many people and that people living with unreasonable debt are more likely to be depressed, anxious, or consider suicide. By 2050 I see we have two options. One path is that our world does not deliver upon commitments to improve inequality and financial inclusion in line with the Sustainable Development Goals. Without this progress, these social determinants of mental health and well-being will continue to put pressure on the global mental health crisis. Alternatively, if progress is made to reduce poverty and inequality and improve financial inclusion, this will make a positive contribution to the mental health of our world.

Bob Macmahon
International affairs journalist; managing editor, Foreign Affairs Magazine, Council on Foreign Relations

I would expect skin transformation to keep young or a pill allowing us to live longer.

Martin Müller
Executive director, Academic Forum, GEneva Science and Diplomacy Anticipator (GESDA)

Personalization of everything is the most amazing trend. The personalization of your digital experience, your health, your food. With technological advancements everything will be tailored, like the medicine you take, your therapies, food you need to eat. Think of healthcare as a Netflix subscription, where on a monthly basis you pay your premium and receive your therapies to keep you in good health and prevent diseases.

Tolullah Oni
Public health physician scientist, urban epidemiologist, University of Cambridge

The future of healthcare is health beyond healthcare. We have long known that the majority of factors that influence health lie outside healthcare. So I see a future where a wide range of sectors such as transport and urban planning work purposefully to create and preserve health, working closely with the healthcare sector to optimize population health for all. Accordingly, the definition of health professionals

would be widened to include diverse actors from city mayors and urban planners to architects and farmers. Critically these health-centric endeavors would seek to reduce health inequities by ensuring healthy infrastructure benefits those most in need.

Bjarte Reve
Partner Considium Consulting Group AS; CEO, Nansen Neuroscience Network

From 2050 and beyond we have an equitable healthcare system where personalized treatment, shared decision-making, and good communication between clinician and patient is the norm.

Caroline Schober
Vice rector of Research and International Affairs at Med Uni Graz

Sensors checking vital and blood parameters on and inside our body and in our environment will double up with genetic information and past medical history to monitor and predict our health status 24/7. We will be nudged (or more than that) to lead a healthier lifestyle, be sent personalized medication automatically, or will be called in for an appointment with the appropriate physician. This will all feel natural to us. But we will still be human beings—more than just our biology translated into parameters and bits. We can only feel healthy if we are seen and treated as individuals with a psyche, a soul, and social needs.

Ivan Vatchkov
Founder and CEO of Kalibra.ai

The future of health will depend on how we change the user experience towards personalization, continuous preventive care, and seamless 24/7 diagnostics with ambient technology.

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Future of Energy

Sangeeth Varghese

Abstract

The energy sector accounts for three-quarters of greenhouse gas emissions presently, and consequently, efforts to mitigate the consequences of climate change rely massively on improving the condition of our energy consumption, production and transportation. Some of the broad trends that are predicted to realize by 2050 include the global energy demand to continue rising at an average annual growth rate to 2% with most of the increased demand coming from South Asian and African countries which experience significant economic growth during these three decades. Most of the increased demand of energy will be in the form of electricity, and efficiency in electricity production, storage and transportation will become absolutely crucial. Almost 77% of new energy demand is predicted to be met using solar and wind energy production, with some help from biofuels and nuclear energy. The realization of a net-zero future requires the adding capacity for 630 GW of solar power and 390 GW of wind power generation every year, mass electrification of vehicles to increase electric vehicles' share of global sales from around 5% presently to 60% by 2050, and significant improvement in energy storage and transmission.

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Tristan Lecomte
Mark Turrell

"A nation that can't control its energy sources can't control its fuutre".—Barack Obama

1 Introduction

The energy sector accounts for three-quarters of greenhouse gas emissions presently, and consequently, efforts to mitigate the consequences of climate change rely massively on improving the condition of our energy consumption, production and transportation. While many declarations for net-zero futures have been made, it requires a lot of efforts at a global level to actually achieve that target. When we aggregate all the countries who have pledged to reach net-zero emission futures, it accounts for almost 70% of the world's carbon dioxide emissions. Even current pledges are not enough for global net-zero emissions, and it would require a lot of political will and policy nous to reach that target. People will be key stakeholders in this process as a lot of hope of a sustainable future also relies on consumer choices and behavioural decisions such as purchasing electric vehicles, installing energy-efficient technologies in households, using small solar power panels for sustainable energy production, and using sustainable means of transport like walking, cycling, or public transportation.

When we talk of a net-zero future, one thing is clear, it will have to primarily be a result of better sources of energy and better usage of energy. The amount of energy required for the future is very unlikely to reduce; indeed most experts agree that the world will continue needing more of it. As developing and underdeveloped countries experience economic progress, their energy demands will move closer to that of developed countries right now. The developed countries on the other hand are unlikely to reduce their energy consumption, with the best hopes being that their demand stabilizes. In addition, population growth is bound to keep increasing energy demand. The world population is predicted to stabilize around 10 billion eventually, and till 2050, it is bound to keep increasing. Consequently, both the gross consumption of energy and per capita consumption of energy will increase across the world. This makes it necessary for us to find cleaner sources of energy, as well as create technologies which are more efficient at using that energy with minimal wastage, in order for us to reduce the resources required to support the planet's energy needs. In that context, we consider some of the broad trends that will move us towards a net-zero future. This includes the trends in global demand of energy, existing patterns of movement towards sustainable energy and predictions of their preponderance by 2050, and plausible improvements in technology that make energy consumption more efficient. These predictions are based on current and historical trends and are therefore always suscept to massive and unexpected disruptions, technological or demographic, which can never be ruled out as a part of human history and future. However, these provide benchmark models that help understand

the current trajectory of the world and the possibility of reaching a net-zero world by 2050.

Some of the broad trends that are predicted to realize by 2050 are listed below. The extent to which these developments and technologies become widespread by then will determine how close the world reaches to a net-zero target, with the most optimistic scenario of fully achieving it not being completely unrealistic and more realistic scenarios also managing to make significant progress towards clean energy.

- Global energy demand will continue rising at an average annual growth rate to 2% with most of the increased demand coming from South Asian and African countries which experience significant economic growth during these three decades.
- Population growth and economic growth in non-Organization for Economic Co-operation and Development (OECD) countries will mean that their share of global energy demand and global GDP begins reflecting their share of world population better, whereas the OECD countries are overrepresented in these metrics right now.
- Most of the increased demand of energy will be in the form of electricity, and efficiency in electricity production, storage and transportation will become absolutely crucial.
- Almost 77% of new energy demand is predicted to be met using solar and wind energy production, with some help from biofuels and nuclear energy.
- Even in the baseline, non-optimistic scenarios of things continuing mostly as they are, renewable energy is predicted to account for 27% of the world's energy consumption in 2050, primarily driven by governmental policies and technological innovations.
- Without significant leaps in clean energy production, storage and transmission, natural gas will retain its share in energy usage due to its lower relative price compared to renewable energy technology and its stability which means weather patterns cannot cause disruptions in its supply.
- The realization of a net-zero future requires the adding capacity for 630 GW of solar power and 390 GW of wind power generation every year, mass electrification of vehicles to increase electric vehicles' share of global sales from around 5% presently to 60% by 2050 and significant improvement in energy storage and transmission.
- Specifically, development of long-duration energy storage technologies is crucial to make solar and wind power stable sources of energy which are not massively disrupted by weather patterns. Developing extensive power grids that cover large areas will also be necessary to ensure regions can substitute for each other in power production.
- Carbon capture, storage and use technologies will be very important and promoted through government taxation, in order to get private industries to also adopt them.

2 Global Energy Demand in 2050

Global energy demand is bound to continue growing; however, McKinsey predicts that the growth will not be as rapid as it has been during the last 15–20 years when energy demand grew at an average of 2%. The major factors that will contribute to slowing down the growth will be that population growth will also be much slower, and global economic growth will stagnate and mainly be concentrated in a few non-OECD countries. Another crucial part of slower growth in energy demand will be the preponderance of the service industry. In most countries, services are becoming the most prominent part of the economy already, and a continuation of this trend would mean countries extracting most of their GDP from services rather than industry. This helps temper energy consumption because industries are the most energy-consuming parts of the economy, while services only come in second.

The average estimates of energy demand growth put it at around 0.7%, which is much slower than historic trends but is also expected given that is it simply not feasible for global energy demand to keep growing linearly. The World Energy Council estimates that global total energy primary supply increased 45% between 1990 and 2010, when it was 546 exajoules. Further progress meant that it grew 6% to 581 in 2019 before crashing due to the coronavirus pandemic in 2020. However, slower growth in energy consumption is already happening, and the World Energy Council predicts it will increase to 879 exajoules if driven purely by market forces and to 696 exajoules if driven mainly by social planning. Consequently, the actual figure is likely to lie between these two extremes as social planning for energy consumption becomes more and more important yet does not substitute market forces entirely.

The main driver of growing energy consumption by 2050 is inevitably going to be regional economic growth. The US Energy Information Administration (IEA) estimates that non-OECD countries in Asia will be the most rapidly progressing nations led by India, whose growth is purported to be the greatest. Beyond India, the rest of non-OECD Asia including China, as well as African countries, will be leaders of economic growth. China's growth is bound to slow from the current rates, but nonetheless, it will maintain a healthy growth lead over OECD countries with saturated economies. These areas already account for almost 70% of the world's population while only making up for 44% of its GDP in 2020. The future will see convergence in these figures with the population share slightly growing to 73% but GDP share increasing significantly to 59% of the world's GDP, more in line with their population share. While the share of OECD countries' energy usage has been much higher than their population historically, this trend will change, and non-OECD countries' energy consumption will come to represent their share of the world population in the future.

Within Asia, India is supposed to make up for most of the economic growth as it reaps dividends of its young demographics and human capital, while current high-growth countries like China witness their growth slowing down in line with the development experiences of the West. Similarly, more advanced Asian economies like Japan and South Korea will also demonstrate slow economic growth, with Japan

particularly struggling to deal with an aging population using technological interventions. The pandemic has already begun processes of companies diversifying their supply chains so as to not be wholly reliant on China. These trends will become more prominent as the preponderance of Chinese goods reduces with other lower-income countries like Vietnam, Mexico, Bangladesh and China filling in for the gap.

Sectoral analysis shows that demand for electricity will grow twice as fast as that for transport with the two biggest economic gainers, India and China, making up for 71% of new capacities. McKinsey predicts that electricity will account for 25% of all energy demanded by 2050 while right now that figure stands at 18%. The trends so far show that the future increase in energy demand will primarily come from electricity demand rather than petroleum demand. Petroleum demand increase will mainly be industrial, and transportation-related, sectors which are invariably somewhat dependent on petroleum-related energy. However, much of residential and commercial energy demand will come from electricity, which is a considerable opportunity as renewable energy sources can possibly substitute for fossil fuels in satisfying this demand.

3 Sources of Energy by 2050: Baseline Scenario

The future is predicted to be increasingly powered by renewable energy, but the extent to which renewable energy takes over from fossil fuels remains to be seen. There are many different estimates and cases for what could happen, but even the most optimistic cases do not completely rule out the use of coal and natural gas, which might remain necessities in some industries. Nonetheless, McKinsey predicts that 77% of the world's new capacity for energy generation will come from solar and wind energy, a further 13% from natural gas which has grown in importance over the last five to six decades, and the shares of nuclear and hydro energy will also modestly increase. Though the share of oil in the world's energy generation has not increased substantially over the last few decades, but that of natural gas and coal have increased substantially, natural gas reserves are still being discovered so it remains quite likely that it will account for more and more of future production of energy, as McKinsey predicts. However, coal's growth is likely to be constrained by the implausibility of finding large amounts of new coal reserves with many countries like India and China already experiencing coal production crisis. One of the other reasons for coal's share of energy to fall will be its vulnerability to climate change-related stressors such as erratic weather patterns which can significantly disrupt coal production processes. Hydro, solar and wind still account for very little of the world's energy production which is a trend that will change in the future as growth of renewable energy becomes exponential rather than incremental.

When it comes to the profile of global energy generation in 2050, there are many different estimates ranging from very hopeful to dire. One of the less optimistic, yet perhaps realistic, predictions come from the IEA's analysis of current trends continuing without major disruptions. They predict that while the share of renewables will more than double in the next three decades, it will grow to substitute

the share of production that is presently dependent on coal, with petroleum retaining its importance as a global energy consumption source and natural gas and nuclear energy also increasing to a certain degree. While it is encouraging that the only significant growth is being done by renewable energy, the crucial challenge remains according to IEA's analysis, that the amount of energy required from petroleum and natural gas will slightly increase. This causes two major challenges for the world: these sources are major contributors to climate change and global warming and continued use of them without significant improvements in efficiency of production and consumption could lead to disastrous outcomes for the climate, and the total stock of these resources available to us is limited and the only way to make it last sustainably is to reduce its consumption which is unlikely to happen.

IEA's analysis argues that renewable energy will account for 27% of the world's energy consumption in 2050, driven mainly by governmental policies that promote renewable energy sources as well as technological innovations in this space. On the other hand, natural gas is predicted to almost retain its share in energy use, mainly because the IEA argues that lower relative prices of natural gas compared to renewable energy, as well as its stability which allows it to be a backup supplier of energy to the more erratically available renewable sources, will drive its demand in the future. On the other hand, petroleum and liquid fuel will retain its share of energy consumption mainly through industry rather than residential demand. The transport energy still remains significantly dependent on liquid fuels, and areas like aviation and shipping are still some ways from discovering feasible alternatives. Additionally, the production of chemical fertilizers and feedstocks also depends on industrial petroleum usage, and this demand is unlikely to decline in the near future.

4 Sources of Energy by 2050: Optimistic Scenarios

However, the business-as-usual prediction by the IEA is not the only analysis by any means. There are many other reports and papers that take different scenarios of technological innovation, global cooperation and social initiatives towards renewable energy, to come up with different predictions for the future. Researchers from Stanford collated 47 different peer-reviewed research papers by 91 authors from across the world which analysed country-specific or region-specific scenarios for whether it is possible to rely entirely on renewable energy in the future by 2050. Their conclusion broadly was that across various scenarios and geographies, it is possible for the world to supply energy reliably using 100%, or at least very close to 100%, renewable energy. Certainly, these scenarios involve a lot of cooperation, technological innovation and political will at the national and international level to be executed. Nonetheless, it offers a glimpse of the best-case scenarios which remain achievable with sufficient coordination. The report argues that Green New Deal roadmaps for 143 countries which account for 99.7% of the world's population are feasible and the progress under them can be rapid enough that 80% of the world's energy is renewable by 2030 itself. Such scenarios also have very positive health

externalities as it could eliminate the 4–7 million deaths that occur worldwide every year due to pollution and climate change.

The researchers from Stanford divided the earth into 24 broad regions, with the idea that every region can work on large energy grids that would stretch across countries and ensure that if one part of the grid is experiencing insufficient renewable energy production, another part will be able to compensate for it. Creating large enough grids provides implicit insurance against shocks to renewable energy production in one area because there would be some parts of the grid at least which are not affected. Even countries in the Middle East, which are currently famously reliant on their fossil fuel stocks, have massive potential to switch completely to renewable energy, as they have massive potential of harnessing solar power. One of the major challenges to renewable energy right now, which the World Economic Forum's analysis agrees with, is that the erratic and unstable nature of renewable energy production makes it necessary to rely on energy storage to smoothen out the supply of energy across days, weeks or even months.

A similar analysis, carried out with an optimistic outlook, is IEA's attempt to analyse the policies and innovations required to reach a net-zero future by 2050. Their report recognizes the difficult challenge of reaching net-zero emissions but argues that with enough political will and appropriate policy decisions, it is possible to reach that target. Technological innovations are at the core of any push towards a net-zero future, as major improvements in energy storage technology, transmission grids and energy efficiency are needed. Electricity needs to become the medium through which the world interacts with energy as it remains the most feasible route through which human demands can be met using sustainable resources. Solar and wind energy needs to be ramped up massively, with IEA estimating that the world needs to add capacity for 630 gigawatts of solar photovoltaic power and 390 gigawatts of wind power generation every year till 2030. Electrification is also crucial in that electric vehicles must become preponderant and industries which rely on fossil fuels need to shift to electric energy inputs. The only caveat will remain with respect to chemical manufacturing industries that rely on petroleum for which substitutes can be found through synthetic materials, but the plausibility of that remains uncertain. Electric vehicles make up for around 5% of global vehicle sales and need to be pushed to at least 60% of annual vehicle sales by 2030. Right now, electric vehicles account for less than 1% of total vehicles. Given the average life cycles of vehicles, it is imperative that a majority of vehicles purchased post 2025 need to be electric, with near universal adoption by 2050. This also depends on improving charging networks to make charging stations available across every country and region, and further, it is important for battery technologies to evolve enough to sustain long-distance travels on single charges. We discuss these and other technological innovations that are necessary for a sustainable future in the next section.

5 Technological Progress for a Net-Zero Future

The question of how far the world can move towards a net-zero reality by 2050 is effectively a question of how far can innovation and technological progress take us? The evolution of power storage and distribution mechanisms, efficiency of energy consumption systems and utilizing our emissions to generate power are all pieces of the puzzle that unlocks a net-zero reality. Some of these innovations are things we are already aware of and are working towards achieving. Certainly, human innovation is boundless, and it is entirely plausible that the innovations of the next few decades far exceed our imagination. This section mainly presents a brief review of the technological progress already being made and what it could mean for sustainable energy.

5.1 Long-Duration Energy Storage

Long-duration energy storage is one of the crucial parts of the puzzle towards shifting energy usage to renewable resources. The major sources of renewable energy are solar and wind energy which are by definition irregular and erratic. Wind and solar energy production happen sporadically through the day and are also often localized in specific regions. Consequently, for any country or region, it is important to have energy storage which can conserve energy for a long period such that it can be produced in large quantities whenever solar and wind power are available and then slowly released for public consumption. For renewable energy to succeed, it is crucial to develop long-duration energy storage technologies and markets alongside it. In that regard, government intervention to ensure that both energy production and storage progress together is essential. These energy storage systems have the purpose of storing large amounts of energy for long durations of times, up to a few weeks at least. While demand for energy is relatively stable across days sand weeks, with some changes associated with winter and summer cycles, the production of energy from solar and wind resources significantly varies according to weather conditions and climactic conditions. There is already significant progress being made in this regard as capacity for more than 5 gigawatts and 65 gigawatt hours has already been developed and made operational.

In the long term, however, much progress remains to be made. The energy storage capacities will have to increase to 1.5 to 2.5 terawatts of capacity, or 85 to 140 terawatt-hours such that it can create a buffer of at least 10% of global electricity consumption. Consequently, this would also require trillions of dollars in investment, from the private or public sector. At the same time, it also helps avoid many gigatons of excess carbon dioxide and other greenhouse gases being released into the atmosphere, with estimates ranging between 1.5 and 2.3 gigatons. McKinsey estimates that in the United States, these long-duration energy storage systems could reduce the costs associated with decarbonizing power systems by $35 billion every year. Once deployed, the running costs for these systems are fairly low as they are scalable, and the main costs are the initial investment into developing and

deploying of new storage facilities. Higher adoption of renewable energy will increase the demand for long-duration energy systems, and their deployment will in turn reduce the costs associated with renewable electricity as well as make its delivery more efficient. Consequently, government policy must promote innovation of long-duration energy storage (LDES) systems such that when renewable energy production scales up, the complementary technologies are available to facilitate its efficient delivery. United Kingdom's government has already launched a $100 million LDES demonstration competition, while in the United States, a $1 billion program is working to reduce costs of LDES systems. Such initiatives are required at a global scale, and whenever a country makes breakthroughs, it is crucial to enable international adoption of those technologies in order to reach decarbonization goals.

5.2 Distributed Variable Generation of Energy

A related technological innovation to long-duration energy storage is developing grids across large expanses of land which can facilitate distributed variable generation of energy such that areas which have more energy generation at one point can transmit it to other areas, with the idea that at least some part of the grid will be able to produce power at any given point of time. Power grids right now are very localized and do not spread over countries or regions, which limits the ability for one part of the grid to compensate other parts where production is lower. Further, power generation from solar and wind can often exceed the capacity of networks to carry the energy to areas where it is being demanded, leading to wastage. Larger power grids will enable energy to be distributed efficiently and smoothly and enable creation of local marketplaces where resources can be effectively utilized, and energy can be traded. Data farming technologies can streamline the process of developing distributed energy generation maps and patterns by simulating various scenarios. Large-scale simulations can help identify key vulnerabilities of any power grids, as well as the optimum size and scale of power grids which will help prevent complete shutdown of energy generation in the grid, while ensuring the size is not too large such that even one part of the grid can power the entire grid in times of crisis. Such simulations can also help determine the parts of the grid which are most vulnerable, and those which are most reliable, using historical data about weather and wind patterns. Data farming is already being used to simulate climate change scenarios and similar models can be adapted to test optimum policies for distributed variable energy generation. The upgradation of power grids is, in many ways, an extremely urgent matter because it can take decades for the complete grid to be overhauled and upgraded.

5.3 Carbon Capture and Storage Technologies

Carbon capture and storage is considered to be a very important part of limiting global warming and having net-zero emissions worldwide. The specific policies and

technologies which are used for carbon capturing will need to be localized according to specific geographical demands including terrains, altitudes, and weather patterns. It essentially involves capturing atmospheric carbon dioxide, or more commonly, carbon dioxide being released by various combustion and energy consumption processes, such that it can be converted to other productive uses later rather than letting it join the atmosphere. Alternatively, carbon capturing can also lead to carbon storage in underground facilities to simply prevent it from escaping into the atmosphere. Already in 2020, it has been used to capture approximately 40 million tonnes of carbon dioxide globally, but it needs to scale up by around 100 times by 2050 to help achieve decarbonization and net-zero emission targets. Some of the important developments needed by 2050 are development of low-cost power generation technologies that utilize carbon capture, prices of carbon dioxide be sufficiently high to justify the costs associated with capturing and transporting it, both industry and electricity generation using carbon dioxide such that the economies of scale can help reduce associated costs while increasing interlinkages and efficiency of usage. Carbon capture systems have immense potential as they can capture up to 80–90% of the carbon dioxide emissions from thermal power plants, and even though the energy system benefits might be small, there will be significant benefits when it comes to mitigating global warming. This is one area where private mechanisms are very unlikely to yield desired results. Government intervention can be subtle; even by simply creating a carbon tax for carbon dioxide released into the atmosphere can be used to encourage industries to use carbon capture technologies. More direct interventions like investing into carbon capture technologies and publicly funded carbon capture systems are also possibly useful policies.

5.4 Evolution of Batteries

When we talk about electrification of households, cars and industries, a major component of that is also upgrading batteries such that their capacities are sufficient for our needs. Modern-day batteries are themselves innovations but still require a lot of volume for storing energy. One major problem with existing electric cars is also that battery capacities are not sufficient for these cars to travel long distances, and they require regular charging. To that effect, battery innovation is a key facet of electric car manufacturing and has gotten a lot of attention. Buses are already running in European cities like Glasgow fueled by batteries but adapting that for large-scale consumer vehicles requires making high-capacity batteries much more compact. Battery innovations already being worked on include faster charging, more capacity and longer lives and this trend is encouraging, and with decent, very plausible progress, the future of transportation is one of electric vehicles powered by high-capacity, fast-charging electrical batteries. In laboratory settings, many successful innovations already exist like “solid-state” lithium-ion batteries which can shrink battery sizes while maintaining capacities by replacing liquid electrolytes with solid electrolytes and exploring the possibility of batteries made of alternatives apart from lithium-ion.

Another evolution that is crucial for the feasibility of widespread use of electric vehicles is the development of charging stations placed at reasonable distances from each other. Vehicles themselves would have to be fitted with smart technology that can analyse the distance it can travel before needing a recharge and the closest recharge points available for use. Additionally, the network of charging points will itself require a very large power grid that covers every part of every country, with no exceptions. Right now, many parts of the world have very erratic access to electricity, or no access at all. To make electric vehicles feasible, it is necessary that power grids themselves become ubiquitous and cover every part of the country. This will in turn also allow for more regular charging stations, which can also practically be much smaller than an average gas station as they require lesser space as they no longer need to store large amounts of petroleum products underground and can simply tap into running power lines and, with a simple charging converter, be ready for use. Further, these charging points will also be fully automated, perhaps powered by smartphones, or simply through unique IDs attached to vehicles such that there is no need to deploy people or cash collection systems. This will reduce costs significantly and also make it much more feasible to have such charging stations in the remotest parts of the country where they remain available for use without needing anyone to constantly guard them. The future of refueling electric vehicles, therefore, is one of automation and ubiquitous availability.

5.5 Hyperlocal Energy Production

While storing and transporting energy across regions, countries and large power grids will be crucial, another aspect that is necessary for sustainable development of energy use is also localized energy productions. High energy density solar panels are already being used in many parts of the world and can be used to produce on-site energy for various building compounds, hotels, hospitals, manufacturing units, industrial units and so on. Replacing traditional solar panels with high energy density panels can allow for much higher production such that these institutions are able to create their own energy to a certain extent, with power gridlines working to supplement local energy creation, especially when local conditions are not amenable to solar or wind energy. Places like manufacturing units also emanate a lot of heat which can itself be harnessed to create energy, as a method of recycling by-products of energy usage for more energy creation. This process of reducing heat wastage has immense potential to create somewhat self-sufficient industrial units and entities.

5.6 Moore's Law for Clean Technology?

In 1965, Gordon Moore, the co-founder of Intel and Fairchild Semiconductor, posited that the number of transistors on a microchip will double every year, and more than five decades later, that proposition still holds true, and technology has

seen exponential improvements, driven in a large part by the increasing power and efficiency of microchips. When it comes to clean technology, while one aspect of the so-called 'Moore's law' has held and growth has been strong and sustained, it has by no means been as large or exponential as in the case of semiconductors. While transistor technology has seen improvements of almost 40% every year, for clean energy, it has lingered around just 8–9% even though the first silicon solar panels were introduced more than 50 years ago and have been around just longer than Moore's prediction.

The reasons for Moore's law to not hold for clean technology are many, but the major simple cause is because clean energy technology including storage and solar panels does not have the characteristics which made Moore's law pertinent. Semiconductors in microchips were only bound by human lithographic technology and always had the potential of being made smaller and closer to each other, in order to reduce the size required for a particular level of computing. As we got better at creating microchips, they could become more powerful and smaller all the time. On the other hand, batteries are restricted by the fact that they require ions to transfer charge, which are often larger than electrons and require more space. While microchip technology improvements were linear in a sense in that they kept making the chips smaller by making the transistors smaller, reducing gaps between them and so on, clean energy technology often requires new materials and technologies entirely in order to progress. The current battery technology is limited by the chemical processes that underlie the transmission of energy, and a more efficient or smaller battery would require a completely new chemical process to support it. This is one other reason why progress in battery technology has been much slower than what was observed for semiconductors.

Another crucial reason why progress in clean energy technology has been slower is that for most part of the last 50 years, it has had very little funding and the focus has not been put on improving these technologies. Progress in clean energy technology often comes from experience, as more and more production leads to better understanding of the technology and where it can be made more efficient. As the world looks towards clean energy to fight climate change and build a more sustainable future, more funds will be pumped into research and development, and the industry will also gain more experience in building storage and production technologies for clean energy. These are bound to give results, and we are likely to see improved growth in the future, albeit it might still not be exponential in the way Moore predicted. Efforts in this regard are already underway, with one such example being the Joint Centre for Energy Storage Research, which aims to improve energy storage density by five times, and also bring down costs by a factor of five. These efforts, powered by public funding, underline the hopes for the future of clean energy technology.

6 Policy Pathway to a Net-Zero Reality

The target to achieve net-zero emissions of greenhouse gases by 2050 is consistent with one of the most pressing global challenges, limiting global temperature rise to 1.5 °C. It would require significant increases in clean energy adoption and ambitions from what has currently been declared by carious governments. Carbon emissions need to fall by at least 40% in the next 10 years to have hope for a completely net-zero emission reality by 2050. All of this will need to be achieved in the face of a doubling of the global GDP and an increase of 25–30% in the world's population by almost 2 billion. The use of coal, oil and other fossil fuels will have to be reduced by at least 90% in the case of coal and 55% for natural gas in order to have emissions which can sustainably be captured and now allowed to become greenhouse gases. Major technological innovations are needed for clean energy production, storage and transmission. Consequently, investment in the energy sector will also need to be at least doubled in the next 10 years and then should keep growing sustainably till 2050. The transition to clean energy is also necessarily a matter of behavioural change as people need to adopt more sustainable practices, and the availability of clean energy is very much dependent on technological changes. Failure in these aspects would make it extremely difficult to achieve a net-zero emission future. Even the most optimistic scenarios do not envision a future with zero use of fossil fuels, and so carbon capture systems would also be essential to ensure that their emissions are managed sustainably and not released. Effectively, while the current trajectory of the world is not headed for a net-zero future, there is still some hope in that the pledges announced by governments are much closer to that reality, and if policymaking can adroitly guide the world towards those pledges, it is not completely unconceivable that the future of the world is one of net-zero greenhouse gas emissions.

Many countries have already declared long-term net-zero greenhouse gas emission target. The countries which have pledged net-zero emissions already make up for almost 70% of global GDP and carbon dioxide emissions. The challenge is translating pledges into proper domestic and international policy, as only a quarter of the countries with net-zero pledges have incorporated their commitment into domestic legislation. If the world were to only follow current policies with no enhancement, it would lead to annual carbon dioxide emissions rising from 34 gigatons to 36 gigatons by 2030 and then remaining stable at that level till 2050. This would be consistent with a global temperature rise of around 2.7 °C by 2100 and is mainly a consequence of relatively less predicted adoption of clean energy according to already stated national policies. However, if we consider the pledges made by global governments and assume that they will be fulfilled through proper policymaking, the global carbon dioxide emissions are stated to fall to 30 gigatons by 2030 and 22 gigatons in 2050, with renewable energy making up for 70% of global energy production by 2050. The main challenge for clean energy still is rapid development such that it can replace coal, oil and other fossil fuels. Nuclear, hydrogen, bioenergy, solar and wind will all play a role in various parts of the world depending on local resource availability and needs. While the current net-zero pledges are encouraging

in that they will almost be sufficient to reach a net-zero reality, there is much work that remains to be done in policymaking to ensure that these pledges become realities. This will include policies to encourage rapid evolution of current power grids, coupled with the use of big data to monitor and manage them, such that their storage and transmission capabilities are sufficiently flexible in both supply and demand of energy. Further, while vehicles will somewhat naturally be replaced, old infrastructure, buildings and equipment will need to be replaced or retrofit with more efficient energy technology to prevent loss of energy due to inefficient technologies. The markets should be encouraged to adopt clean energy through interventions like nudge-based taxation, providing common networks and public infrastructure that reduces costs of clean technology like carbon capture and creating new markets for things like resilient, clean energy power grids. It is absolutely crucial that governments begin putting in a lot of funds into revamping their power grids immediately because while the development of clean energy is happening through the private market, efficient mechanisms to transmit and store clean energy are not aspects private markets can address or are currently working on.

7 Input from Interviewees

Asanga Abeyagoonasekera
Foreign policy specialist; founding director general of the Institute of National Security Studies Sri Lanka

New technology and new inventions for extractions will impact the future of energy, while figuring out how to protect ocean and other natural resources.

Magnus Brunner
Austrian Minister of Finance

Thanks to investments in clean solutions as well as breakthrough technologies by innovative companies and not to say the least, thanks to the unprecedented cooperation between politics, businesses and the wider population, we successfully managed to drastically reduce our CO_2 emissions while simultaneously increasing our prosperity and quality of life.

Furthermore, an intact environment and an innovative economy were achieved through market-based incentives and technology rather than prohibitions. The Republic of Austria also contributed to redirecting money towards climate-friendly investments not only by the regulative framework, but also by switching to and issuing green bonds and green loans. Nobody was left behind. Thus, the acceptance among the population for the transformation towards a climate-neutral future was and remains high.

Renewable energy has replaced fossil fuels; hydrogen, electricity and synthetic fuels gradually drove out petrol and diesel; and our industry competitively produces goods that are in demand worldwide, as all regions attempt to achieve the goals set out by the Paris Agreement. The ‘Energiewende’ as we often call it even in English, or perhaps more strikingly, the low-carbon energy transformation was a central

challenge for the Austrian society and our economic system in particular – and while it was challenging, it was a tremendous success story and both humankind and our planet benefit from it.

Soulaima Gourani
Entrepreneur, author and keynote speaker; CEO and co-founder of Happioh

Green growth societies will become a reality in many countries. A lot of countries will aim to become independent from wooden fuel, coal, oil and gas. One of the biggest changes is that big cities will grow while small societies will shrink.

Tristan Lecomte
Chief executive officer, Pur Projet

One invention that I want to see in 50 years is new source of energy—new fuel, like water for cars.

Mark Turrell
Strategist, educator, entrepreneur; founder and CEO of Orasci

Technology is developing in such a pace that new energy sources will always be found. Just look at computer history: magnetic storage, modems in 1980s. Storage of data has been growing exponentially. We are used to do what we used to do.

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Future of Climate Change

Sangeeth Varghese

Abstract

Climate change and global warming are civilizational threats to human existence on Earth and need to be addressed immediately. The impacts of climate change are bound to be widespread, impacting every part of human life and the planet's functioning. Climate change disbalances global climate systems by altering pressure areas, temperatures and wind patterns which has many knock-on effects for climactic conditions and weather patterns across the world. In this book, we are predicting that global warming will most likely be limited to 1.5 °C with a less than 30% chance of overshooting this target. The warming will continue at 0.1–0.3 °C per decade in the next three decades, with the optimum target being 1 °C. The pathway to 1.5 °C warming is one of net-zero emissions by 2050–2055. This makes it necessary for widespread adoption of clean energy through electricity, much higher adoption of electrical vehicles, massive progress in clean energy technology like storage and transportation and mass adoption of carbon capture and use systems. However, 6% of insects, 8% of plants and 4% of vertebrates are predicted to lose their ecosystems and possibly go extinct or have to evolve rapidly. Large-scale climate migration is quite likely with an estimated 216 million people across the world becoming internal climate migrants. The worst affected regions will be North Africa, Sub-Saharan Africa, South Asia and the Pacific.

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Interviewees
Gina Badenoch
Jane Burston
Arturo Condo
Lars Flottrong
Tritan Lecomte
Robert Krotzer
Moran Sol Broza
Barbara Steiner

> 'To all of you who choose to look the other way every day because you seem more frightened of the changes that can prevent catastrophic climate change than the catastrophic climate change itself. Your silence is worst of all'.—Greta Thunberg

1 Introduction

Climate change and global warming are civilizational threats to human existence on Earth and need to be addressed immediately. Many consider that climate change is already a full-blown crisis, and things are dire enough that if action is not taken immediately, there would be no coming back from the consequences. In that regard, international-level coordination and action is already underway as many countries have announced net-zero pledges and actions like the COP-26 or the Glasgow Climate Change Conference reinforced the global understanding that climate change is an urgent concern, and if appropriate steps are not taken immediately, by the time the dire consequences affect the world, we will not be able to do anything to stop them.

The impacts of climate change are bound to be widespread, impacting every part of human life and the planet's functioning. Climate change disbalances global climate systems by altering pressure areas, temperatures and wind patterns which has many knock-on effects for climactic conditions and weather patterns across the world. Further, disbalanced ecosystems due to warmer temperatures, more saline water intrusion and the extinction of species which cannot adapt to climate change will result in the transformation of ecosystems across the world ranging from tundra and permafrost ecosystems in Siberia to tropical rainforest systems of the Amazon basin. They will all look radically different in the next few decades if global warming is not curtailed. For humans, the loss of livelihoods is a major concern and so is internal migration due to climate change. Internal migration can be triggered by a variety of the consequences of climate change, which include coastal areas being flooded, drought conditions in some regions, water scarcity, risks of food insecurity and direct heat stroke-related morbidity concerns.

Across the world, it is understood that the difference between a global warming of 1.5 °C and 2 °C is a civilizational threat as the reality of a 2 °C warming is one which is beset with large-scale disasters, loss of life and an altering of human lives to the

extent that living on Earth will become gradually unsustainable. However, restricting warming to 1.5 °C has potential to maintain human life in an adapted format, which mitigates the risk of climate change. To achieve this, a net-zero emission reality is necessary and must be achieved by 2050, with the maximum limit of 2055, which gives us a two-thirds chance of restricting global warming to the desired limits. The changes that we are bound to see by 2050 due to climate change are discussed in this report and largely include the following:

- Global warming will most likely be limited to 1.5 °C with a less than 30% chance of overshooting this target. The warming will continue at 0.1–0.3 °C per decade in the next three decades, with the optimum target being 1 °C.
- Human activities like industrialization have been the cause of 1 °C warming above pre-industrial levels in the last century alone. Even after cutting down to net-zero emissions, the accumulated effect of persistent greenhouse gases like carbon dioxide will remain.
- Arctic, Antarctic, Small Island Developing Nations and coastal regions of countries or continents will be the worst affected.
- Warm water coral reefs and fisheries are bound to be severely impacted, while flooding becomes more common both from oceans and internal river systems.
- The pathway to 1.5 °C warming is one of net-zero emissions by 2050–2055. This makes it necessary for widespread adoption of clean energy through electricity, much higher adoption of electrical vehicles, massive progress in clean energy technology like storage and transportation and mass adoption of carbon capture and use systems.
- Mean temperatures of all regions will rise, with extreme hot day temperatures rising by almost 3 °C, while cold nights become warmer by 4 °C. Sea levels will rise to threaten coastal areas with expected sea level rise ranging between 26 and 77 centimetres.
- Globally, 6% of insects, 8% of plants and 4% of vertebrates are predicted to lose their ecosystems and possibly go extinct or have to evolve rapidly. Forest fires will become more frequent, while the threat of zoonotic diseases in humans increases.
- Almost 1.5–2.5 million square kilometres of tundra and permafrost area will thaw, whereas we will lose 70–90% of the global coral reefs. Many species may shift latitudes upwards, especially in marine ecosystems.
- Agriculture will be severely impacted by climate change, as it is one of the major contributors of greenhouse gases, and erratic or extreme weather patterns will severely affect productivity in countries where agriculture is reliant on weather patterns.
- Human dietary patterns would have to become more environmentally conscious by shifting away from ruminant meats to other animal-based meat or the most carbon-efficient plant proteins. Livestock consumption and production will need to be curtailed as that process is a major source of greenhouse gases. Meanwhile, we will need to reduce food waste and loss by at least 50%.

- Large-scale climate migration is quite likely with an estimated 216 million people across the world becoming internal climate migrants. The worst affected regions will be North Africa, Sub-Saharan Africa, South Asia and the Pacific.
- The causes of large-scale migration will include food insecurity, water scarcity and threats of flooding which will become common in coastal areas due to sea level rises.

2 Global Warming of 1.5 Degrees

The most likely scenario of global warming pegs the warming compared to pre-industrial levels at around 1.5–2°C. There are many significant differences in the small range of 0.5-degree celsius extra warming. However, urgent action, as is evident from national policies and international meetings like the COP-26, points to the fact that countries across the world are recognizing the civilizational threat of climate change and are acting to avoid that. The likelier scenario, therefore, is for countries to kick into action and restrict global warming to 1.5°C. However, such warming will not be completely inconsequential either, and while it avoids the worst possible scenarios and worst outcomes, there would still be significant consequences for the world. The Intergovernmental Panel on Climate Change (IPCC) has prepared a special report on the global warming of 1.5°C which envisions a world where climate change is mitigated but the consequences of decades of unabated industrialization are still felt across the world. They find that a warming of 1.5 degrees is significantly better on all accounts than one of 2 degrees, which is not a surprising conclusion given that the effect of even half a degree of warming is extremely large on weather patterns, sea levels and other large geographic phenomenon.

Already, human industrialization has been the reason for almost the 1.0 °C of global warming above the pre-industrial levels, with the range of warming varying between 0.8 °C and 1.2 °C. This is bound to increase to an average of 1.5 °C by 2050 if it continues increasing at the current rate. However, these models are all probabilistic and the more action that is taken, the higher probability we have of restricting warming to 1.5 °C. Even in a no-action taken scenario, there is a very small chance we may end up achieving the target of 1.5 °C warming, and even with all the precautions and actions taken, there is a small chance the warming exceeds that level simply due to the damage we have already caused. Policy pathways, therefore, are somewhat working on maximizing the chances we have of restricting global warming to prescribed targets. Over the past few decades, observations show that human-activity-related global warming has steadily increased by 0.1–0.3 °C per decade, and urgent action is needed to stem that tide and prevent anything more than 0.1 °C of warming per decade for the next few decades, if we are to achieve our targets.

There is also significant variation in how various parts of the earth are affected with the Arctic and Antarctic areas experiencing much higher warming than the global average (by a factor of two or three times) and places closer to the ocean having lesser warming on average than those far away from it. The flipside to this is

obviously that the places closest to the ocean are most vulnerable to global-warming-related rises in sea levels and ocean- or sea-originating natural disasters. The intensity and frequency of extreme weather events have already increased significantly in the last few decades, with higher instances of cyclones, hurricanes, tsunamis, etc. The warming effects of human emissions over the past century or so are unlikely to ever be reserved completely and it is quite plausible that this warming persists for not just centuries, but millennia, and cause persistent changes in climate systems across the world. The effects of past global warming are persistent and permanent in this sense. However, they are also unlikely to push the global warming levels beyond 1.5 °C, which functions well for policymaking as they can focus on mainly preventing current emissions.

One such pathway is reaching a world of net-zero global carbon emissions, which is considered to be a necessary and inevitable destination by the IPCC. The major difference arises in how significantly different the path taken to reach there would be to the present reality and, consequently, how many decades it would take us to reach a net-zero reality. Any delays in that regard add to the warming of the earth, and as we discussed, that would be persistent and permanent for centuries to come. In fact, the best-case scenario possible is for net-zero emissions to be reached by 2040 which would result in a more than 95% chance of restraining global warming to below 1.5 °C, but that remains an unlikely scenario. The more likely result is that we are able to cut down emissions by half till 2030 and then reach net-zero between 2050 and 2055, which is the baseline scenario in which we still have a two-thirds chance of meeting the targeted warming level. However, in the worst-case scenario, if no action were to be taken, it is highly unlikely that the target is reached and a warming level of 2 °C becomes the most likely scenario, which is a dire reality.

In terms of predicted impacts, the predicted risks can vary from high to very high risk for unique and threatened systems like the coral reefs, from moderate to high risk when it comes to extreme weather events which are already being witnessed across the world, from moderate to high risk when it comes to distribution and aggregate scale of global impacts as it is going to a global crisis and again moderate to high risk for large-scale singular events such as tsunamis and floods which can threaten a large number of people at once. Unique systems like coral reefs and the Arctic are bound to be existentially threatened by global warming, while fisheries will understandably be much more severely impacted than terrestrial agriculture. Coastal flooding and river flooding are all set to become much more common and threaten lives as well.

3 Pathway to 1.5 °C Warming

The pathway to limiting global warming to 1.5 °C depends on reaching a world with net-zero carbon emissions and doing so hastily. The International Energy Agency has mapped out a possible pathway for the world to reach net-zero emissions by 2050, and that is the necessary reality needed for limiting global warming to these targets as well. To prevent warming overshooting beyond 1.5 °C requires cutting net

carbon dioxide emissions by almost half in the next decade, with the other half being reduced in the two decades between 2030 and 2050. According to climactic models, to have a good shot at restricting global warming to 1.5 °C, the net-zero carbon emission world needs to be reached latest by 2055. If it gets delayed to around 2070, then the global warming target revises to 2 °C which has much more severe impacts on human lives and extreme climactic conditions and resembles an apocalyptic scenario. The necessary conditions for reaching net-zero emissions involves a lot of technological innovation, consumer behaviour changes and most of all strong and determined policymaking. Net-zero emission targets are at loggerheads with economic development targets which are often major political economy concerns, and myopic electoral visions that only extend 4–5 years in most countries can fail to account for the long-term target of sustainable development that reconciles economic development with climactic considerations.

A net-zero emission world needs to reduce emissions of methane, black carbon and nitrous oxide from sectors such as waste, agriculture and industrial production. The side benefits of net-zero emissions include better health for people as the air they breathe is less polluted, aside from the obvious benefit of avoiding climate catastrophes. The necessity of a net-zero emission world primarily comes from the need to limit the total human emissions of carbon dioxide beginning from the pre-industrial era. If we are to keep to 1.5 °C of global warming, we can at best have around 40–45 gigatons of carbon dioxide emissions per year till 2030 and then 20–25 gigatons between 2030 and 2050, to have at least a 50% chance of limiting global warming to 1.5 °C. Further, the available addition that can be made to global atmospheric greenhouse gas stock is also going to reduce significantly by 2050 due to the thawing of permafrost in polar regions. When the permafrost thaws due to warmer temperatures, it will release large amounts of methane which are currently trapped underground, further reducing the emissions humans can make. The estimates for the methane emission coming from permafrost thawing range between 50 and 100 gigatons in the next 100 years, and it remains to be seen how much would be released by 2050.

To reach a target of net-zero emissions, the major responsibility lies with the energy sector which needs to radically transform over the next three decades. As developing countries undergo economic progress, their energy demands are bound to increase, which will increase global energy demands by almost 50% by 2050, with an annual average growth rate of around 2%. Most of this additional demand will be in the form of electricity, which is where the great hope for the future lies, as we must transition to an electric reality in order to avoid reliance on fossil fuels. This will require transformation of electric production, supply and storage systems and also our transportation systems. The first step is obviously ramping up clean energy production with the IEA estimating that realizing a net-zero future by 2050 requires adding capacity for generating 630 gigawatts of solar power and 390 gigawatts of wind power every year. In this scenario, three-fourths of all new-energy demand will be met using solar and wind energy, with some contributions from biofuels and nuclear energy as substitutes for the stability provided by fossil fuels. To store and transport this clean energy in an efficient manner, major progress is needed in

long-duration energy storage systems as solar and wind energy generation is necessarily erratic and relies on climactic conditions. For them to be stable sources of energy, it is necessary that a major part of produced energy is stored to be used when production is not feasible. To ensure against weather shocks, it is important to make large power grids that cover many regions such that any one region can support the whole grid in cases of unfavourable weather conditions or failure of one part of the grid.

Further, to reduce reliance on fossil fuels, electric vehicles need to become the norm and their sales need to account for at least 60% of global sales by 2050, whereas they only account for 5% of annual global vehicle sales right now. Improved electrification and power grids will also allow for regular, automated electric vehicle recharging stations to be set up across the world to make their use feasible and convenient. Despite all of this, some industries will continue relying on natural gas and petroleum due to their constraints, such as chemical production plants, and for them, it will be necessary to ensure that the carbon emissions from production processes are minimized. Carbon capture and use technologies are already being experimentally developed, but it will be crucial for governments to nudge industries towards adopting them. Private economic processes will lead to very delayed adoption of carbon capture, so policies like a carbon tax and rebates for costs incurred in carbon capture could go a long way in ensuring that private industries also adopt these technologies.

4 Impact on Ecological and Climactic Systems

The impacts of climate change are bound to be varied on different agricultural, oceanic and climactic systems. The mean temperatures of all regions will secularly rise, with more inhabited cities with higher levels of pollution or greenhouse gas emissions having more extreme weather conditions. Rainfall will also become much more erratic and heavier in most parts of the world, while at the same time the likelihood of drought conditions increases in other regions. Extreme hot days in mid-latitude areas would warm up by almost 3 °C, while extreme cold nights may also warm up by up to 4 °C. However, the number of extreme hot days are also expected to rise rapidly. Such conditions will affect cities in the Mediterranean, India, China and Middle East significantly. Global mean sea level rise is a major threat to coastal areas and restricting global warming to 1.5 °C as opposed to 2 °C will mean the sea level rise would be lower by almost 10 centimetres, which would put lesser regions under risk and also buy countries and regions more time to navigate sea level rises. The absolute levels of sea level rise range from somewhere between 26 and 77 centimetres with an average expected rise of 52 cm. The reduction of just 10 centimetres from global sea level rise will be significant as according to current populations, it would put ten million fewer people at risk of living in flooded areas or other sea level-related vulnerabilities. Unlike warming or even global carbon dioxide levels, sea level rises are not predicted to be curtailed permanently, but only delayed in order to buy humans enough time to adapt to them

efficiently. Even a warming of 1.5 °C will be enough for sea levels to continue rising for at least a couple of centuries as the ice sheets of the polar areas slowly melt away. However, reducing warming and slowing down the loss of ice sheets is crucial to be able to adapt to these changes rather than face them in an apocalyptic scenario. Low-lying coastal areas and small islands will inevitably face many challenges to their ecological balance, even if they avoid full-scale disasters like tsunamis and flooding, as saltwater will intrude their ecological systems and imbalance it, while also damage their infrastructure.

The impact of global warming will also be felt in wider ecological systems, as species loss and extinction will be an unavoidable reality, which in turn has knock-on effects on the ecological balance of the areas where those species lived, as a part of the complex food web is missing. This will be true across freshwater, terrestrial, coastal and even marine ecosystems. According to the IPCC, even at a 1.5 °C warming level, 6% of insects, 8% of plants and 4% of vertebrates will lose their ecosystems, which is still a damage limitation as these numbers would be more than doubled with a warming of 2 °C. Meanwhile, we already see forest fires becoming more prominent across the globe with repeated outbreaks in places like North America, India and Australia. More intrusion into forest spaces coupled with imbalanced and shrinking ecosystems will lead to more such events in 2050. This will also result in many terrestrial ecosystems being transformed as new balances will emerge in the face of excess warming and species going extinct. Similar to marine ecosystems, tundra forests that rely on cold climate for their survival will also be threatened with woody shrubs that usually grow in more temperate conditions invading tundra ecosystems and leading to further warming of these areas. Permafrost areas and tundra ecosystems are projected to thaw rapidly as we lose almost 1.5–2.5 million square kilometres of these areas by 2050.

Global warming will also have significant impacts on oceanic temperatures which will lead to increases in ocean acidity and decreases in oceanic oxygen levels. This is already underway through warm-water coral reefs being affected and facing existential risks with most of them predicted to be wiped out in the long run. Coral reefs will decline by somewhere between 70% and 90% with a warming of 1.5 °C and are almost certain to be completely wiped out at 2 °C. As a consequence of warming of oceans, it is also very likely that marine species adapt by shifting to higher latitudes where the oceanic temperatures resemble their normal ecological conditions. However, many species are also bound to be lost due to this process, and such ecological shifts will inevitably reduce the productivity of fisheries, aquaculture and any other human activities dependent on marine ecology. Higher levels of greenhouse gases, specifically carbon dioxide, are also bound to increase ocean acidity levels which would in turn threaten various marine ecosystems by challenging the survival of species like algae and some kinds of fish which depend on normal ocean calcification processes. Global fishery models predict a decrease in marine fishery productivity of almost 1.5 million tonnes in the next three decades due to global warming.

Some of the other expected weather changes by 2050 due to climate change include:

- **Temperature extremes:** Heat waves will become more intensive, more frequent and longer lasting, as cold weather episodes decrease. Daily minimum temperatures will rise rapidly, while the number of frost days reduces in higher latitudes.
- **Precipitation:** Rainfall will increase substantially in tropics, decrease in the subtropical areas and increase again for higher latitudes. Higher global average temperatures will mean more water evaporation and, consequently, more precipitation. Extreme precipitation events like droughts or floods will increase in frequency across the world, but specifically for mid- and high-latitude areas.
- **Snow and ice covers:** Global warming will reduce the snow cover and sea ice cover to a large extent as glaciers and ice cap lose a lot of mass due to longer periods of melting in the summer and shorter winter precipitation to compensate for it. These processes are also what would lead to the inevitable increase of sea levels across the world, with ice melting from the Arctic and Antarctic significantly adding to global mean sea levels. Meanwhile, permafrost regions are also expected to experience widespread thawing due to the warmer temperatures.
- **Regional monsoons:** Asian monsoons are likely to become more extreme and witness increases in precipitation. Similarly, the African and Australian monsoons are also expected to increase, whereas monsoons over Mexico and Central America are likely to reduce. Asian monsoons will be significantly impacted by carbon aerosols whose impact remains hard to predict, and uncertainty prevails about their future.
- **Ocean acidification:** Higher concentration of carbon dioxide in the air is associated with more acidic oceans with the pH level predicted to fall by 0.14 to 0.35 units in the twenty-first century. The surface waters of oceans will be immediately affected, while deep ocean areas will be only marginally impacted.
- **Sea levels:** The average rate of increase of sea levels will exceed the historical rate average for 1961–2003, with an estimated rise in sea levels of 3.8 mm/year. The melting of glaciers, polar ice caps and the Greenland ice sheet will all be significant contributors to rising sea levels.

5 Impact on Human Lives and Livelihoods

Meanwhile, humans are obviously bound to be very significantly impacted by climate change and even a global warming of 1.5 °C, which is a hopeful figure, will lead to unprecedented changes in human existence. These changes will affect people's health, livelihoods, food security, physical security and water supply, as well as general economic growth. While in urban settings, people living in coastal regions are most vulnerable to the consequences of global warming, indigenous people who rely on natural resources and ecological balance for their livelihoods and survival are bound to be the most affected by climate change. Further, people who rely on agriculture for their livelihoods will also be significantly affected by erratic weather conditions leading to uncertain produce. Even residents of colder regions, such as those living in Nordic countries and the Arctic region, will be significantly

impacted by the sudden transformation of their climate and surroundings. Further, Small Island Developing States and Least Developed Countries are bound to have to curtail their development to try and tackle the climate crisis, which puts further strains on their economic capacities. As a consequence, especially amongst the most vulnerable populations, poverty rates could increase with several hundred million people pushed into poverty by global-warming-related risks. Consequences on human health are also bound to be significant, although the risk of direct heat-related deaths will not be very high, as indirect effects will become very significant and severe. These will include risks to food security arising from threats to agricultural productivity and increased threat of diseases like dengue and malaria. Receding forest areas and unstable ecological climates are also bound to increase human exposure to zoonotic diseases. With the coronavirus pandemic, humans have already experienced the severe threat exposure to zoonotic diseases holds at a civilizational level, but invasions into forest regions and increased out-migration from unstable ecological systems are bound to increase our vulnerability to more zoonotic disease outbreaks.

6 Climate-Change-Related Migration

Climate-change-induced migration is bound to become one of the major drivers of internal migration patterns in the next few decades. Population trends, distributions and patterns are all bound to change significantly over the next few decades as the world population approaches a stable level and global-warming-induced internal migration continues to rise. The World Bank's Groundswell report (2021) attempts to model internal migration to find out what the impact of climate change will be for various regions of the world. The most vulnerable people across the world will be the most affected by these changes, and by 2050, as many as 216 million people across the world could become internal climate migrants. Even in the more optimistic scenario of a world where the climate crisis is managed well, it is still expected that around 100 million people will become internal climate migrants which is a substantial amount. Some of the key drivers of migration will be slow-onset impacts, such as water scarcity, shocks to food security and crop productivity, and sea level rises which make it unfeasible to live in coastal areas. Massive internal migration will also inevitably lead to political strife and could very conceivably undo the work done so far in reducing extreme poverty from many parts of the world.

Out of these 216 million, 86 million could be from Sub-Saharan Africa alone representing 4.2% of the total population of the area, with another 48 million from East Asia and Pacific, 41 million from South Asia and 20 million from North Africa where it again accounts for 9% of the predicted population. The scale of migration will be massive in the world's most poor regions and places which are most vulnerable to changes induced by climate change. Sub-Saharan Africa has both these features as there are many people living in poverty there, and it is highly vulnerable to the impacts of climate change as it has many fragile dryland ecosystems and also comprises of many coastlines around which people would be

most affected. Agriculture continues to depend on rain in this region, and erratic and extreme rainfall patterns would cause not just employment loss for the large share of population employed in agricultural work, but also threaten the food security of people in the region. Further up north, countries in North Africa will also see large shares of population become internal migrants because many of them are already in desert areas where water scarcity is bound to become even more extreme due to climate change. In South Asia, Bangladesh is bound to be the most affected country with up to 20 million internal climate migrants by 2050, which is 50% of the total projected migrants for the entire South Asia region. Additionally, while the scale of migration will not be large as their populations are small to begin with, Small Island Developing States are bound to face extreme hardships as saltwater intrudes into their ecosystems, their coastal areas get flooded, and extreme weather events cause massive destruction, all of which will lead many people to be not just internal climate migrants, but possibly attempt to migrate to other countries.

Agricultural transformation is also necessary to sustain a net-zero reality as currently, it is one of the major sources of greenhouse gas emissions, responsible for almost one-fourth of global emissions alongside land-use changes. Agriculture's greenhouse gas exports notoriously include methane and nitrous oxide, with both gases having stronger warming effects than carbon dioxide over 20 years. Agriculture is responsible for 45% of global methane emissions, with 80% of that coming from livestock, and also accounts for 80% of global nitrous oxide emissions from the use of fertilizers. However, the good thing is that these gases have short lives, especially methane which only persists in the atmosphere for 12 years. Consequently, rapid action in agricultural transformation and the curtailing of livestock use can cut down methane production significantly, which will also show in atmospheric methane levels within a decade and a half. There is a lot of potential to reverse the impact of methane on global warming, which is different from the experience with carbon dioxide, which is persistent and likely to remain in the atmosphere in the infinite time horizon.

The changes required in agriculture, specifically, and food production, in general, are very large-scale behavioural shifts which require mass coordination. Agriculture employs almost 2 billion people across the world, who will all need to shift to more sustainable practices in order for structural transformations to be effective. At the same time, many shifts are needed from the consumer sector as well. Currently, we waste 33% of all of the world's food production and consume three times the recommended level of animal protein. Cutting down on wastage reduces the total production, and therefore resources, needed to sustain human food demand, while reducing dependence on animal meats shifts focus away from the heavy greenhouse-gas-emitting production of livestock.

In a McKinsey Quarterly report (August 2022) identifying the pathway for agriculture to reach a net-zero emission reality, the most crucial measures that will be adopted by 2050 in order to cut down emissions will include the following:

- Adopting zero-emission on-farm machinery and equipment, with increased use of clean energy-powered equipment, and installing solar panels on farms.

- **Rice cultivation:**
  - Improving fertilization practices in rice cultivation where overfertilization often leads to excess release of nitrous oxide.
  - Improving rice paddy water management as the water-logged soils of rice paddies are prime ground for methane-producing bacteria.
  - Expanding the use of dry direct seeding in rice cultivation.
- **Livestock production**:
  - Employing greenhouse-gas-focused genetic selection and breeding of animals to ensure the production of animal protein happens with lesser greenhouse gas emissions.
  - Improving animal health monitoring and illness prevention mechanisms to make livestock production more efficient.
  - Modifying animal feeds by optimizing the amount of land required to grow it and expanding the use of additives that enhance livestock production.
  - Massively expanding the use of anaerobic manure digesters and scaling up the production of biofuels such that methane produced by livestock is converted to useful biofuels rather than becoming part of greenhouse gases.
- **Other crops:**
  - Reducing overfertilization and overuse of nitrogen fertilizers in agricultural production.
  - Increasing the use of no-tillage or low-tillage agricultural practices.
  - Increasing the adoption of controlled-release and stabilized fertilizers to minimize the emissions resulting from fertilizer use.
- **Consumer-side changes:**
  - Shifting livestock consumption to more environment-friendly alternatives like pork, poultry and fish instead of ruminant animals like beef and lamb which are ten times as carbon-intensive as other animal proteins and 30 times as carbon-intensive as plant-based proteins.
  - Eliminating food loss and waste needs, with the target of reducing it below 20% by 2050 which would reduce emissions from food waste by 40% globally.
- Natural carbon sinks like forest areas have immense potential to absorb carbon dioxide and other greenhouse gases, and carefully cultivating them over the next few decades has immense potential to support almost 6–8 gigatons of carbon sequestration, but it would require reforestation of almost 50–60% of land area that has been deforested over the last 150 years.

Global warming of 1.5 °C is likely to result in small net reductions of production of key crops like wheat, rice, maize and other cereals. Most of these reductions are likely to come from heavily weather-dependent agricultural systems in Sub-Saharan Africa, Southeast Asia and Southern America. At the same time, nutritional qualities of crops are also likely to take a toll due to changing weather patterns. However, efforts in this regard are already being made through biofortified crops which are likely to become preponderant and also resilient to climate change. This is why the net reductions will be small and not very large, as efforts are underway to create

climate-resilient and nutrient-fortified crops with some breakthroughs having already been made, pointing to significant innovations in this field in the future. However, while agriculture may be genetically modified to become resilient, it is highly unlikely similar processes will be very successful for livestock as they are also affected by climactic changes, faster spread of diseases and reduced water availability. Consequently, it is very likely that livestock-dependent meat becomes more expensive and unaffordable as livestock themselves are threatened by climate change. Already, movements are underway that call for veganism as the dominant nutritional plan as livestock take up a significant proportion of human agricultural production and cause a lot of net pollution which is unsustainable in the face of efforts to reduce global warming.

7 Climate Change and Sustainable Development Goals

While the world undergoes transformational and structural changes in order to adapt the realities of the climate crises, sustainable development to improve the quality of human life continues to be a major challenge. Prioritizing one over the other might give some returns in the short run but will have dire consequences in the long term. Consequently, short-term planning and policymaking, such as the one driven by electoral incentives, are unlikely to encourage a synthesis of these concerns. Excess global warming will drastically destroy systems and cause widespread loss of life and livelihoods, which would be antithetical to the goals of sustainable development. At the same time, developing without concern for environmental impacts is exactly what has resulted in the urgent situation we find ourselves in and will inevitably result in disastrous outcomes which could be civilizational threats. Delaying action to reduce emissions will make the challenge progressively tougher, as costs associated with technological adoption continue rising, carbon capture infrastructure would remain undeveloped, and lack of experience with clean energy technology will reduce the nous with which policymakers and innovators are tackling environmental challenges.

Poverty eradication is a major Sustainable Development Goal, and it would be much easier to achieve it in a world where global warming is limited to 1.5 °C as opposed to 2 °C, as that would necessitate fewer trade-offs when it comes to economic development and also reduce the impacts warming has on lives and living conditions. The United Nations Sustainable Development Goals from 2015 acknowledge these crucial linkages between global warming and developmental challenges. Mitigation of vulnerabilities concerning climate change and adapting local communities are regions to equip them enough to tackle the challenge on their own to a decent extent, which are both aspects of the challenge to limit warming levels. Many Sustainable Development Goals (SDGs) stand to be threatened by global warming unless the levels are managed, as impacts on agricultural systems are bound to disturb food security, while the intrusion of saline water in freshwater ecosystems will disturb the availability of consumable freshwater, and developing countries need to achieve economic progress without increasing greenhouse gas

emissions which is starkly different from historical developmental processes where economic development and carbon dioxide emissions were closely related. Consequently, policymaking for economic progress, food security and water security all need to account for climate change realities, and only limiting warming to 1.5 °C can help ameliorate these negative consequences so that the world can meet sustainable development goals while ensuring limited global warming. At the same time, poorly designed policies have the risk of threatening both climate change targets and Sustainable Development Goals, and the linkages between the two necessitate that policy targeted towards either of the two challenges remains actively cognizant of the externalities posed towards the other challenge. The exact impacts on Sustainable Development Goals remain to be seen. At one level, curtailing climate change is good for economic progress and human well-being, and at the same time, it places restrictions on how rapidly countries can develop in the modern age. Consequently, the net effect on aspects like poverty reduction is somewhat vague, and the specific interactions and synergies between climactic and sustainable development goals will determine the direction and magnitude of the net effect. The most efficient way of achieving both targets is by reducing energy demand, managing the levels of material consumption and altering food consumption patterns to emit lesser greenhouse gases. There will be many positive health externalities to preventing global warming from overshooting target levels, including cleaner air especially for people living in urban areas of South Asia, more robust agricultural systems which contribute towards food security and regular supply of clean freshwater for human consumption, aside from the obvious consequence of fewer out-migrations from coastal areas.

The challenge of limiting global carbon emissions itself presents economic opportunities to developing countries to invest in technologies that will define our future. Further, it is possible for governments across the world to attempt to divert global finance towards investing in climate-resilient infrastructure to harness private funds in modernizing old infrastructure and ensuring any new projects are up to the challenge. Similarly, government intervention is exactly what creates incentives against carbon dioxide dumping into the atmosphere by industries and mobilizes public and private finance towards clean energy infrastructure. On average, the annual investment needed in clean energy is around 2.4 trillion dollars till 2035, and while countries have expressed their concerns regarding climate change, most are yet to dedicate any significant portion of their GDP into fighting the crisis. The changes consistent with reaching emission targets can only become feasible in the face of disruptive technological progress when it comes to the production, storage and transportation of that energy.

8 Conclusion

The climate crisis remains one of the largest threats faced by humanity at a civilizational level. Urgent action is needed to ensure that we get through this challenge by adapting our lives to be more sustainable and in line with what the earth can allow

for, rather than exploiting natural resources to no end. In many ways, even after restricting global warming to the current target of 1.5 °C, the consequences of historical carbon emissions will continue to persist. What we need to ensure is that those consequences are manageable in that they can be mitigated and do not turn into large-scale disasters. As we adapt to this new reality, more erratic and extreme weather is an inevitable reality, as many species go extinct, and earth's ecosystems are permanently transformed by the warming of temperatures across the world. Our dietary patterns will also have to evolve to the challenge, as agriculture will become more sustainable by using technologies and implants which reduce greenhouse gas emissions, while also eliminating or reducing production of foods that are very carbon-intensive like lamb and beef. Many of the consequences of warming, such as those on weather patterns, are things we would have to adapt to live with, while also ensuring that we do not exacerbate the problem with further emissions. Consequently, the future of the world in 2050 is one of an adapted reality to mitigate the consequences of climate change, but also one of net-zero emissions.

9 Input from Interviewees

Gina Badenoch
Social entrepreneur and photographer; founder of Ojos que Sienten AC and Capaxia UK

Nature is paying back. We are a bit late. Sadly, I believe that we will see worst.

Jane Burston
Executive director and founder, Clean Air Fund

By 2050 we will have transformed energy, industry and agriculture. Most of us will live in cities—and mayors and communities will have led the way in making them greener, cleaner, more accessible places that are good for our health.

Unfortunately, we'll also be adapting to the consequences of the global warming we didn't avoid. We'll have developed some infrastructure that helps us deal with the increase in extreme weather events, but many countries will need support to deal with the loss of and damage that will arise.

Arturo Condo
President, EARTH University

We believe that by 2050 the world will have succeeded in curbing GHG emissions through large-scale systems change supported by social and technological innovation. A much-needed food systems revolution will be an important part of this change, including a shift towards nature-positive food production. This revolution will be led by a global movement of front-line leaders equipped with the values, skills and attitudes needed to support primary food producers in making the transition to climate-friendly production systems.

Lars Flottrong
Business advisor, MoB
Strategy and risk management

The most important thing we should leave to the next generation that will ensure the safety of planet Earth? A still green earth with the chance to survive and to develop further.

In order to achieve this, what should mankind do? Humankind should urgently agree on immediate steps and measures to stop the destruction of our earth. Carbon emission has to be put under control and to be reduced. Waste production should be reduced and the focus should be on renewables materials.

The countries have to reduce the military spending and to re-channel the funds into science and search. New food production, water cleaning and production and air cleaning technologies have to be developed in order to survive.

Political and/or regional conflicts have to be brought to an end and a global democratic institute has to be established, providing equal rights to all people regardless of there national belonging or religion.

Robert Krotzer
City councilor of Graz, Austria, for Health and Care

Sustainable production, sustainable consumption, sustainable transport: all this leads to massive reductions in greenhouse gas emissions.

Tristan Lecomte
Chief executive officer, Pur Projet

I hope to see the settling of the climate crisis, which is the major risk affecting our future to be solved within the next 50 years.

Moran Sol Broza
Sustainable impact entrepreneur; founder of Be. and Sol Food

Soon, we will be using technology to help visualize Earth's finite natural resources and understand the impact of our choices on us as individuals—and the collective—in real time. Once this begins to affect the mindset and behaviors of a critical mass (consumers), we will see a domino effect on society: borders will change their functions, governments will adjust legislation and agreements, and corporations will be forced to shift their business models and processes of manufacturing with less/zero waste. In the future, climate change will not only refer to the natural environment around us (plants, animals, insects, etc.), but recognize the importance of the interaction between us and how we treat one another.

Barbara Steiner
Director of the Bauhaus Dessau Foundation

A complete rethink has begun in the construction sector to stop cement production and sand mining. The European Climate Foundation with its hundreds of partner organizations worldwide worked successfully at the forefront of a global movement

to ensure a livable planet for future generations. Together they succeeded in calling for legislation to avoid energy-intensive building materials and replace them with alternatives. Buildings are seen as 'urban mines', materials are 'harvested', and digital twins allow the reuse resource potential to be increased. Recycled concrete, new building materials and techniques offer alternatives. The re-appreciation of traditional materials and techniques has led to a re-appreciation of indigenous knowledge and cultural techniques.

Composite material made of, e.g. clay, pulp and mycelium, 3D printed in brick-like modules, allows complex and light forms. The living material allows the 'bricks' to grow together. The use of mortar, which causes high CO_2 pollution due to its high cement content and energy-intensive production process, can be avoided. The prediction that there would be no more beaches in 2050 has fortunately not come true. The construction industry—until 2025 the world's largest consumer of sand—has stopped its overexploitation. Beach vacation is still possible.

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Future of Transportation

Tamás Landesz and Karine Sargsyan

Abstract

What will the transport of the future look like? If we think about it, several pictures from science fantasy and Hollywood films appear in our minds. The ideas like flying taxis, uncrewed cars, and flights to other planets are some, but what fantastic ideas may become a reality?

Over the next three decades technological improvements will radically transform the way we are transported today. More people will be living in urban areas, demanding clean energy. Electric vehicles using clean energy for charging will be widespread; we will be driving on smart highways and road systems. Hyperloops and high-speed trains will provide viable alternatives to the current airplane flights. For intercontinental travel we will see the development of point-to-point suborbital flights.

Interviewees
Asanga Abeyagoonasekera
Maurizio Bussi
Soulaima Gourani
Tristan Lecomte

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Image 1 Future of transportation. Original photo: Herrengasse Graz, Austria. Illustrated by: Astghik Kyurumyan, used with permission

Bob MacMahon
Serj Tankian
Mark Turrell
Arnaud Ventura
Alexis Von Hoensbroech

> "If we can drive down the cost of transportation in space, we can do great things."—Elon Musk

What will the transport of the future look like? If we think about it, several pictures from science fantasy and Hollywood films appear in our minds. The ideas like flying taxis, uncrewed cars, and flights to other planets are some, but what fantastic ideas may become a reality? In addition to our expert predictions, I suggest looking into the nearest future transport through research laboratories and services currently working on market innovation and testing new models. We consider patterns of development transport spheres, learn about the latest achievements of science and technology, look into our experts' predictions, and then predict what to expect from the future and how portable and transportable the future humans will be. Is there a significant change? Let us see (Image 1).

At first, I thought of the security of future transportation: clash flying cars with an owner-reactive knapsack—it looks like we once will have business with such

accidents. We are talking about future travel, travel in the city, between cities, countries and continents, and even planets and galaxies and transporting cargo.

Before the climatic Summit in Glasgow, the IEA published a road map, "Net Zero by 2050," which contains radical methods to progress carbon neutrality worldwide. For example, experts advise entirely against gasoline-powered cars by 2035. But the most natural alternative is electric cars (IEA, 2022). In the last 35,000 years, humanity had at least 20 vehicle revolutions, including the invention of ropes, bridges, wheels, etc. Total digitalization brings the technological displacement of people and goods to a new coil history, on which individual transport and engine's internal combustion may stay in the past. World sales of cars in 2020 fell by 14.8% to 77.7 million pieces, based on data from LMC Automotive (SGL Carbon, 2020). Care about ecology and digital breakthroughs in sharing economics (collaborative economy consumption using Internet platforms) forced many consumers to question whether they generally want to own a car. We passed the peak popularity of owning a car and driving now less. There is also a significant difference in habits between millennials and baby boomers, between different generations. The youth more often refuse to possess a car.

Private transport is becoming more public; we see the rise of phenomena like CarSharing, drive buddies, and, last but not least, Uber. We see vehicles, not more as goods but as services. New mobility and transport in future cities include not only such phenomena as carsharing or carpooling (services for trips with fellow travelers like BlaBlaCar) but also digital platforms that allow passengers to find the optimal route using all possible species of urban transport and use them with a single ticket. Some regions already have implemented that kind of ticket for most public transportation (see Graz, Styria, Austria). In the coming years, per synergy with the technology of autonomous transport funds, public transport may completely oust personal.

At the beginning of 2022, the number of carsharing users in big metropoles of Europe exceeded 3.4 million people, and it is expected to rise to 19.7 million by 2027 (Statista, 2022).

Micromobility is also a future-prone movement: movement at a small distance using compact transport means (unicycle, segway, electric scooter, bicycle, or e-bike). Also, this is one of the fast-growing development trends in city transport networks. Investment in this sector since 2015 exceeded $5.2 billion, comparable to the total volume investment in telematics and intelligent systems to regulate traffic, as calculated by McKinsey (McKinsey 2019/2020) (Möller et al. 2019).

Kick-sharing also supports micromobility: scooter and bike rentals serve residents and tourists in major cities to get to necessary locations inside cities, bypassing plugs. According to McKinsey, about 60% of automotive trips on all transportation means in the world is on distances less than 8 km, and many people could save time and money instead of cars, choosing to rent bicycles or scooters (McKinsey 2019/2020) (Möller et al. 2019). Dense urban development and shortage of places for parking make usage of own transport irrational: time spent on searching parking places starts to exceed the time of travel. In addition, mini electric transport measures are more environmentally friendly: per 1 kWh of energy, petrol automobiles may drive 1.3 km; electric automobiles, approximately 6.6 km; and

electric scooters, around 133 km. According to forecasts by 2030, market-rolled micromobility transport funds in China, the EU, and the USA will reach a minimum of $300 billion up to $500 billion.

Transport generates approximately 15.9% of the world's emissions of greenhouse gases, and the lion share accounts for cars (11.9%), calculated by the World Resources Institute. Aviation and maritime transportation generate 1.9% and 1.7%, respectively, of the world emission volume (WRI, 2021). There is global agreement on seeking alternative and more eco-friendly kinds of fuel: like an alternative to gasoline and diesel—electricity or solar energy. The carbon track of electric cars, even taking into account all stages of production and CO_2 emissions, is 19–69% lower than motorized vehicles of internal combustion, according to the International Council on Clean Transportation (ICCT) (Biker, 2021). Buyers of electric cars are captivated not only by the thought of taking care of nature but also the potential related savings.

In 2004 the agency of advanced developments of the US Department of Defense (DARPA, 2014) announced the first competition for autonomous cars. Cars must drive a 230-kilometer track without the intervention of people, but they had no winner that year. The first winner was honored only in 2005. Since developing microelectronics, technologies like computer vision and artificial intelligence have allowed developers of autopilots to make colossal breakthroughs and send unmanned transport on roads. Unmanned cars and trucks, robot taxis, courier robots, and delivery drones are already a reality—their development was supported by technological giants (Apple, Google, etc), automakers (Tesla, VW, Audi, BMW, etc.), banks, and even Uber.

This development is also proper for delivery robots and transport drones. By the forecasts of BCG, in 2025, about 600,000 drone devices will be produced in the world, and by 2035 their volume will increase to 21.1 million. By 2035 more than a third of machines produced will be autonomous, considers BCG (Amoukteh et al., 2017).

Artificial intelligence, machine learning, and big data analytics will make future transport smarter: these technologies will lead to fundamental changes in the transport sector. By leaning on virtual tools and analytics, cities will be able to optimize transport flows and logistical companies—routes of delivery. Political regulation will favorably affect sales of electric cars. By 2030 US President Joe Biden intends to equalize the number of electric vehicles and vehicles with the internal combustion engine. Norway has more ambitious plans to stop the sale of petrol and diesel cars as early as 2025. For this, electric vehicles are promoted through generous political and fiscal preferences: e.g., exemptions from VAT, registration fees, and free parking. Sales growth contributes to including innovation and the development of novel technologies in transportation.

The distribution of electric cars will only help reach complete carbon neutrality once their charging does not use electricity generated from coal, oil, and natural gas, in connection with this expected increase in shares of renewable sources, including energy from the sun and wind, up to 80% by 2050 (see chapter "Future of Energy").

Some startups develop electric car solar elements that generate electricity for trips on distances up to 70 km after a day spent in the sun.

Cities in the future will become more comfortable for cyclists. Cars on roads will meet less often—especially in large cities. Madrid, Copenhagen, and Hamburg apply political pressure to become maximum green capitals, car-free and smart cities. In addition, automotive trails will become superfast between cities if more electric vehicles are included. The roads will change, too, in parallel to transport and will provide inhabited points of energy. Public transport in the future will go on renewable resources that are unusual. Authorities in London have already started transferring urban buses on biofuel, which is partially made from coffee shop thick. Coffee waste will be collected from factories, bars, coffee shops, and restaurants in the city and then sent to processing. New fuel reduces the number of harmful emissions by 10–15% (Stilwell, 2022). Lack of coffee waste is not expected—the population of London annually produces 200 thousand tons of coffee waste. Urban buses in the future will become green not only in terms of fuel sources but also in a direct sense—on rooftops, public transport will be gardens with living plants. Such change can improve the ecological situation in the cities and lead to reduction of harmful emissions in the air.

In the cities, those who want to use neither public buses as convenient means of transport, nor bicycles, in the future flying taxis will be available. Uber already promised to run flying taxis in 2025 with small light-engine aircraft equipped with an electric engine. The company plans to introduce quiet airplanes in large cities. Also, passenger drones will be able to transport people, sure in the beginning, with some restrictions in weight, maximum speed, distance, and time in the air. Trains will speed up, posing a robust competition to aircrafts. Vacuum trains will be two times faster than aircraft. Hyperloop already showed trains and passenger cabins, passed the first tests, and clocked trains up to 310 kilometers per hour on a test tube way in Nevada. And, of course, future trains will only ride on energy from renewable sources.

Aircraft is the most customary modern travelers' choice of transport, although it is not the most eco-friendly due to enormous CO2 emissions. However, in the near future, aircrafts flying on biofuel will fulfill the first step towards reduced ecological footprint (Johnson, 2021). An example is the flight between the USA and Australia using biofuels produced from unique varieties of mustard seeds (Gohd, 2018). By data, these decrease emissions of carbon dioxide gas per flight by 18 tons compared to using ordinary kerosene. Another option is the airplane on solar batteries. Such aircraft called Solar Impulse 2 already completed the first ever flight on solar batteries through the Atlantic Ocean. The way of car or aircraft production will also change. We will be able to print our transport measures on a 3D printer.

Inter- and intragalactic flights will become possible only with technological change into renewable solar energy and will be in the near future. Nevertheless, I hope to see more exceptional transportation methods like "warp engine" or "beam" technology (Abrams, 2009).

Emerging technologies will continue to evolve and change. But there are customer trends in ways that are hard to predict. With novel technology, which has become an integral part of transport planning, we must be intelligent and innovative. The future plan is for a wide variety of options, each with its opportunities and challenges. Through a series of technological developments, we will be able to change transport providers' mobility capabilities. This includes:

- Navigation with technological support
- International public transport for diverse customers
- More service possibilities with connected and automated system vehicles
- New dedicated devices for short journeys
- The use of drones to support future transport missions
- Transport using alternative fuels

In conclusion, over the next three decades, these technological improvements will radically transform the way we are transported today. More people will be living in urban areas, demanding clean energy. Electric vehicles using clean energy for charging will be widespread; we will be driving on smart highways and road systems. Hyperloops and high-speed trains will provide viable alternatives to the current airplane flights. For intercontinental travel we will see the development of point-to-point suborbital flights (e.g., New York to Sydney in 30 minutes). In order to arrive there, the currently aging infrastructure (including roads, bridges, highways) will require a significant upgrade around the world, keeping future sustainability and cost-efficiency in mind. We may see super tall buildings emerging, with their sky-bar offering a unique viewpoint at mind-bending heights of 10 kilometers (height of Mount Everest) or even up to 30 kilometers. This will be possible with the development of superstrong carbon-based materials. On the very top of these magnificent constructs, we may see spaceports, offering a more cost-effective way to launch spacecrafts. We may not be able to say "beam me up Scotty" just yet, but we could very well be able to ask our autonomous elevator "bring me up" to the top of this giant high-rise building to savor a special Star Trek cocktail before sunrise.

1 Input from Interviewees

Asanga Abeyagoonasekera
Foreign policy specialist; founding director general of the Institute of National Security Studies Sri Lanka

Electric cars and alternative energy sources will have big breakthroughs, in the next 30 years.

Maurizio Bussi
UN diplomat and director at the International Labour Organization

Superfast transportation, shot as a bullet from London to New York. Some generations ago it was a boat, now a plane, bringing down travel time from 3 weeks to 6 hours—shortening it to 10 minutes will not be such a radical shift.

Soulaima Gourani
Entrepreneur, author, and keynote speaker; CEO and co-founder of Happioh

We will drive electric cars and own driverless automobiles. We will not experience traffic accidents anymore. Robots will control the traffic, and cars will be able to run faster, closer together, and safer.

Tristan Lecomte
Chief executive officer, Pur Projet

Decarbonated life for 12 billion people? You won't be able to travel unless you are allowed by your state. If half of the population starts traveling, there would be hell. So the value will not be in moving around, but staying in your space, with your family, and close to your home.

Travel will be more regulated, and from home everything will be possible, including work; get whatever you want; services will be better organized to cater for this new reality.

Bob Macmahon
International affairs journalist; managing editor, Foreign Affairs Magazine, Council on Foreign Relations

Shortening radically the time travel would be nice to have in the future.

Serj Tankian
Singer of System of a Down

Although carbon-neutral travel will likely be implemented in the future, most communications will be done in likely a holographic type of environment. This technology is already being used by Cisco systems for business in its earlier stages and was originally developed by a company named Musion in London.

Mark Tankian
Strategist, educator, and entrepreneur; founder and CEO of Orasci

Future is pointing towards space. We want to go up! It will drive technology and thinking. We will be on another planet in 50 years (would be great if that be outside of our galaxy with us on the spaceship, as regenerated 90-year-olds looking young, as today).

Arnaud Ventura
Financial inclusion specialist; co-founder and vice president of Positive Planet Group

Many big inventions will redefine the world in the next 50 centuries, but the leading ones I would like to mention will be in the field of travel both on the planet and in space, in the field of communication as one will be able to communicate with anyone on the planet whatever their language is as well as in the field of energy. Those innovations will help the world to become an even smaller place than it is today allowing most citizen to move and communicate freely with one other.

Alexis Von Hoensbroech
CEO Westjet Airlines

Transportation needs to become sustainable: In 2050 we will fly across the globe with zero carbon footprint. New technologies and sustainable aviation fuels will allow us to discover the world without polluting the planet. Airlines connect people, cultures, and economies. They play a vital role in spreading wealth around the globe, foster friendship between different cultures, and facilitate the economies in their home countries. Aviation will further grow across the globe and we will be able to fly without worrying about our CO_2 emission.

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Future of Communication and Interaction

Karine Sargsyan

Abstract

The effects of digitization can now be seen in almost all life areas—from avatars to mixed reality. Communication will continue to change in the future. Telephones, smartphones, and the Internet are changing human interaction. With chatbots and artificial intelligence, modern ways of establishing contact are possible. One thing is for sure, 20 years from now, using a cell phone to chat with friends will be as outdated as using a landline phone today. By then, mixed reality technology will allow people to see virtual copies of their friends in the real world and see the world through friends' eyes and help them accomplish real-world tasks.

Today's VR and AR systems show only a fraction of what is possible with mixed reality. MR systems can share many communication signals and allow people to communicate in ways that have never been possible.

Interviewees
Muna AbuSulayman
Thomas Arnoldner
Gina Badenoch
Jesmane Boggenpoel
Svetlana Flottrong
Bob MacMahon
Olivier Oullier
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Tobby Simon
Ian Solomon
Mark Turrell
Stefan Verra
Lisa Witter

> "'Where are the people?' resumed the little prince at last. 'It's a little lonely in the desert. . .'
> 'It is lonely when you're among people, too,' said the snake."—Antoine de Saint-Exupéry

One thing is for sure, 30 years from now, using a smartphone to chat with friends will be as outdated as using a landline phone today.

By then, mixed reality technology will allow people to see virtual copies of their friends in the real world and see the world through friends' eyes and help them accomplish real-world tasks. Yet, I think the future of distance communication is not in VR systems but in mixed reality. Our vision of the communication systems of the future is diverse.

Some years ago, I went shopping in the local IKEA market and got lucky to participate in a fantastic fundraising initiative by the United Nations Children's Fund (UNICEF). To convince the people that it is important to donate to a specific African project, the young interns offered to put on a VR headset offering costumers to see the situation on the ground with their own eyes. In a second, I moved from Graz to a small village in Ghana. I could see people in the small village's center go to their habitat room, turn my virtual face to them, and wave my virtual hand at them. This was my first experience of a shared virtual world. I went home and looked for the unusual headset I got acquainted with on the net. There were several, at that time, costly ones on the market for personal usage, but what excited me was that the same equipment cost more than a million dollars only some years before. Today, even more, forced by the coronavirus pandemic, VR conferences are becoming more common. Several companies are developing collaborative virtual spaces. VR is regularly used by more than 30,000 people a month, and joint VR applications are gaining popularity (Rec Room Wiki) (Rec Romm Wiki 2022).

One of the most significant benefits of VR conferencing is that it allows people to use some communication signals they use in person (more familiar and trustworthy). Not only can they talk to each other—they have virtual bodies that allow them to turn toward each other, shake hands, and use various nonverbal gestures. Eventually, they can interact with the virtual environment around them by pointing to objects or playing games together. Users can play or create collaborative 3D sketches together. All this allows a human being to achieve a greater degree of social presence than in traditional audio or video conferencing. It is more comfortable and "nearer", so I think shared mixed reality is the next communication hype.

VR conferences have many potential companies invest tens of millions of dollars to create appropriate platforms (50 + Metaverse Statistics). But mixed reality (MR) conferences can have an even more significant impact because of their connection to the real world. Mixed reality is defined as a technology that mixes

the real and virtual worlds (what is mixed reality?). VR separates people from the real world, while MR tries to expand real-world interactions or add elements of the surrounding world to the VR environment. The benefits of using not the VR but MR platforms are pressing (adopted and supplemented by Juan A. Sánchez-Margallo et al.):

- People can get help with real-world tasks from remote users (e.g., MR surgery possibilities are already existing and are used).
- Virtual people will be placed in real space.
- Support for the transition from collaborative artificial reality (AR) to VR.
- The use of MR images to enhance remote communication signals.
- Providing users with the possibility to share their points of view and see everything through the eyes of another person.
- Establishing a connection between the task space and the communication space.
- Support for natural spatial signals for remote communication.

Perhaps the biggest benefit of MR conferences is their focus on a collaborative view of the workspace. For many real-world tasks, such as remote maintenance, it is much more important to see what a person is working on rather than his face. This capability can be applied in various areas, from remote assistance to operating room medical support or collaborative play (Collaboration and Preparation: What Mixed Reality Surgery Affords the Operating Room) (Guillot 2021; Margallo et al. 2021).

Almost 20 years ago, the first MR system was developed as an AR conferencing application that put virtual avatars of people into the real world of users. They could turn over name cards, and these people appeared in front of them. All this happened with the help of a virtual reality helmet. The system's main advantage was that it moved conferences from the computer screen to the "real world." People found that the video avatar of the speaker in a real environment provided a greater degree of social presence than his image on a computer screen.

Around the same time, we got the possibility of using spatial signals in developing a wearable AR system that allowed virtual people to appear around a person using a small computer and wearing a screen on their head. In this case, a spatial orientation of the audio to get people's voices coming from their virtual avatars was applied (WearCom: A Wearable Communication Space) (Billinghurst et al. 1998). It was made as in a face-to-face conversation in a large crowd; people could easily separate the speech of different people, even when they spoke almost simultaneously.

While this was promising, the problem was that human video avatars were flat rectangles. If you looked at them from the other side, they just disappeared, which is definitely not the case with real, 3D people. This problem was solved a couple of years later with the 3D Live System, where the producers solved the problem by using multiple cameras to record people. This created the illusion that a real person is standing in a real space. A virtual copy of a person could be shown in VR and an AR environment. This allowed users to use movements and gestures like in a face-to-face conversation.

The term "mixed reality" describes the space between real-world interface technologies and entirely virtual environments (the space of overlapping) (Microsoft 2022). Many communication systems already exist at specific points in this space, for example, face-to-face communication in the real world or conferences in the virtual space. MR conferences provide people with the ability to navigate the mixed space. For example, the MagicBook project (the MagicBook) worked on an interface that maintained direct face-to-face dialogues, has the functionality to support AR or VR interactions and a mixture of all mentioned (The MagicBook project 2022). Using this system, people could read the book and look at the pages through the display while AR content appeared on the screen. Users could switch to a VR experience when seeing an interesting AR scene. In this VR scene, one of the people could see the real-world interlocutor as a giant head hovering in the sky. This is how MagicBook was/is supporting seamless transitions between the real world, AR, and VR.

These prototypes have shown that MR technology can embed virtual interlocutors into the user's real world. Unlike VR conferences, the MR interface enhances real-world communication and allows users to get help with any assignment. If we speak about the current state of MR technology and conferences, the first thing is Microsoft's unveiled MR version of Skype with its HoloLens headset. The user can place the Skype window anywhere in the space and see the video from the discusser. At the same time, the HoloLens camera can transmit video to the remote user, and they can see the partner's environment and add AR annotations to it to help them complete tasks. At the same time, the remote user sees the surrounding reality through the eyes of the HoloLens user.

There are also a large number of start-ups in this area. For example, I can mention Mimesys as a holographic communication platform that can capture images of individuals and place them together in a virtual space. Another example is the holo-portal: DoubleMe provides a lightweight version of holo-portation for communication. Both companies focus on collecting data about people, and Envisage AR captures the user's environment and shares it with remote interlocutors. We will see a lot more activity in the next few years in this area. These systems show that the MR conference experience can be built on existing AR and VR commercial platforms and make it more "real."

Several developments will continue to improve MR conferences and allow people to communicate more effectively than ever before. In particular, there are now three crucial trends that will be more dominant in the future:

- Natural communication: With the increase in communication speed, it becomes possible to expand the communication experience (not only audio signals but also gestures), leading to more natural communication.
- Experience recording: A technology is being developed that will allow people to capture their surroundings and experiences. That is, there is a transition from photography to recording three-dimensional scenes.

- Latent understanding: Computers will begin to understand more about users and their environment. This will allow them to understand hidden behaviors, such as the direction of a person's look.

All of these trends are coming together in a direction that seeks to create systems that allow us to share what we see, hear, and feel. Unlike traditional communication tools, empathic systems will enable you to understand the interlocutor's point of view more deeply, see with his eyes, and hear what he hears.

As an example, our Empathy Glasses may be mentioned. It is an AR display that can recognize facial expressions and track the direction of your gaze. The remote interlocutor sees not only the surrounding environment but also the facial expression and information about the direction of the person's gaze with glasses. It is one of the first systems to share gaze direction information and is just the beginning of learning about empathic telecommuting technology.

Goodbye phone . . .

Twenty years from now, using a cell phone to chat with friends will be as outdated as using a landline phone today. By then, mixed reality technology will allow people to see virtual copies of their friends in the real world and see the world through friends' eyes and help them accomplish real-world tasks.

Today's VR and AR systems show only a fraction of what is possible with mixed reality. MR systems can share a large number of communication signals and allow people to communicate in ways that have never been possible before. On your next call, imagine you can see, hear, and feel what your friends see, hear, and feel (The Future of Human-Computer Interaction) (Canny 2006).

> "I shall look at you out of the corner of my eye, and you will say nothing. Words are the source of misunderstandings."
>
> —Antoine de Saint-Exupéry

Perceptual interfaces: The other important piece of future interfaces will be "perception." The naivest example can be speech recognition, or more precisely, the so-called computer vision. Modern smartphones are outstanding platforms for speech tools, as they are equipped with cameras and a decent amount of microchips in digital signal processors. They act as portable personal computers (PCs) and are adept in computer vision (saved photos or videos and camera signals). A straightforward illustration is the barcode reading with a smartphone camera. This development is going to be not the last one. We are using virtual glasses, but those will be once replaced with more advanced holo-systems.

Augmented reality is the very first thing that awaits us in the very near future. In the augmented reality system, it will be possible to look at the world through the technological layer. In the smartphone, some augmented reality applications already exist today. Another viable option is augmented reality glasses. The first call to our near future in this direction is Google Glass. Using Google Glass, you can look at the world around you and see digital information about what you are looking at in real time.

The effects of digitization can now be seen in almost all areas of life—from avatars and mixed reality. Communication of the future is going to be the communication services and digitization. For instance, modern booking and ordering processes, smart homes, and generally more flexible processes influence everyday life as well as the world of work. Digital change does not stop at communication either. Telephones, smartphones, and the Internet are changing human interaction. With chatbots and artificial intelligence, modern ways of establishing contact are possible. While the methods used to look different in the past with cave painting, parchment scrolls, and Morse code, nothing has changed about one statement:

> "You cannot not communicate."—Paul Watzlawick

From telephoning to texting: Communication is constantly changing, and in the age of smartphones, the World Wide Web, and ever-better data transmission rates, it is more diverse than ever. Back then, via drums, courier services, carrier pigeons, or telegrams, communication today is under the digital star. Using the first cell phone in 1983 was a big step, especially regarding flexibility. Because in order to be reachable, the population was no longer tied to one address for receiving messages or calls. Nine years later, sending the first short message service (SMS) was an alternative to making a phone call. The short messages put accessibility to a new level and made it possible to contact the conversation partner outside of fixed times.

Image-text combination: Text messages are still prevalent today. Above all, digital natives and Generation Y are among those who talk less over the phone than over short message services. What was initially sent via SMS now finds its way worldwide via Internet-based services such as WhatsApp or Threema. Social networks such as Facebook or Twitter are also modernizing communication. While conversations often took place face to face between at least two people or within a conference, an entire community now takes part in the news. With apps like Snapchat and Instagram, an image-text combination is also coming into focus. That means: Communication between two or more people is no longer just over the phone or in writing but also via pictures anytime and anywhere. Sending emoticons and photographs is now available in various messenger services—as is the integration of voice messages. So there is still the chance to speak to the other person via short message services instead of making a phone call.

Communication will continue to change in the future, primarily in discussion: 3D video telephony. Accordingly, communication should no longer only take place via the screens; instead, the other person should be virtually projected into the discussion room without being present. The communication itself then takes place via special glasses. Virtual and real content merge—"mixed reality" is the keyword. The communications industry expects considerable further developments and opportunities from this. But for authentic representations, those responsible first need the appropriate technical prerequisites. Although good image quality is already possible in two dimensions, it still takes patience to play back high-quality images in 3D.

The virtual self: The possibility of communicating via avatars and holograms goes one step further. In this scenario, images of people are created on the computer using scans and algorithms. The avatar's movements can then be controlled independently of the recordings on the PC. This also makes it possible to send the virtual self to places without actually being present. This topic was already dealt with in detail in the well-known Hollywood film "Surrogates"—and should find its way into reality. This type of communication can play a role, especially concerning consumption. In this example, the avatars are sent out for shopping. This can be in grocery stores or clothing stores. The communication between machine or avatar and human is therefore becoming more critical—and may even develop into a predominantly machine-to-machine communication if not only the population but also companies in their business atrocity.

Information overload is also highly traded in connection with future communication: Big Data. After all, digitalization is changing the tools people use to communicate and exchange information. The focus is shifting to people who no longer only pass on messages and data via mobile and stationary end devices but act as transmitters themselves. This means a constant exchange between the person and their environment. This means that people around you immediately know, for example, the name, age, or hobbies of the other person. However, it remains to be seen what these representations might look like. A type of data and information exchange in its infancy is already being used in so-called wearables. For example, fitness trackers collect data such as the number of steps taken, calories burned, or heart rate. This information can then be viewed on the tracker itself or in an app, from which it can be shared with other interested parties on social media simultaneously.

Think emails: When looking at the possible future of communication, one thing stands out—there will probably not be any new means of communication. Rather, the existing ones are constantly evolving with the possibilities of the digital revolution. This is also the case with the already established email. The address of the recipient should therefore be more emotional and thus also more personal. Through targeted addressing in different senses (so-called sensual-musical codes in emails, supporting images, and movie clips in the background), fellow human beings are included even more explicitly in the communication process. Other aspects discussed here are artificial intelligence and thought transmission because: email programs should be set up so that they learn something new from email to email. This means that with the help of an algorithm, the programs develop further, recognize recurring communication tasks, and make it easier for the sender to transmit so-called smart mails. In addition, control via facial expressions and gestures should be possible in the future.

Communicate virtually: In addition to everyday life, digital change also affects communication at work. Managers are now adapting the framework conditions to modern, digital realities. From the error culture to the management culture to the work processes—the changes associated with digitization influence numerous strands in companies. Since managers rely more on virtual teams due to decentralized locations and internationalization, the change also affects communication. With the help of computers, smartphones, and the Internet, this is now

technically easier to implement than it was a few years ago. But the challenges lie in the agreement of changed requirements of the employees, increased demands of the customers, and the existence in a steadily growing market.

Controlled communication? With all the innovations, opportunities, and possibilities, however, two aspects must not be ignored: data protection and security. Because the increasing amount of information and data also increase transparency, people develop into transparent individuals (Cyba 1998). Is it true that digitalization and changing communication result in opportunities and possibilities—for example, long-distance relationships, families in different countries, or overlapping deadlines. Fractionally with data protection, is the data always available for everyone, or will there be guidelines and settings? And what about security in this context? Those responsible still have to address aspects to control the developing communication from the start.

Human-computer interaction or so-called man-machine communication: Humans, interfaces, and technological systems are rapidly becoming a single entity that is encouraged in the wake of Industry 4.0. The question remains if as many human-machine arrangements as possible bear our progress. Does it not rather defy us than encourage us? Do the constantly evolving technical opportunities unite us? Or are they detaching us from the essence of who we are as human beings? Communicating with one another, resolving problems with one another, and merging together are all part of humanity. We are surrounded by an ever-increasing number of machines—both in our private and professional lives. Starting with a smart home that promotes security and comfort, it extends to digital factories and fully automated workplaces, and they are all controlled by a mobile dialogue solution. Are hardware, software, and especially AI nowadays and in the future intruding into the last barbican of human communication? Are chatbots and voice assistants such as Siri, Alexa, or Google Now about to replace the conversation of two real human beings?

If the content is excellent: Both yes and no, since AI is intelligent—as the term already indicates. Voice assistants constantly learn; they are able to listen, to speak, and to comprehend the information. They can certainly have a high intelligence coefficient (IQ). This presents a number of supremacy features. The navi control of a vehicle allows us to keep our eyes and awareness of the traffic because we are talking to the voice assistant and not have to use our mobile phone with our hands. For hotel searches via smartphone and customer service requests to the telecommunications provider via phone call, it works great. So, in terms of content, definitely.

What is lacking is emotion, because the machine lacks emotional intelligence (EQ). I am able to communicate to a customer information system what exact function has malfunctioned, but the system still cannot understand how annoyed I am. It is not that intelligent, after all. And that is in all conscience clear: at the moment, it is a pristine setting of the written language, in which voice and body language are missing.

When there is a lack of empathy: If we take for granted that verbal communication was fabricated to manifest a need, desire, or feeling, so being honest, the verbal expression alone is unable do that. It takes also, e.g., the right attitude and tone. A

term like "great" can sound sarcastic, nonsensical, flattering, or enthusiastic, depending on the pronunciation and facial expression. Anyway, the statement could be very different if one can recognize the subtlety of the sound. To perceive those messages, one does not require to possess intelligence but rather empathy. The thing is, smart people often do not see the nitty-gritty—like highly intelligent chatbots (just trust me on this one). If a customer says "*super*," that means customer satisfaction: this is the system standard setting, as registered in the beginning and recognized, no matter how mockery and offending it was said.

When communication is relational: Relationships between human beings are created to over 75% by personal communication. Contrariwise, it is also true that the same 3/4 of communication is relational: better or worse. And as this ¾ of the communication is not insignificant, the certitude persists that human communication will be impossible to substitute by anything that is not just about a purely pertinent hint except if we are earnestly considering the relationship with an electronic of holographic gadget. If we try to replace it, it can end in a disaster.

As a kid, I was sure I could collect smiles (positive energy), and as soon as I was in a crowded place, I was smiling at every person coming across me. Most strangers, I mean the majority, were smiling back, and I used to trust in the magic power of one smile. The funny thing about it is that it was really working. In virtual communication, it is different. I hope and see the future of human communication in the magic power of a smile. It is positive energy, independent of the means of communication, if it is a real-world or virtual contact or maybe a communication method, that we do not really even have in our widest phantasies yet.

> "The future belongs to those who believe in the beauty of their dreams."—Eleonore Roosevelt

1 Input from Interviewees

Muna Abusulayman
Social impact and development leader; co-founder of Healthkey Technologies, Partner Transform VC

The severity of misinformation and its negative impact will be accelerated as the sophisticated and realistic distortions of reality through deep fakes and AI will allow it to flourish, creating severe polarization and discord. This will affect our everyday lives, as well as scientists and government high officials will be under continuous coordinated attacks.

Thomas Arnoldner
CEO, A1 Telekom Austria Group

The future of communication means that everything which can be connected will be connected. People and machines will be seamlessly interacting at rapid speed without any hassle, even in today's underserved areas. Consumers around the globe

will not sense this network layer and the Internet of Things will be as natural as taking a phone call today. The basis for connectivity lies in digital infrastructure, which will impact our growth, prosperity, and competitiveness throughout the next decades. The two main trends of our times, digitalization and sustainability, are empowering people to make use of new digital services in an environmentally friendly way. Autonomous cars; drone taxis; holograms; outstanding innovations in health care, education, and entertainment; and many more we cannot yet imagine will move from science fiction into reality.

Gina Badenoch
Social entrepreneur and photographer; founder of Ojos que Sienten AC and Capaxia, UK

I really don't believe that technology will take over basic human values, like tolerance, love, compassion. The world will never be a robot. There is a growing need for balance, people going into yoga, mindfulness, meditation. Technology will reach a point when enough is enough.

Jesmane Boggenpoel
Author of My Blood Divides and Unites

In 2050, human interaction will infuse mixed reality and screens more than ever that will advance how we educate, collaborate, and innovate. We need to shape this world so that we leverage technology while retaining the essence and sacredness of human connection. Thus, people must intentionally carve out time for "pure" human interactions that are not veiled by screens. More formal interventions will be needed to address digital addiction. Tools for youth to encourage deeper in-person interaction should be created.

Svetlana Flottrong
Entrepreneur, marketing, and business consulting
EUNYSS Business Solutions company

Since 2010 the world has been living with the cult of beautiful pictures. Already now we see the phenomenon which is called advertisement blindness. In order to avoid it, the business has moved to the direction of video creation and performing. This tendency will go on in a more sophisticated way. The business will compete in the ability to catch your attention. You will be surrounded with VR and AR video content everywhere and each minute. And all this content will come to you through smart glasses, bio modification tool, and other devices. Pupil eye tracking and thoughts tracking will definitely be a part of it.

The next 30 years will be under the motto: permanent influence, mind control. People will try to find some space for privacy.

The WWW will be converted into something unique where all information, data, mindset, training, business, etc. will be consolidated. Let's call it "The Source."

There would be two main forms of everyday information flow: offline-human communication (OHC) and human-computer interaction (HCI).

OHC means the process of live face-to-face message transmission between two or more persons with the intent of creating a shared understanding.

HCI is a process of information transfer between people and all forms of computer and data centers.

There will be more HCI in our life than OHC.

OHC will be a social privilege not a social norm!

Direct everyday human ties will be severed. They will be replaced by augmented reality and virtual reality.

Our main accessory will be a headset like smart glasses. It will be the main source of entertainment, information transmission, and also main control tool. We will use it either for info, news searching, for video calls, and for video conferences, for all kinds of communications. All our Internet search history, digital trace will be captured and analyzed by AI. All this info will be gathered by "The Source."

"The Source" will own all information and herewith the world, . . . and the people.

Digital trace will define your "personality" for the employer and consequently your social status and standard of living. That is why people will try to take under more control their presence and future: they will resist the fact that AI can define their life and the life of their children. They will become more selective and careful with HCI in order to modify their "digital personality" for AI.

"The Source" will offer bio modification tool for improving people's communication style (standard of living), namely, brain stimulation to improve its performance—telepathy, accelerated learning ability. You won't have to implant anything; it will be a head set with the function of transcranial electrostimulation. People will be able to transmit thoughts at a distance and you won't need even to phone in order to talk. Great, very convenient. But it will have also additional veiled functions: "The Source" will get the possibility to control, gather, and analyze your thoughts. Nothing personal just business.

At first people will be in euphoria from the possibility to become the better version of themselves, to obtain the best expertise in their business field with the help of bio modification tool.

But afterwards the humankind will realize the price for it: total control, loss of emotions, less individuality, no direct people connections (no need—you can do everything remotely), loneliness, social vacuum. OHC will be equal to zero.

People will look for private space and alternatives and will come back to books, real one, not digital. There can't be pupil eye or thoughts tracking when you read a printed version of book. Printed books will be a new treasure, as the prior tendency was to go digital; by this moment printed media will almost disappear.

People will try to live out of the big cities to get more freedom. New digital free social communes will appear where OHC will be the rule not a wish.

Real live teacher (not a digital one) who can adapt the education process of your kid to his abilities, who can improve them and his knowledge without bio stimulation tools will be also a privilege.

Though you will get the opportunity with the help of bio stimulation to learn as many languages as you wish, people will tend to improve their abilities and knowledge naturally and to talk and understand other languages by themselves without any artificial or bio modification tool. As it will be an issue of cybersecurity, business will tend to hire such "natural" interpreters for their negotiations in order to keep their business secrets inside the "small circle." The people able to talk different foreign languages without any bio stimulation tool will be in high demand.

The society and human interaction will be more complicated than they are now. The development of technology and manipulation of our thoughts and behavior will be very much affected by "The Source" and the digital world. However, the humankind, remembering the past, will learn its lessons and get back to traditional ways of communication, learning, teaching. The world won't launch a new revolution against the digital progress, but will undergo some kind of turnaround and will reduce the role of "The Source" and establish a new format of being digital at one side and caring about traditions, privacy, and the right to be an individual at the other side. The new combination of both streams will allow to develop faster and in a much more perspective way.

Bob Macmahon
International affairs journalist; managing editor, Foreign Affairs Magazine, Council on Foreign Relations

I see further consolidation of legacy media, like Times, CNN, BBC, etc. But also the individual from his bedroom will be able to influence world media event. Distribution of information is really widespread today. Diplomats need to be able to use Twitter, use new media; more complex, more multipurpose diplomats are emerging. Cyberthreats will be increasing in the future.

We will see demand-driven as opposed to supply-driven news consumption in 50 years. We will have the ability to access issues you care about. Real-time updates, access to the best possible sources, in different languages. Streaming will be available in a more coherent way than now. Future will be more about organizing all the available info (data mining). A bit like the movie minority report. Link up anywhere you are and be presented with choices, i.e., personalization of news.

Olivier Oullier
Professor of behavioural and brain sciences; co-founder and chairman of the Board of Inclusive Brains

The end of death is something big tech companies have been working on for a while. By end of death, I mean end of physical death.

When you physically die as a body, your mind could survive in a non-biological way, being uploaded in the cloud together with your memories, who knows?

Let's say one wants to bring Marie Curie or Albert Einstein back to life virtually. This would imply not only recreating their brains (which will be possible eventually). Yet it'll be hard to train those brains with all the events, emotions, and experiences that shaped their lives. This seems difficult. YET.

Maybe in 20 years there'll be biomimetic tech that will store everything you do. It could help "uploading one's brain to the cloud." But bringing back Lincoln or Bach will be so hard, I think, as we won't be able to recreate the interactions they had.

David Rodin
Moral and political philosopher; founder and CEO of Principia Advisory

Next generations should think carefully and rationally and with fired passion. Honestly and rigorously ask questions about the world around us. We shall embrace the process of deliberation and exchange of ideas.

Caroline Schober
Vice rector of Research and International Affairs at Med Uni Graz

Today, we are talking to (or texting) each other over our mobiles. Soon our mobiles (or a chip in whatever is around) will sort out all the organizational issues for us by themselves. So we are left to chat our time away—or really connect, i.e., not to the Internet, but to each other. We should put a real effort into practicing the ability to say something (not just talk) and listen attentively over a prolonged period of time to our fellow human beings. Feeling connected to others is key in feeling understood and secure—a connection that cannot be substituted.

Tobby Simon
Founder and president of Synergia Foundation

Ability to communicate with people very well is for me the most important. People tend to use the left side of the brain more prevalently. Technology is becoming so empowering that you see almost nobody anymore. In the future maybe kids don't need their parents anymore.

Ian Solomon
Professor of practice of public policy; dean, Batten School of Leadership and Public Policy

Pace of innovation and advancement in technology, but not in human cooperation and problem-solving. I would like to see technological advancement applied to how humans interact.

Our social technology should also be developed. New generation should be helped to solve problems more peacefully. We have the tools and ability to address main challenges, but how should we cooperate. How to deal with zero-sum mentality, working together.

I am not so concerned about a pill to be developed that would allow people to live forever.

Mark Turrell
Strategist, educator, and entrepreneur; founder and CEO of Orasci

Power of the masses (humanity 3.0). Complex systems surround us, analogies (human society moving away from being a chimpanzee brain to a human brain);

humanity is the collection of human connections; we are rewiring the planet, as we are becoming a sharing society.

What are your drivers in the next 50 years? I mapped out my plan to change the world and I am implementing it, e.g., scaling and spreading. Most people fail because they don't spread stuff. This secret sauce of spread makes me be involved in many things. I want to do new things every day!

Stefan Verra
Body language expert

Don't get me wrong. I am a tech aficionado and highly interested in new things to come. But with every new technology we run the risk of neglecting our human needs. Being appreciated, being listened to, being loved. I predict that with every step toward an artificial reality humans will find ways to connect on a real-world personal level.

Lisa Witter
Executive, serial entrepreneur, writer, and public speaker; co-founder and executive chairman of Apolitical

Now I am seeing new voices emerging, lot more voices, influencers. Role of a curator and trusted advisor is imperative to filter voices. Nods of influence will change which will have a fantastic effect on how to solve problems in the world.

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Future of Sex and Gender

Tamás Landesz and Karine Sargsyan

Abstract

The sex tech industry is set to experience significant changes as it grows in value and attracts more users. The industry is often divided into five main branches: remote sex, robots, immersive entertainment, virtual sex, and augmentation. Virtual reality (VR) technology has the potential to transform sexual experiences, allowing people to explore different identities and experiment with new sensations. Haptic and multisensory experiences will revolutionize virtual sex, and virtual sexology will enhance people's sexual skills. The COVID-19 pandemic has had an impact on sexual lives, with people turning to sexting and sex toys. The article explores the possibility of humans falling in love, marrying, having sex with robots, and merging with machines. VR contact lenses may even enable dream-based sex. However, the article notes that human touch and contact remain crucial in sexual experiences and technology cannot fully replace them. Despite new technological developments the future of sex will continue to be about the pursuit of pleasure, while genuine human relationships will remain essential.

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Interviewees
Malak Al Akiely
Georgie Benardete
Silvia Console Battilana
Carola Ferstl
Rossana Figuera
Sadiq Gillani
Rebeca Hwang
Lily Lapenna
Pia Mancini
Kate Roberts

> In the future, we will have sex with whoever we want, at any time or place that we want, at any age that we want—Ray Kurzweil

Ask your partner in bed "how do you want me to make you feel?," and not "what do you want me to do?" This year's Valentine's Day seemed like any other; those in coming years might be wildly different.

In 2017, the sex tech industry was valued to be a 30 billion US dollar industry with a growing rate of 30% per year. (Goczynska-Han, 2020). Talking about sex has still many taboos in most cultures. Technology can make sex more approachable and easier to talk about with people who matter the most.

Women are stepping into this male-dominated business sector, which will be transformative. We are likely at the dawn of a new sexual revolution. Currently, the sex tech business is like the Wild West, with no rules and very little ethical considerations, e.g., having sex with a robot takes away consent from the act. But this will certainly change as we move into the future.

A report on the Future of Sex classifies different branches of the sex tech industry. These are (i) remote sex; (ii) robots; (iii) immersive entertainment; (iv) virtual sex; and (v) augmentation (Owsianik & Dawson, 2022).

In her TEDx talk "The Future of Sex", Bryony Cole shared her perspective on the future of sex and technology. In the virtual space, you will be able to go on a date on Mars, swap bodies, and have sex exploring different identities. This will question our traditional preferences and our humanity will be looked at through different prisms over time (TEDxTalks, 2019).

A 2020 survey found that more and more people, would have sex with a robot (Nguyen, 2020). Will we consider it cheating, having sex with robots? According to forecasts, in the next 30 years, one in ten people will have had sex with a robot.

Gender-neutral perspectives are emerging in the real world, further facilitated by the virtual world. Haptic, multisensory experiences are set to revolutionize virtual sex. As a result, "peculiarities of vaginomics" may become a technological field of research.

In the virtual realm, porn is the obvious driver of innovation, which is not always without negative consequences, e.g., deep-fake porn where faces can be swapped to portray anyone (including politicians or celebrities) performing a sex act and

published online. Nevertheless, the development of virtual spaces and technology allows other areas to emerge. Virtual sexology promises to make you a better lover; sex education will be able to create an immersive private environment where one can fully explore sexuality, or sex education programs will teach boys and girls about consent.

The need to limit travel and to introduce lockdowns amidst the pandemic impacted our sexual lives like nothing before. Many had no physical contacts with their partners for months, and as a consequence, we had to adapt. As work and shopping increasingly turned to virtual solutions, so did sex. Sexting saw a rise as did the sale of sex toys (Dubé et al., 2020). According to the Future of Sex report, more than 25% of young people will have had a long-distance sexual experience (Owsianik & Dawson, 2022).

1 Love and Sex with Robots

The popular American HBO show *Westworld* depicted inhumane violence that humans can inflict on robotic companions. Robots are machines intended to make human lives better, but some fear they will steal our jobs and our hearts. Male robots are called androids, whereas female robots are gynoids. In Westworld, advances in the field are taking them into the more complex domains of sex, emotions, and love.

> Humans will fall in love with robots, humans will marry robots, and humans will have sex with robots, all as (what will be regarded as) 'normal' extensions of our feelings of love and sexual desire for other humans (Levy, 2007).

One in ten young adults will have had sex with a humanoid robot by 2050. Adult performers and some B-list celebrities will sell robotic replicas of themselves designed for sex by 2033. Sci-fi sex fantasies will spring to life as people can enhance their biology and merge with machines.

> Erogenous zones and orgasms are simply the product of chemicals firing in the brain. If scientists can replicate that feeling by firing signals from an implanted chip or a brain wave headset, then it might even be the end of sex altogether (Istvan, 2014)

In the far-off future, technology could develop that directly stimulates the brain. Orgasms could be produced instantaneously. Nevertheless, this is nothing new, and we do need self-regulation to control our desire to get satisfied and pleasured (Williams, 2019). In an experiment from 1958, John C. Lilly generated a sixteen-hour orgasm! Science is science, and scientists are curious by nature, so Lilly decided to explore the "infinite meanings," possible addictiveness, and capability of the body for orgasm through his experiments: he built a little box with a button (remote control), so that the monkey, by pressing the button, had a complete orgasm induced by a fine wire electrode into the brain. But the system was programmed so that the monkey could press the button once every 3 minutes only, meaning that the monkey had to wait 3 minutes to get another orgasm. Guess what

happened? The monkey pressed the control button every 3 minutes for 16 consecutive hours and then fell asleep. After about 8 hours of sleep, the monkey again pressed the button for 16 consecutive hours and then went back to sleep for another 8 hours. The team had to stop the experiment because the monkey had lost its memory. He just wanted to push that button and had forgotten to eat, drink, etc., for many days. Direct stimulation without control mechanisms can also cause harm for a human (Williams, 2019).

According to UK futurists, in 2050, sexual contact between a person and an electronic device or a robot will occur more frequently than between two people. Futurologist Ian Pearson (2016a) predicts the spread of sex toys interacting with augmented and virtual reality. New technologies will bring an intimate relationship with robots to such a level that they will not differ from interpersonal contact.

Pearson believes that there will be a best of both worlds. Human and emotional relationships will continue, but they will be separated from sex or else made better and safer by the use of technology. You could download your favorite star avatar during physical sex, getting the security, affection, and hopefully love of being with a real partner, along with the option to indulge your wildest fantasies.

Pearson predicts that many people will still have their reservations about sex with robots at first but gradually get used to them. The mechanical behavior and their feel will improve, as they start to develop strong emotional bonds, and any squeamishness will gradually go away. As well as enhancing appearances, virtual reality (VR) will help those who feel unfulfilled to explore their sexual fantasies and to unleash their imagination, alone or with their partner.

Night clubs will soon be using robotic dancers. The robots will be pricey, especially if it features humanlike soft materials and is able to imitate human moves. The robots even come with a customizable personality and only the emotional baggage you want. A perfect solution for people who want sex with no strings attached that excludes emotional feelings and commitment.

There is also a prediction for robot fetish or the sexual desire for statues or mannequins. But can you fall in love with a robot? Can the robots fall in love with you?

2 Dream Sex

Another feature of the future VR headset is that it can be replaced by active contact lenses. Tiny lasers or LEDs will allow written images directly onto the retina. Ultrahigh-definition display overlaying will replace whatever or whoever you are looking at. Controlling this could be through one's thoughts, eyebrow muscles, or simply blinking.

Can you keep the contact lenses on while sleeping? The contact lenses would lie under your eyelids, so you could still see images with your eyes closed. While sleeping, they could be linked to a computer that detects when you are in a dream state and what images you are seeing and then injects images or video to enhance

your dream. Go one step further and link your dreams to others dreaming at the same time.

Our world will soon have virtual reality technology, dream sex, and directly stimulate orgasms by the touch of an icon or instant message. Apparently, this will make sex easier, safer, more frequent, and more fun. Pearson (2016b) predicts that by 2030, most people will have some form of virtual sex.

There will still be various innovative porn subscriptions and the pay-as-you-go webcam sites that we already have, but virtual reality will create lucrative 3D opportunities that offer lots more fun and feeling or personal involvement. Use a 3D immersive environment to interact with graphics and environment customized to your preferences, with a variety of gadgets providing the physical sensations.

VR offers to combine the best of imagination and reality. You can even use avatars as well as real people to fulfill fantasies. It will need tools to adjust appearance and behavior and a range of devices to connect bodies to information technology for the sex experience. VR contact lenses will allow you to see a different person than the one you are having sex with, such as a celebrity, and you can even instantly change their face or costume. Of course, this would require proper regulation in order not to spiral out of control, similar to Lilly's experimental monkey hitting the button.

According to predictions published by the 2050 Earth Project, sex toys will continue to play an important role in enhancing and exploring people's sexuality, even with the rise of digital dating and a more distant world. Physical touch and the desire for it will still be crucial in sexual experiences, both alone and with a partner. While tools such as specialized gloves, helmets, and glasses can help create a virtual erotic experience, human contact cannot be fully replaced by toys or robots. And new ethical questions will emerge as the technologies evolve.

3 A New Reproductive Revolution

The article by Brandon Ambrosino (2019) for BBC Future explores the possibility of a new sexual revolution where more people will choose to conceive in a lab through in vitro fertilization (IVF). Greely (2018), the author of "The End of Sex And The Future of Human Reproduction," predicts that in the future, people will still have sex but not as often for the purpose of making babies. The article also notes that the purpose of sex only for procreation has its roots in ancient times, but pleaesure is the main reason why most people have sex. The article references a quote from a 1968 Readers Digest article that suggested the birth control pill could have a more significant impact on society than the nuclear bomb.

Many scientists claim that population rates peaked already and are in decline, to reach 0% growth rate by 2100 Roser et al., 2013. Concurrently, trials are already underway with male contraceptives that do not suppress a man's libido or affect his weight or health, like women have had to endure for decades.

How will gossip look when lab-made men in a holographic bar try to discuss their sex partners while enjoying a glass of genetically modified beer? Will they gossip about new retroviruses that can survive on silicone?

According to Ambrosino (2019), longer life expectancies are challenging traditional notions of monogamy and commitment. With people living longer, the idea of having one sexual partner for life becomes harder to achieve. Divorce and remarriage rates are already on the rise, and some futurists predict that life expectancy will continue to increase significantly. Therefore, the traditional commitment "till death do us part" may no longer be a realistic goal for many people.

Alexis Madrigal has written in The Atlantic that these days, women only have a very general sense of when in their lives they'll stop being fertile, but in the future, women will have more "personalized" biological clocks, so they'll know exactly when they'll stop being able to make babies. Couples of the future will also have a better idea of when they should try to conceive. Personal hormone trackers that detect bodily changes through the skin could become a normal part of tracking our fertility (Madrigal, 2014).

Researchers are exploring genetic engineering as a way to cure sick children by removing or replacing genes. In the future, technologies such as CRISPR may also be used to enhance children by correcting issues such as crooked teeth or poor eyesight, potentially even improving IQ (Big Think, 2011). These advances raise unprecedented moral, philosophical, and regulatory implications. For example, if genetic modifications are done on the germline, they will be inherited and passed down through future generations, raising dystopian fears of re-engineering the human species and opening the door to misuse. But without a doubt, gene editing will revolutionise the prevention and treatment of diseases and conditions including cancer, as long we ensure global access and democratization—or will only the rich be able to afford it? How will gossip look when lab-made men in a holographic bar try to discuss their sex partners while enjoying a glass of genetically modified beer? Will they gossip about new retroviruses that can survive on silicone?

4 Shifting Gender Roles

A study by Oxford University has shown that as more women join the workforce, household dynamics will continue to change. The study predicts that by 2050, men and women in many developed countries will share childcare and household chores.

The future may bring a crisis of masculinity as robots replace men, mainly affecting blue-collar male workers. While it is not easy being a woman, it may be increasingly challenging being a man. In the United States, for instance, a record number of more than 100,000 people died last year of drug overdose of which 70% were men. In China, authorities are worried about a "masculinity crisis" as Chinese boys are becoming 'less masculine', and they are trying to strengthen the "yang spirit" in order to balance the more feminine yin force in Taoism.

The Japanese media often write about "fasting men," where 43% of unmarried Japanese between 18 and 34 are still virgins. A related phenomenon is the

misogynistic "incel" movement in the United States and Canada of men who label themselves as "involuntary celibates." They often turn radical, blame women for their lack of access to sex, and spread conspiracy theories.

But as technology advances, a face or costume can be customized and changed at an instance. Therefore, you might sometimes experience one gender and sometimes another, including while performing sex. Will people become accustomed to gender experimentation, making sexuality more fluid?

With sex now influenced by engineering and imagination, new categories could also be created, including new kinds of genitalia, gender roles, and behaviors. Gender fluidity with robotics is definitely a debated subject.

Alan Winfield, a Professor of Robotics at the *University of the West of England, Bristol*, has some "serious doubts about the morality of designing and building robots to resemble men or women, boys or girls." He says that designing a robot with a gender is deceptive. Giving robots a gender does not have "any meaningful sense." Therefore, he feels by "gendering and especially sexualising robots we surely objectify." Meaning the robots are no longer an object but a sexual representation of a woman or man. Hence, he says "sexualised robots will surely only deepen the already acute problem of the objectification of real women and girls." So, non-gender specific robots could well be potential sexual partners in the future (Winfield, 2016).

People will one day (between 2050 and 2065, depending on their budget) be able to use an android body as their own or even swap bodies with another person. Some will do so to be young again; many will do so to swap gender. Lots will do both. Genders can be swapped in computer games, why not "come back" and live all over again as a woman for real?.

5 Input from Interviewees

Malak Al Akiely
Managing Director of Golden Wheat for Grain Trading and Cofounder of Golden Kayan for Oil & Energy

The impact of robotics and AI will be profound; I am on the optimistic side about more acceptance to who we are and what we can be - where visualization becomes a reality! Positive human interaction, mental resiliency, and spiritual communication skills will be more essential and vital to our true human identity, existence, and beyond.

Georgie Benardete
Cofounder Futurian

The global legalization of psychedelics in 2030 will reconnect us to presence and love, and we will search for a post-Tinder, intimate quality in our sexual and human interactions.

Silvia Console Battilana
Angel investor and CEO Auctionomics

Will virtual avatars have incorporated sensors to make remote intimacy possible for couples that are apart? And will you get young generations be shy about in person contacts if the virtual version is somehow enhanced?

Carola Ferstl
Author, journalist, and media personality

I hope that there will continue to be physical interaction between humans. Nonetheless, I believe that technology will enable us to create emotions and sexual hormones artificially, which will hopefully allow everyone to benefit from sexuality. And dissatisfaction will be a thing from the past.

Rossana Figuera
Founder and CEO of Soul Pod Collective

Plant medicine has rapidly elevated the collective consciousness of the human race, once in the verge of extinction. We now understand that there is no "other." We relate to each other as one in harmony with the natural world of which we are part of. Masculine and feminine exist in perfect polarity, relaxed in the protection and safety they grant each other. We continue to evolve and grow, bound by the universal, infinite source that binds us all: love.

Sadiq Gillani
Thought leader on the travel industry and career/self-development

By 2050, we will move beyond pronouns and labels of sexuality, opening up rather than limiting ourselves.

Rebeca Hwang
Professor of Practice at Thunderbird School of Management and Partner at Kalei Ventures

Today's popular deep fakes are the pinnacle of a trend of performative human interaction that has been brewing for a while: social media videos highlighting fake glamorous lifestyles, short-lived relationships that need to look and sound evolved, and selfies intending to misrepresent influence and access. Influencers who don't quite influence much are rather enslaved to a self-esteem barometer subject to popular validation.

The backlash will be rotund. The next decades will witness the comeback of the desire of deep and genuine connections. Sex—both in terms of gender identity and the sexual act—will become mediums for meaningful linkages, because in so many other realms, the tie is weak. Physical, tangible, and palpable connection through sex will contrast with the more widespread interaction with avatars, metaverse, and digital versions of humans. Sex will regain its functional role: not the historical reproductive goal, but rather, the bridging of humans via a material and substantive interaction.

Lily Lapenna
Founder and CEO of GLEOW Group

Beyond 2050, love will remain the core of the human endeavor. The most important currency will be longevity. The human obsession with extending life is driven by the desire to prolong the experience of love in all its forms. Living into the hundreds will allow us to love across more generations, to have sex, and to procreate until much later in life. Older parents on average will remain youthful, connected, healthy, and energetic and will live to be great great grandparents. Innovation in science, technology, and psychology will allow for us to pursue love for longer.

Pia Mancini
Democracy activist, open source sustainer, cofounder and CEO at Open Collective, and Chair of DemocracyEarth Foundation

The future of identity in 2050 will be both planetary and unique. The future I see or maybe the one I want to see—I am an optimist at heart—is one where human interactions happen at a planetary scale. We have finally been able to move beyond our fragmented identities long enough to see ourselves as peers that steward a commons, this planet. At the same time, identities (including gender and life choices) will increasingly diversify to the point of being unique. That hyper-diversification makes them less fragmented as tribes will become smaller and smaller.

Kate Roberts
Founder and CEO of The Body Agency

In 2050, sexual contact between person and an electronic device or a robot will occur more frequently than between two people.

I see the future of sex and gender in 2050 to be stigma and taboo free, to have the health products and services freely available to both genders equally, and to give equal importance on the reproductive years of a woman as well as menopause and beyond.

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Future of Consumption

Karine Sargsyan

Abstract

The development of the Internet and the ubiquitous technologization of retail have become one of the fundamental driving forces transforming the whole picture of the world. Changing the essence of the product—changing retail and changing end users' expectations and novel comprehensive real world are affecting customers online behavior, where and exactly how they choose and buy, and the very concept of a product. The new paradigm of the customer journey, that very "relationship" with the customer, provides a wealth of opportunities to justify the value of their product. Technology will not only facilitate convenient and fast shopping but increasingly satisfy the customer's curiosity inclined to experiment with new products. The source of these metamorphoses will be the solutions of the future: predictive analysis, processing, and collection of big data, virtual, and augmented reality; machine vision; cashless experience; intelligent loyalty programs; a unified shopping experience in all channels; possible content distribution; built ecosystems; speech technologies; blockchain; and many other solutions that seem to us still a curiosity, but this is already a wonderful present, which is actively used by many.

Interviewees
Fatoumata Ba
Diane Binder
Soulaima Gourani
Sabine Herlitschka

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Olivier Oullier
Barbara Steiner
Lisa Witter

> The consumption society has made us feel that happiness lies in having things, and has failed to teach us the happiness of not having things.—Elise M Boulding

A global consumer revolution is at hand, and an unprecedented rise in the global middle class will accompany it. Nearly 3 billion people—more than 40% of the world's population today—will join the middle class by 2050, and virtually, all of these people are from developing countries (HSBC bank economic analysis). This group will consume up to two-thirds of all goods and services (now one-third). Experts note that developing countries are already actively adapting new technologies, equipment, and management skills. This leads to an increase in labor productivity and real incomes of the population, and the positive trend so far has no prerequisites for a change in vector. Spending on food and other essential products is becoming a smaller share of the consumer basket of people in developing countries who have more money left to improve their quality of life. Suppose developed countries provide less than 2% of the annual growth in the consumer market over the next four decades (Cingano, 2014). In that case, countries such as Russia, China, India, the Philippines, Peru, and Malaysia will be able to demonstrate an annual increase in the real incomes of the population. This will nevertheless also depend on the shops and their functionality. What will a retail space look like in the year 2050? Future shopping, a word combination that evokes excitement and fear, especially regarding the picture of the future of trading. Are there really no shops, shopping centers, and everything that businesses and buyers are so used to on the market map? And if they remain? In what form? And what scenarios of interaction with the buyer will be applied in them? Changes are happening so fast, and it becomes so difficult to comply with them that it makes sense for retailers to look closely, listen, and try on even the most fantastic forecasts. After all, when the author of utopian novels Edward Bellamy back in 1888 in the novel "Looking Back" first described plastic cards that can be used to pay in stores, his fantasy was hardly taken seriously (Bellamy, 1888). However, here they are—filling our wallets, significantly displacing cash. And even they are gradually leaving payment scenarios, giving way to AliPay, Apple Pay, SelfiePay, and other payment mechanics. Changing consumer values and needs has become a new factor that largely determined the development of retail, and technology has become one of the fundamental driving forces transforming the whole picture of the world (HSBC Trinkaus & Burkhardt 2012). They will remain the factor dictating significant shifts in trade structure in the near future.

In 30 years, everything will be different! But how exactly? Imagine the consumer of 2050 and their new lifestyle. By then, the traditional district, with its residential, transportation, commercial, entertainment, and retail elements, will be overflowing with technology. Most residents will need to forget the usual office locations and work at home or in coworking spaces. As a result, the number of citizens using

transport and moving around the city on a daily basis will also decrease (Amador de San José, 2021) (see Chapter 8: Future of Transporation). Consumers can get what they want without leaving home or as close as possible to their habitat. Personalization will rule the show, which bots and numerous robotic assistants will provide. Retail outlets will become experiment centers where customers can test products only to have them delivered home. The margins of real life and virtual reality will blur as customers seek more entertainment and experiences. The research company Euromonitor International conducted a study that resulted in a vision of what retail stores will become in this distant and, in fact, the very near 2050 (Bogdanova, 2021). How will retail develop, and what new retail formats may appear in 30 years?

Changing the essence of the product—changing retail and changing end users' expectations and novel comprehensive real world are affecting customers online behavior, where and exactly how they choose and buy, and the very concept of a product. For Karl Marx, everything was quite simple: "A commodity is a product of labor that can satisfy any need of the buyer and be exchanged through purchase and sale." (Marx, 1867) At the same time, according to the economist, a commodity has only two properties: the first is the use value created by specific labor; the second is exchange value or the value created by abstract labor. In 2023, the "life" of a product has become much more enjoyable. It has become not only a subject for exchanging "goods - money" but also an occasion for dialogue between the producer and the consumer. And this trend will intensify, changing the entire structure of retail. Now shopping is a journey into the world of relationships, subject to more than one clear goal—buying. The perfect journey provides added value during the search, selection, and after the purchase, turning the transaction into a long-term "romance." This scenario turns the classic game on its head, where the retailer offers and convinces and the consumer agrees. The customer demands, and the manufacturer and retailer try to meet these requirements. This way of relationships has largely corrected the basic concept of trade—the price, as long as the cost of the final product is in the basic range, is an essential factor influencing the purchase decision. However, for retailers who find it difficult to compete on price, the new paradigm of the customer journey, that very "relationship" with the customer, provides a wealth of opportunities to justify the value of their product. Physical points of sale will remain an essential part of the customer journey and will continue to play a role in 2050, although their functions will change. A total of 47% of consumers worldwide want to "see or try" a product before buying (Agbanrin, 2019). And the main destroyer of the traditional way of trading will remain the Internet—great and powerful. Modern consumers are no longer perceived in isolation from gadgets and the Internet. The total availability of the Internet and round-the-clock online mode provide a new level of convenience, simplicity, and awareness.

The total availability of the Internet and round-the-clock online mode provide a new level of comfort, easiness, and awareness. As a consequence, buyers are becoming more irritated, testy, and tough to satisfy. Their awareness is also becoming a new challenge for brands and manufacturers, which dictates new scenarios for communication with the audience (Decker, 2022). Brands and retailers have no

choice but to follow the buyer along his path and catch the latter in all channels: in the online store, application, messenger, or social networks. According to Euromonitor analysts, physical stores will not disappear completely—they remain an experimental platform where you can see, touch, smell, or try on goods. Categories such as clothing, accessories, and cosmetics will also remain in demand in physical retail. Virtual reality and 3D images in 30 years will not replace the emotions caused by direct contact and "live" study of these product groups.

Along with the bigger share of digital technologies in trading, the impulse to be exposed to "more" generates a fundamental shift in customer needs and appraises. Consumers prioritize experience above purchasing more products. And it is precisely the provision of a unique experience to the audience that will continue to help brands justify a higher retail price than competitors. How the "face" of the retail store will change with each passing day, the separation of the purchase decision from the physical outlet is felt stronger. And retail will increasingly use technology and innovative solutions to remove barriers between the product offer and the buyer, whose needs for everyday purchases will not decrease. Technology will not only facilitate convenient and fast shopping but increasingly satisfy the customer's curiosity inclined to experiment with new products. First, physical retailers will be responsible for making impulse purchases and purchasing consumer goods with limited regularity. Wearable technology and voice assistants will guide the shopper through the retail space; merchandise will be automatically inserted into a virtual order list; and humanoid robots will handle the sale service, inventory, and even the management. The emergence of a new format of experimental spaces on the territory of which will be tested products require more thorough study.

Retailers may charge a fee for entering such exclusive locations, offering customers a unique experience in return. It will be a hybrid format that combines the presentation of interesting products and unusual practical activities. Examples of such locations are already appearing in current Russian retail. Thus, the largest DIY retailer Leroy Merlin launched the Idea Factory. Master classes are held daily in the new space, where visitors to the hypermarket can create interior elements or lovely gifts with their own hands. Thus, creativity becomes the basis for testing an expensive tool and new, unusual materials, and it is possible that it is after such contact that the buyer decides to purchase a hitherto unfamiliar technique or interesting raw materials. Key features in the future retail store areas: The development of online commerce and the ubiquitous technologization of retail will inevitably lead to changes in a store windows' design and delivery scenarios.

Grocery stores everywhere organize separate entrances for receiving and issuing online orders. Thanks to video monitoring systems, retailers will learn to identify visitors who already have access to the trading space to make them the most relevant offers. Shop windows will finally lose their decorative function and become a platform for informing the audience about prices, new offers, products, and activities. Entry and exit biometrics will identify visitors at the entrance of the store and, as a result, make personalized offers to customers. Cash desks will disappear at the exit—payment for purchases will be created automatically when leaving the outlet. As mentioned earlier, for the convenience of serving online

customers who purchase using the click and collect model, there will be different entrances for those who pick up an order or are just planning to make it. An essential element of the future store will be the test zone, which will use the most advanced VR technologies (Mcdowell, 2020). A virtual fitting room, a virtual mirror, a virtual stylist, or even virtual reality will likely be situated in locations where this or that thing will be checked for fitting. Fitting rooms will be the very last and optional step for a purchase. Thanks to technology here in the fitting and testing area, the consumer will be offered hundreds of options for a complete look or makeup based on the individual data and preferences of the buyer.

Retail in 30 years will be a fantastic sight, and not even the buyer but his digital twin will be at the head of the trade pyramid. The first thing that would surprise today's buyer is that information about the buyer is stored not from the cradle but considering previous generations. It will be possible to build a customer profile for several generations based on robust, intelligent quantum computing systems. But the buyer himself does not participate in this routine because all the "dirty" work on the choice of goods and involvement in marketing activities will be done by the digital twin. There will also be an exquisite evolution of the assortment, which will become not just huge but endless.

Moreover, its expansion will only occur through mass production in the context of releasing personalized goods. An avatar powered by powerful calculations can only choose such products, and our shopping will only consist in putting mental check marks and approving this or that purchase. Shopping will lose the function of choice but will acquire the function of supporting the choice made by our avatar. Based on Euromonitor analysts' forecasts regarding the complete disappearance of cash registers in the form in which they operate now, the cashless service, which is now gaining momentum, will become a natural solution for stores of the future (Konish, 2022). For the buyer, all barriers will disappear, anything can be taken, and many digital surfaces will naturally immerse you in different contexts of using this thing. For a consumer who is hungry for impressions, more than one advertisement, review, or video is needed. And as a result, a new film genre will appear. There will be a "property" cinema: the promotion of goods with the help of highly artistic and emotional films created by artificial intelligence (Agatov, 2020). You will be in the lead role with the product you want to purchase. With new computing power, such films will be created on the fly in a split second. At the same time, the picture of the future retail presented by the author of the concept of "Store 4.0" will not have the usual segments. Shoe retail, clothing retail, mass market, and premium—everything will merge into a single ecosystem.

The task will be exclusively to satisfy human needs, doing this with the utmost barrier-free not only in the context of the purchase process but also in terms of the overall product offer. The source of these metamorphoses will be the solutions of the future: predictive analysis, processing, and collection of big data, virtual and augmented reality; machine vision; cashless experience; intelligent loyalty programs; a unified shopping experience in all channels; possible content distribution; built ecosystems; speech technologies; blockchain; and many other solutions that seem

to us still a curiosity, but this is already a wonderful present, which is actively used by many.

1 Input from Interviewees

Fatoumata BA
Founder and executive chair, Janngo Capital

In 2050, the future of consumption will be. . . African! With a population of over 2.5 billion people, including 60% of the world population below 25 and 40% of the world population below 18, Africa is poised to become both the largest workforce and consumer market globally. By, 2100, nearly 1/3 of the world population will be African. What does it mean? Well, we need to find now massive ways to feed, educate, house, care for, and employ more than 1 billion people in less than 30 years. We believe traditional development models have failed because they were unbalanced and unsustainable either only focusing on commercial returns or too heavily aid-based: our thesis strikes the right balance between delivering solid returns to investors while being socially accountable, solving key market failures, and leveraging capital and technology to help leapfrog development. That's our Ikigai, our reason for being, as Janngo means "Tomorrow" or "Future" in Fulani.

Diane Binder
Business executive and social entrepreneur, founding partner, and CEO of Regenepolis

The system upon which our civilizations have been thriving for over a century is fast destroying the very ecosystems that sustain us for our living—through air pollution, soil degradation, deforestation, and extinction of millions of species. It is also destroying our democratic system and values with global inequalities rising again.

Yet, people are growing more conscious of the fragility of our planet and at times of dire circumstances are looking for improved well-being and health, for an increased sense of belonging and community, and a growing care for impact. It is possible to harness this willpower to shift the system to a more favorable axis, putting the planet and people first, for a flourishing biosphere.

To do so, I believe we need to focus on regeneration, both for our societies and for nature. We need to fight for climate justice, build more equitable societies, and help safeguard the planet for future generations. We need to radically shift our production and consumption systems, the way we live together and relate to one another and the way we measure progress, as we cannot view human progress solely in terms of income and wealth but rather well-being and happiness. We need to make sure we seek prosperity within planet boundaries.

Soulaima Gourani
Entrepreneur, author and keynote speaker, CEO, and cofounder of Happioh

I believe that much of what we know today will still exist in the next 50 years. We will still eat home-cooked food; wear clothes; give birth; and experience conflicts, wars, and love just as we do today.

And all the products in existence in the last 50 years will most likely still be around in the next 50 years. However, a lot of the technologies today will become obsolete and will be replaced with better and more sophisticated ones, which are beyond our current level of comprehension. We stand on the brink of an explosion of inventions that will change our lives to the same degree as the Internet has done or more.

The 3D printing technology will lead us to the fourth industrial revolution. You will be able to print most products at home. In the beginning, you will only be able to print simple things such as a pizza, but over time, it will be possible to print highly advanced products in the privacy of your home. We will own less and rent and share more.

Sabine Herlitschka
CEO of Infineon Technologies Austria AG

Imagine driving in cars with zero emissions and arriving safe and relaxed with no traffic jams. Imagine communicating easily with people and devices by knowing your data is connected and secure. Imagine generating and consuming renewable energies wherever you are in a smart and energy efficient world. Is the future coming our way? No, we are shaping it today!

Major challenges of our times, such as climate protection or future health, need smart, often digital and data-based solutions. We are working already today on smart technologies that achieve more and consume less to make life easier, safer, and greener.

Olivier Oullier
Professor of behavioural and brain sciences and cofounder and chairman of the board of Inclusive Brains

What will be the biggest invention? Teleportation of some sort—things disappear and reappear at least for physical objects. Almost already possible, when printing items and living tissues. Yet, how does one recreate intentions and experiences is the big question.

Barbara Steiner
Director of Bauhaus Dessau Foundation

Turn less into more: Ecosystems have recovered. Humans learned how to turn less into more: first, by increasing resource efficiency and multiplying the yield from every ton of oil, copper, bauxite, ore, and from every kilowatt of electricity and second, by voluntary self-limitation, a conscious choice to live modestly in order to distribute resources more fairly and not disadvantage future generations. The

weariness of consumption as an end in life, socioeconomic inequality of distribution, and the destruction of nature has led to attitude changes. All those measures have helped to reduce the gap between resource consumption and limited raw material reserves.

Coevolution with nature and the use of the productivity of nature itself paved the way, e.g., the conversion of sunlight into energy, the productivity of microbiological processes, and the process chains of organic life that knows no waste. This has led to a new nature-culture relationship and new forms of collaborations between human and nonhuman beings.

Lisa Witter
Executive, serial entrepreneur, writer and public speaker, and cofounder and executive chairman of Apolitical

A lot of what our economy is based on is basics. Political and economic model will shift to a more collaborative model, i.e., communal living. Raise to own, and manipulate the brain.

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Future of Food

Tamás Landesz

Abstract

The world is facing significant challenges in providing food and water security to a growing population without harming the environment. To address these challenges, the production of bioproducts and healthy, high-quality foods will become more critical, with protein coming from synthetic processes and insects. Agricultural production will move closer to where people live, using technologies such as horizontal agriculture, rooftops, synthetic biology, and genetically modified plants. Governments need to facilitate the dialogue surrounding the societal impacts of new technologies related to food, such as nanotechnology and biotechnology. The business-as-usual approach is no longer viable, and all countries must commit to sharing responsibility in implementing fundamental changes, including raising consumer awareness, proper regulations, and more equitable income distribution. The future of food requires innovation and entrepreneurship, supported by a community of researchers, entrepreneurs, and governments to achieve a sustainable, healthy, and equitable food supply chain. This includes reducing food waste through innovative technologies, sustainable agriculture, and significant dietary shifts. Microorganisms will be used to produce carbs, proteins, and fats, with lab-grown meat replacing animal farming. With smart cities impacting food consumption and waste reduction, personalized food products and better food packaging will be developed.

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Interviewees
Maurizio Bussi
Lars Flottrong
Verena Kassar
Robert Krotzer
Tristan Lecomte
Serj Tankian
Freija Van Dujine

> We need to start thinking about the future of food if we are going to feed 9 billion people in a way that does not destroy our environment.—Bill Gates

Food and water security are one of the biggest challenges facing our planet in the coming decades. Although these challenges are not new, relatively few people have considered how we would address the likely collapse of our food chains.

The world needs a revolution in food supply and energy, more than a revolution in computing technology.

According to Maurizio Bussi, a senior official at the International Labour Organization, current consumption patterns are not sustainable. Water, food, and air will be created artificially from available materials around us. Think of artificial hamburgers created in the laboratory. In the future, there may only be artificial meat, and people may not remember the taste of a real one. We will not have the same need for cows as today. Air and water pollution-related technology will win influence, as everything related to food is extremely important. We will need them in order to survive. In Western countries, we will experience a higher focus on the production of bioproducts and healthy, high-quality foods.

Some other interesting trends to consider, as expressed by our interviewees are as follows:

- Animals will continue to obtain legal rights that will limit the current processing methods.
- In 2050, only the superrich will be able to afford to eat animals, perhaps even on a clandestine basis.
- The protein we need, we will get from insects and synthetic processes.
- We will become a more vegetarian society, and our pharmacopeia will be delivered mostly in the form of smart foods.
- Agricultural production will move back where people live, e.g., horizontal agriculture, rooftops, synthetic biology, genetically modified plants, organic base materials, etc.
- Genetic understanding will bring us closer to understanding our food and energy needs.

Governments can play a role in facilitating the dialogue surrounding the societal impacts of new technologies, such as nanotechnology and biotechnology. As these technologies represent considerable change, citizens need to be consulted and have

their voices heard on how far such technologies should go when related to food. Governments can also play a role in supporting health awareness, for instance, by monitoring studies and generating information that we need in order to have a discussion on health and safety.

1 The Future of Food and Agriculture

According to "The Future of food and agriculture—alternative pathways to 2050" (FAO, 2018) report the "world of freedom from fear and want" as envisioned by the founders of the United Nations has yet to be achieved. The same is true to the world free from hunger and malnutrition, despite the great socioeconomic progress and significant welfare improvements worldwide.

The Food and Agriculture Organization of the United Nations' (FAO) estimates indicate that "821 million people, approximately one out of every nine people in the world were undernourished in 2017." Concurrently, food insecurity is contributing to undernutrition, as well as overweight and obesity, and "high rates of these forms of malnutrition coexist in many countries." The targets of the second Sustainable Development Goal (SDG) address the challenges of hunger, food insecurity, and malnutrition in all its forms. According to FAO, "current progress towards eliminating hunger and malnutrition is still insufficient to meet the goals of the 2030 Agenda for Sustainable Development. Much of humanity's progress has come at a considerable cost to the environment. This has led to the degradation of natural resources and is contributing to climate change. Sustainable food and agriculture systems cannot be achieved without significant additional efforts and change of the 'business as usual' approach. Different pathways are possible to address current challenges, depending on the evolution of a variety of factors such as population growth, dietary choices, technological progress, income distribution, the state and use of natural resources, climate changes and efforts to prevent and resolve conflicts."

Food and agricultural systems are affected by trends that may negatively impact their future sustainability. Shifting course is a must; we cannot continue doing "business as usual." Attaining a more sustainable future will not be easy. All countries must commit to share responsibility in implementing fundamental changes.

According to FAO "raising consumer awareness will help contain the need to unnecessarily expand food production and reduce the 'triple burden' of malnutrition, but producing more will be unavoidable, and the way forward is doing so with less." As we move toward sustainability, food prices may see a drastic increase, yet environmental sustainability and food security are not mutually exclusive. We must thrive to achieve a more equitable income distribution, which needs to include better access to assets for vulnerable groups. Food and agricultural sectors have an important role to play, but they cannot succeed ensuring equitable access to food on their own.

The combo of raising awareness and proper regulations can help contain the expansion of agricultural sectors. Managing demand through education is also critical to reduce the "triple burden" of malnutrition. Food prices should be "right." Dietary patterns of high-income countries need balancing. International trade could help synchronize food production to reduce food deficits.

Sustainable agricultural intensification is key to saving land. Using water more efficiently is becoming a crucial factor. However, significant investments are needed in this sector.

Tristan Lecomte, founder of Pur Project, sees most innovations in agriculture in the past 50 years as a failure and just added up failure after failure. Science is divided between people working separately on pesticides, fungicides, and fertilizers, whereas nature is a totally interdependent system. Trees, virus, insects, and plants all interact together in a natural ecosystem. By having scientists working on each of them in a separate field, they have disbalanced our ecosystem the more they innovated, making it worse and worse. This is true in agriculture but also in food, medicines, and transport affecting our ways of life. Innovating to have more had drawbacks, and innovating to tackle that issue created new issues.

Lecomte argues that change is imminent by changing the way science serves us—not to be used to fight the environment and nature but to be used to observe and try to understand nature. We will never get there 100%, because it is so complex, but we should observe instead of trying to innovate and rationalize, creating problems.

A big shift by 2050, according to Lecomte, will be to use science to create a better understanding and find a better balance, a better way to live in harmony with nature. A total rethink how humans interact with nature, using technology and science to connect us with nature, instead of disconnecting us thinking that we can control it. For example, in agriculture—fields will not be cultivated anymore. We will return to "wild agriculture," planting many trees to recreate an ecosystem like in a forest (much more resilient and diverse than the monoculture agricultural field, which is a failure, as we know it, because we lose much of the nutrients, forcing us to use a lot of fertilizers.

> There will be sensors in the field checking the imbalances in nutrients, moistures, making up for this by using natural fertilizers for example by planting new trees. Science helping to get back to nature, wild nature, because it is much more powerful than any innovation we can think of. (Tristan Lecomte)

Thanks to genetic technologies, crops now produce more nutritious food, are more resistant to disease, drought and climate change, and require fewer environmental resources, such as water, fertilizer, and pesticides. We can even produce potatoes that produce less of a cancer-causing substance when fried, or medicinal foods that could be used as vaccines or other medicines (Ritchie, 2022). At the same time Lecomte argues that genetically modified organisms and pesticides kill an insect, another insect grows, and a new pesticide is needed, leading to an infernal circle. According Lecomte scarcity should not be an issue. A Japanese farmer called Fuku Oka for 50 years did wild agriculture and produced more rice than any other

farmer in Japan. He said don't do anything, just look at the forest soil, which is the richest, whereas agricultural soil is the poorest, explains Lecomte.

With what we produce today in food, we could feed 12 billion people, but half of the food we produce is wasted or does not reach people. And we eat so much meat—more than 50% of deforestation is linked to meat consumption. Why is it in India, cows are sacred? Because our ancestors understood that cows are a great source of fuel (burning faecalis) and fertilizer, but if you eat it, you eat up a lot of grass and forest, etc. So it is not wise to eat them. In other countries, our ancestors said that trees are sacred; people were living within their ecosystem and nature. But we lost all this and created an imbalance. Lecomte thinks that scarcity will be solved when we reconsider how we consume within the cycle of nature.

The National Geographic Society published a five-step plan to feed the world: "By 2050 we will need to feed two billion more people. How can we do that without overwhelming the planet? The truth is that our need for food poses one of the biggest dangers to the planet. Agriculture is among the greatest contributors to global warming, emitting more greenhouse gases than all our cars, trucks, trains and airplanes combined—largely from methane released by cattle and rice farms, nitrous oxide from fertilized fields, and carbon dioxide from the cutting of rain forests to grown crops or raise livestock." Farming is the principal consumer of water supplies and a major polluter. Fertilizers and manure disrupt the ecosystems of lakes, rivers, and coastal areas across all continents. Agriculture has also an increased negative impact on biodiversity. Transforming grassland and forests into farms, agriculture has been a major reason for wildlife extinction. Increasing global population is not the only reason for rising food needs. Improving economic status across populations worldwide, especially in China and India, is resulting in more demand for meat, eggs, and dairy, putting more pressure on the system to grow more corn and soybeans to feed more cattle, pigs, and chickens. If these trends continue, we will require about twice as much crops by 2050.

Together, the five steps suggested by the National Geographic Society could more than double the world's food output and drastically cut the environmental impact of agriculture worldwide:

- Step One: *Freeze agriculture's footprint; avoid further deforestation as a top priority.*
- Step Two: *Grow more on farms we've got; using high-tech, precision farming systems, as well as approaches borrowed from organic farming, we could boost yields in less productive farmlands—especially in Africa, Latin America, and eastern Europe—where there are "yield gaps." We can be more efficient about where we grow, what we grow, and how we grow.*
- Step Three: *Use resources more efficiently; advances in both conventional and organic farming can give us more "crop per drop" from our water and nutrients.*
- Step Four: *Shift diets; today, only 55 percent of the world's crop calories feed people directly; the rest are fed to livestock (about 36 percent) or turned into biofuels and industrial products (roughly 9 percent). Finding more efficient ways to grow meat and shifting to less meat-intensive diets—at least in countries with*

already a meat-rich diet—could free up substantial amounts of food across the world.

- Step Five: *Reduce waste; an estimated 25 percent of the world's food calories and up to 50 percent of total food weight are lost or wasted before they can be consumed. Of all the options for boosting food availability, tackling waste would be one of the most effective.*

But big shifts require big commitment. We are facing a pivotal moment, requiring finding a balance between food security and the preservation of our global environment. Our choices on what to purchase in the supermarket will help decide the future.

Concurrently, BBC Future series published a segment titled "Follow the Food" recommending five solutions to trigger this much needed transformation and rethink our food supply chains:

1. *Creating robot farmers and carrying out monotonous tasks conventionally done by humans with greater accuracy and less waste.*
2. *Preserving precious dirt, by using smaller, lighter robots to do the jobs currently performed by tractors.*
3. *Giving waste a second chance; as according to the United Nations, an estimated third of all food produced ends up rotting in the bins of consumers and retailers. One brilliant idea is using apps like "Too Good To Go," which enables retailers to shift food destined for the bin—but still perfectly edible—to customers at a reduced cost.*
4. *Slowing the aging process, for instance, in bananas by modifying their DNA, so that they produce far less ethylene.*
5. *Making smarter choices and building a world fed by sustainable agriculture is a daunting task and will require all stakeholders to come together.*

2 Future Environmental Changes on Food Consumption

Climate change will gradually impact all sectors in agriculture. If left unattended, climate change will further increase poverty and inequalities. Its impacts go well beyond crop yields. Greenhouse gas emissions can only be reduced by additional investment in agriculture. But these are not sufficient—drastic economy-wide greenhouse gas reductions would be required.

Freija van Duijne, former President of the Dutch Future Society, adds that in the future, the focus on sustainability will grow, driven largely by societal pressure. As a result, food and ingredients impacting heavily on the environment will be replaced by more sustainable alternatives. In terms of reducing food waste, the inclusion of sensors and chips will help to give a more precise indication of when the quality and safety of a food product have expired. She adds that such digital components will also help to improve the logistics of supermarkets, with the aim of minimizing waste and ensuring the continued availability of products. Also, as people will increasingly

live in single households and eat on the go, the production of single portion sizes will help in tackling food waste."

3 Impact of Smart Cities on Food Consumption, Waste Reduction, and Synthetic Foods

Van Duijne (2018) has researched the subject of future of food extensively. She envisions that in the decades to come, the focus on health will increase. Many products that are currently considered to be unhealthy will be redesigned to remove the unhealthy components and replace them with health-enhancing ingredients, without compromising the taste or attractiveness of the food itself. She also envisions that we will witness the emergence of personalized food products, which will be adapted based on an individual's risk profile for certain diseases. In her view, the distinction between food and medicine will gradually disappear, which will be supported by the increased incorporation into the Western diet of special ingredients, such as exotic plant ingredients and spices, known for their health enhancing properties.

Furthermore, food packaging will improve in order to retain the quality of a product for longer while minimizing the quantity of materials and by using more environmentally sound materials. In order to achieve these future visions, Van Duijne adds that we need to create a stimulating environment for innovation and entrepreneurship, which can be facilitated by the entire community of researchers, entrepreneurs, and governments. To do this, it is her view that certain regulations also need to be examined closely. For example, food safety regulations are of course very important for the development of novel foods and novel food ingredients; however, we need to assess the difficulties and challenges such regulations pose for entrepreneurs wanting to bring innovative ingredients to the market. She adds that to further innovation on a business level, scientific research can also help to stimulate and identify new horizons and inspirational products beyond 2050.

Avoiding Food Divides Between the Rich and Marginalized Communities

Defeating undernourishment requires reducing poverty and inequalities in order to avoid food divides between the rich and marginalized communities. Environmental sustainability and food security do not need to be a zero-sum game. A more equitable income distribution allows for improved and healthier diets. Transitioning toward sustainability could improve the profitability of farms including agricultural employment. While the food and agricultural sectors remain important, they won't be sufficient alone to guarantee equitable access to food.

Future of Food Menu

"Do you have any dietary restrictions?" they would ask you when booking a Michelin star restaurant in the South of France. Demand for vegan, flexitarian, pescatarian, and other type of meat-free diets has substantially increased in the past decade. But there is still a long way to go to reduce meat consumption.

The EAT-Lancet Commission on Food, Planet, and Health (2022) determined that substantial dietary shifts must take place by 2050. "Global consumption of

fruits, vegetables, nuts and legumes will have to double, and consumption of foods such as red meat and sugar will have to be reduced by more than 50%," the panel of experts judged. Plant-based "meat; is already with us. The Beyond Burger and the Impossible Burger are widely available. The real challenge on the long run will be to persuade consumers to embrace cultivated or lab-grown meat. These will be developed from animal or fish cells in the nutrient bath of a 'bioreactor.'" According to Bruce Friedrich from the Good Food Institute, which works to develop alternative meat, "people will look back at the idea of growing live animals for meat in the same way that we look back at horse-drawn carriages for getting from London to Brussels." We may still have some heritage breed farms and slaughterhouses where the animals are treated well, but it will be a limited market."

According to Chloe Rutzerveld, a food designer and futurist, we will switch to a whole new diet built with "microorganisms such as fungi, bacteria, yeast and microalgae to produce the carbs, proteins and fats we need. This food will again be produced in bioreactors, before filtered and dried into powders. She claims that 3D-printing technology will be able to replicate the texture and flavours of regular food." Eating microorganisms grown in bioreactors will be transformative.

Of course, not everyone agrees that we would move to lab-grown food, but the number of proponents is continuously growing. Rutzerveld opines that "by 2050, climate change will dramatically affect what we can eat and drink. We will have to return to more seasonal patterns of eating – bananas, for example, will no longer be a cheap household staple." Junk food consumption is predicted to rise in historically impoverished communities, especially in low- and middle-income countries (LMICs), driving the problem of obesity. It is projected that globally, 60% of men and 50% of women will be obese by 2050, projecting the current trends. We will need policies that reduce the abilities of companies to sell junk food at low prices.

We shall eat more fruit, vegetables, wholegrains, less junk food, and possibly less meat and dairy. According to the British "future of food report," we may add jellyfish to our 2050 diet. Others predict that we will be eating insects for protein intake; drink alcosynth beverages without having to endure a hangover the day after; consume sonic-enhanced foods playing on our taste buds; eat edible plastic bottles to reduce waste; buy purple bread and farmed fish; and lab meat, miso super food, fungi, and algae among others. Given that we cannot take a cow or a chicken to space, our increased venturing to outer space will necessarily create the need for space farming. We may grow fungi, flies and microgreens in space to feed our astronauts.

4. **Input from Interviewees**

Maurizio Bussi
UN diplomat and director at the International Labour Organization

Current consumption patterns are not sustainable. Water, food, and air will be created artificially from available materials around us. Think of artificial hamburgers created in the laboratory. In the future, there may only be artificial meat, and people may not remember the taste of a real one. We will not have the same need for cows as today. Air and water pollution-related technology will win influence, as everything

related to food is extremely important. We will need them in order to survive. In Western countries, we will experience a higher focus on the production of bioproducts and healthy, high-quality foods.

Lars Flottrong
Business Advisor, MoB

Strategy and risk management

High-protein insects (already part of the menu in Asia), algae from the oceans, artificial food, multilevel greenhouses with organic growing based on renewal energy, super protein shakes, and dry powder cocktails will replace everything we eat today. Barbeque Saturday will be something that humankind knows from school books and stories that older generation tells the youth. A natural grown T-bone steak will cost as much as a suburban cottage and be available only to the richest people.

Is this fantasy or just one of these ongoing horror scenarios?

Not at all!

The world population clock reports a current population of 7,920,000, whereas the annual population increase reaches a 68,000,000.

In 2050, we expect to reach 10,000,000,000!

Already today, we take more from our earth than the latter offers and produces. We take more and more, consume too many resources, pollute too much water, catch too many fish, eat too much meat, cut too much wood, and produce too much carbon dioxide. We have been exhausting the earth's reserves.

Humans use as much ecological resources as if we lived on 1.7 earths.

The day on which natural resources are used up for the whole year is World Exhaustion Day—or Earth Overshoot Day. This is earlier every year!

And these are only the hard facts.

If we add to it the current trend to organic food, which is grown without pesticides and fertilizers but requires significantly more agricultural land, then we quickly realize that we face our earth's limits very, very soon. And this is not only because the available space to grow food is limited but also because of the fact that all other resources like the rainforest (which is already under heavy pressure as it occupies potential farming land) are as important for the future of our planet and the humankind as food is. The same relates to water.

If we still want to secure the future of our earth, we will have to fully reconsider the future food production and consumption picture. As there won't be enough farming land on one side, a growing population on the other one, new options have to be chosen.

The scenario described at the beginning seems to be more than realistic given all the facts and ecological problems we are creating every day.

Natural meat will be very expensive and very limited, as the cow head count will be reduced to a minimum to fight carbon emission and the land plots for cows will be rare. 3D food printing is one of the most challenging but at the same time promising tech directions to solve part of the future food problems. Whereas the first 3D burger was at around EUR 250,000, today's 3D burgers are at around EUR 15. The tech business promises to reach the McDonalds price already in 2022–2023. The meat

animal cells are grown in a laboratory and then “reprocessed” in a 3D printer into a burger. No cows and no farming land are required. Experts say that the taste is the same, and no difference can be found. Technology will be developing further, and very soon, we will see the first Wagyu steak from a 3D printer.

3D printing of French blue cheese, a fresh drafted, sorry, printed, ale from the 3D beer printer will be as normal as eating and drinking. Whether everybody has their own printer at home and just purchases the necessary basics and ingredients or whether the supermarket is just a food printing store is up to personal fantasy and/or income. But food will come out of a machine!

Insects are still an unknown part of the food menu, even if in Asia they are part of the food basket. What we know is that they seem to be everywhere, do not need care or a dedicated agro-policy, and present a potentially super source of protein. However, we do not know whether they present toxically, allergy, or other risks. Insects might become both stand-alone meals (what about a mealworm salad for a light lunch?) or ingredients and additions to rice or other courses.

Insect breeding seems to be less resource-consuming and less expensive than growing wheat, vegetables, and fruits, and they most probably present a never-ending source of “nice” food.

Algae are already worldwide well-known and an integrated part of vegetarian menus. With the increasing greenhouse effect and as a consequence the warming of the oceans, we see a growing algae “crop” every year.

Business would say—every problem is an opportunity, and exactly that is what humankind has to do as well. Once all our doing destroys the environment but at the same time leads to an increasing offer of algae, let’s farm it.

Gathering algae in the oceans would help reoxygenate the water (algae consume a lot of oxygen and lead to the disappearance of the hitherto known underwater world) and would also provide a high source of healthy food. This would work out, of course, only in the case it is done environmentally friendly with a strong focus on surviving fauna and flora.

Multilevel greenhouses (please imagine a 12-level glass greenhouse, flooded with light) where ecological food will be grown based on the latest technologies and where only renewable energies would be used and effect on nature will be brought to an absolute minimum will cover a significant part of the world. Of course, only if these land parts are still available for these high-tech food farms. Four to five crops per year, grown with the use of genetic science, robots, and artificial intelligence, but not left without humans' love and care, are possible. However, genetic science has to be developed with all the responsibility to health and safety and not only based on shareholders’ value.

Protein shakes, powder food, and energy batons will become as usual as bread is today. Already used by sportsmen to fasten muscle growth, they will perform an integrated part of our daily consumption like all the other mentioned options. Instead of a 5-course dinner, we will have a small—hopefully tasty—quick shake or power baton. What else do we need?

Water is a limited resource as well but even more important than food. A human can survive without food for a while, however, without water cannot. The available

freshwater resources are dramatically shrinking; large lakes like the Baikal are under risk or already disappeared like the Poopó lake in Bolivia; the glaciers are disappearing, and rivers are dirty and messed up. There won't be enough fresh water available to provide the daily norm of drinking water to the 10b humans, not talking about irrigation of farming land and the agriculture needs to grow enough food. Humankind will have to develop new technologies to desalinate salt water and to convert it into the most valuable part of our needs besides air and oxygen.

Based on all the points described above, a typical daily menu would look like the following:

Breakfast: Protein bar and desalinated water

Lunch: Warm mealworm salad, 3D escalope on algae mousse, fried locusts in sweet breading, and desalinated water

Dinner: Fresh fried cockroaches with 3D potato, sweet sand grass dessert, and artificial wine

Tasty?

We understand that humankind tastes will change and will have to change, as natural food will be a deficit and unreachable for 98% of the population. However, even the provided replacement still needs an existing earth with an environment allowing to breathe, grow, and live.

It is our responsibility to care about our planet, to take immediate measures to rescue what is still available, to rechannel all possible funds into science, to search for new feed technologies, and to stop waste production and carbon emission. Only if we really do everything depending on us today—and not tomorrow—humankind will get a chance to survive. It is up to us to decide what we are going to leave our children—a green planet or a gray one.

Verena Kassar
Founder of Zero Waste Academy

I envision a positive food system of the future:

The food retail trade as we know it now will no longer be the central marketing system for food. With an increased focus on regional and local production, most of our food will come from the local area and will be delivered in a climate-neutral way by drones and electric delivery. Everyone can afford good quality food because the environmental impact is factored into the value of the food.

Industrial agriculture is therefore very low, and we can see a resurgence of biodiversity, all over the world.

Robert Krotzer
City councillor of Graz, Austria for Health and Care

In the future, social inequality, poverty, and hunger will be a thing of the past.

Tristan Lecomte
Chief executive officer, Pur Projet

2050 will see a big shift. We will use science to create a better understanding and find a better balance, a better way to live in harmony with nature. A total rethink how

humans interact with nature, using technology and science to connect us with nature, instead of thinking that we can control it. For example, in agriculture—fields will not be cultivated anymore. We will return to "wild agriculture," planting many trees to recreate an ecosystem like in a forest (much more resilient and diverse than the monoculture agricultural field, which is a failure, as we know it, because we lose much of the nutrients, forcing us to use a lot of fertilizers. The chemicals in the agricultural sector today still come from world war rocket fuels.

Serj Tankian
Singer of System of a Down

All food will have to be sourced locally to combat carbon waste. Farm-to-table industries will grow exponentially along with agricultural intelligence so that people can grow their own food anywhere in the world.

Freija Van Duijne
Futurist, public speaker, foresight expert, CEO, and founder of Future Motions

In the future, the focus on sustainability will grow, driven largely by societal pressure. As a result, food and ingredients impacting heavily on the environment will be replaced by more sustainable alternatives. In terms of reducing food waste, the inclusion of sensors and chips will help to give a more precise indication of when the quality and safety of a food product have expired. She adds that such digital components will also help to improve the logistics of supermarkets, with the aim of minimizing waste and ensuring the continued availability of products. Also, as people will increasingly live in single households and eat on the go, the production of single portion sizes will also help in tackling food waste.

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Future of Families

Karine Sargsyan

Abstract

The generally accepted standard conception of the family today tends to look like this: a man and a woman (greater acceptance if same race, same religion, and similar age), hopefully with a sound mind and a strong body, are getting married (mainly in a publicly staged spectacle called wedding). How will the family change in the future? What about multigenerational families or families without children? How will the concept of family change? Are marriages with robots and the artificial upbringing of children the future? Will traditional values still exist, and how will the perception of "family" change in the foreseeable future? And what about marriages of love and marriages of convenience?

Interviewees
Eli Beer
Tristan Lecomte
Caroline Schober
Tobby Simon
Lucian Tarnowski
Mark Turrell
Lisa Witter

"It would not be much of a universe if it wasn't home to the people you love."—Stephen Hawking

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I would like to start this chapter with a confession: I love my family; I love the idea of the future because of my family—because I can only imagine my future with them. I also fully agree with one of the greatest minds of the twentieth century, Steven Hawking, that the universe is only fascinating as it is home to my loved ones. To imagine one's own family in the future is one thing; the other is to develop a theory of the "family concept" in the future and how the paradigm will develop in 30 years.

Although several specialists, organizations, and even the Organisation for Economic Co-operation and Development (OEDC) have already produced devoted reports and scientific works on the future of family and home, those always depend on the profession as well as the authors' point of view; I want to offer you some classic ideas about how a family might look like in the future and what kind of society concepts there may be, which, perhaps, will affect the development of family relationships (OECD, 2012; Thornton, 2005).

Family: a small group established by marriage or by consanguinity, whose members are bound together by common life, mutual help, and moral and legal responsibility.

The generally accepted standard conception of the family today tends to look like this: a man and a woman (greater acceptance if same race, same religion, and similar age), hopefully with a sound mind and a strong body, are getting married (mainly in a publicly staged spectacle called wedding). They will be (intended) devoted to each other and to the idea of having a joint home and having children and raising them together, to work, to retire, and to die while remaining in each other's lives as a constant or so-called anchor. The commonly accepted myth is that when one spouse dies, the other one has the right to start another family, carrying the grief in their soul. We all know that. Family is thus postulated as a small group based on marriage or consanguinity, whose members are bound together by common life, mutual help, and moral and legal responsibility. Any violation of this "common sense," even if accepted, is in modern times considered a deviation, as it is noticed and discussed, although the common accepted concept is usually never a topic of private or public discussions. Children born of other types of cohabitation are still considered illegitimate in some ways.

Anyone, who wants to be with a person of their own sex, is referred to as gay or lesbian; people who have been married several times are considered to be neurotic, and those attracted to group marriages are called sexy monsters. Most of us who (willingly or not) fit in with the "commonly accepted concept" label "different thinkers" and/or "different sensors" as "immoral" without taking into consideration that human nature is subject to strong changes over the time axis.

If the majority of people was able to live an open-minded life to be honorable and sincere and to not hide behind made-up excuses and other social curtains, families would have a great and bright future. We could provide the world with a completely new definition of family relationships, which unfortunately has not yet been tried.

Countless people will know what I am talking about. This one place—the absolutely real world, where you love and you feel—is the best. However, the number of people who will understand and live in such a "truthful" relationship is

too little compared to the others. Sometimes I get a sense of fear and surprise when I think about how the future people, family, and family concepts will look like. What should we do to at least try to achieve a balance of human interactions for tomorrow and the far future?

We must pay attention to the education of children, and by this, I do not mean school education, literature, or science, although these are also extremely important but to the teaching of relationships and loyalty (OECD, 2012). There will be a change of practicalities and orientation within adults to create all conditions for the development of their own mindset and at the same time the mindsets of the young children they are raising. This means that children will be considered as a full-fledged personality from the moment of their birth and will be educated correspondingly. Accordingly, the child will be treated like a person who feels, sees, and recognizes himself/herself in his/her own way throughout the entire period of his/her development. They will be treated as individuals and therefore differently to everyone else. The same thing will happen with their parents (Harari, 2018). They should be determined, healthy, strong, energetic, and attractive. They must be willing to take the initiative in their hands, not waiting for help and not shifting the responsibility to others (Sorabji, 2018). These people should be creative and holistic by nature. They will not shy away from criticism in their discourse or of their work but, on the contrary, meet it with joy as it is a possibility for further development and advancement.

The future human beings will pay attention to their body as well as to their soul and understand all the processes so that this knowledge will make them aware of their emotional needs and dependencies and of their sexuality and appreciation, which are important and beautiful parts of themselves. The people will be full of warm feelings and less competitive and angry, which will build the basis of future families and the acceptance of different forms of future families (Shelton-Colangelo et al., 2006). In addition, I hope that with the help of more self-knowledgeable people in family structures, problems such as indifference and unfair attitude toward others—either physical or social—will be resolved in the future (Bandura, 1995). Human nature is highly variable. I believe that the family of the future will be much stronger, more important, and better in omnifarious forms and will form the basis of society. In the last 50 years, relationships within family structures worldwide have changed so much that they are not comparable to previous changes in history (Boulding, 2017; Elliott, 1970). If the same amount of change occurs within the next 50 years, then even by 2050 family life will look very different from now.

In recent years, there have been significant changes related to specific family issues that establish new relationships. Divorce is now generally accepted; it is seen as a social measure rather than a personal tragedy. Several factors influence a changed situation of the modern family conception, e.g., contraception, free abortion rights, family planning, an increased desire and interest to work, the form of appearance at a new job or in a new position, open conversations about sexual topics (in the case of family, sex is the physical glue of emotional and conscious commitment to a relationship), a more proactive (if not aggressive) position of women, the increasing variety of occupations and jobs in which women can/may

work, changes in formal conditions for the entry into adulthood, changes in the sphere of education, and the increased average life expectancy (Cyba, 1998; Kulmer, 2011). Moreover, it seems that new foundations, doctrines, and criteria for human existence have already emerged. These changes drive and generate further changes.

In view of all these changes and factors, the question arises: Exactly what is the direction we have to choose, and what should we do to persist and develop our moral idea of a family? First of all, we need to aspire to become more responsible as individuals, to not be afraid to make a choice on our own, to be courageous, and to build future plans that start with our own needs yet somehow are aligned with the needs of the world's population, so that we can immediately recognize the problem of paramount importance for a better global future. I believe that we are on the threshold of a new evolution in the history of mankind and in the development of social units (Harari, 2018; Davies, 2005; Garner et al., 2013; Rothman & Wheeler, 2013; Thornton, 2005). Perhaps the human being as a person has never experienced so much fear and dissatisfaction as at this moment. Everywhere huge crowds with unselected and dogged information flows are taking to the stress and demanding change. The main slogan nowadays remains the defense of self-esteem and the "inner circle" of the family.

I think we are witnessing the beginning of a multifactorial process with several components like the eradication of relationships, building on forces, dictatorship, obedience, and stereotypes. Mankind will not be destroyed by nuclear war (as predicted in the Cold War period) but by the lack of confidence in (family) relationships, a great dislike and absolutely inhuman attitude toward each other, and the subconscious dividing people into rich and poor or manager and managed, leading to enormous human disrespect and disregard for feelings and one's own dignity. The old, traditional, deep-rooted orientation became obsolete at the beginning of the new century. In addition, the following questions arise: will the traditional idea of family die if the old foundations are lost in the modernization and new age of acceptance and antidiscrimination? Moreover, will a new concept of a social, familiarly trusted unit exist to sustain our civilization? Personally, I believe in the first option and hope that traditions in some form will be preserved and coexist with the new forms of social cohabitee, allowing each person their unique choice (of happiness in the social medium) without stigmatization and shame of any form. With the population aging, the social acceptance component of futurization is becoming somewhat slower, but we still need history to recognize the progress (Rowland, 2012).

Marriage usually legalizes the relationship between a man and a woman, equalizes their rights to joint property, and provides a guarantee against mutual exploitation. But why is there a clear restriction of one man and one woman in a marriage? If we are honest with each other and take full responsibility for our actions, why do we have to exploit each other? Why do adults feel it is necessary to marry? Perhaps it is not necessary to chase marriage but better to wait and meet true love?

One fact is absolutely indisputable. The modern adult man today is very much dependent on how he was brought up in his childhood (Leira & Saraceno, 2008).

Childhood is the time when the basic principles of the human world develop, and this happens under the influence of the people who educate them (Roesch, 2015). In this way, one can say that the "childhood" of today is the future of tomorrow.

Will there be families in the future, and what will they look like? Interestingly, people have not lost the desire to raise children and consequently create a family (emotional, not legal). In addition, we are setting new and narrower norms of human behavior and demand our children to meet them.

How will the family change in the future? And how will the concept of family change? Are marriages with robots and the artificial upbringing of children the future? Will traditional values still exist, and how will the perception of "family" change in the foreseeable future? These are too many questions at once, but let's try to make a prediction, let's say an educated guess.

The world is changing rapidly. In addition, regardless of whether we like it or not, the classic model of family is about to slip into oblivion and at best leaves us only with a counterfeit version. I would like to point out another example: In the 1950s and 1960s of the twentieth century, the traditional image of a family was that of a husband in a suit who is driving home from work while his wife is at home finishing the cake and combing her kid's hair and rehearsing a wide smile. That was the generally accepted "greatest aim" of a woman.

One should understand that it was not possible for women to have access to education, to work, and to earn as much as men at that time. The role of a housewife was the best as possible, with all the consequences, with all pros and contras (Thornton, 2005). Of course, there were also little helpers for the everyday housewife. An example is a drug called "Frauengold," which, translated from German into English, means "women's gold." It was sold to housewives, who were so called "unbalanced" (Frauengold, 1957). Funnily enough, it contained 16.5% alcohol, and that was the main culprit for the calming effect. This was a legal form of female alcoholism for a better control of husbands. Things are different today (Hess & Sussman, 2014). Those pictures are transformed into a museum exhibit. At some point, today's habits will be, too.

Is it possible that in the future we will learn how to make children robots, programmed to be disinterested in sincere love, as shown in the movies that point out artificial intelligence? By observing what is happening to the institute of marriage, we can also see a significant change that has taken place over the last decades. Young people are more than ever concerned with self-realization and self-expression (Hickmott, 2011). Women have become more independent, and family roles are changing (Hess & Sussman, 2014). Entry into marriage and the birth of a child are postponed. The number of divorces is growing, birth rates are falling, and civil marriage is gaining in importance (Janssen, 2020).

Anyone can become the breadwinner now, even the teenager who sits behind the laptop and makes Youtube or TikTok videos. Who has to take care of the child is no longer predefined" by default" (Elliott, 1970).

Studies show that young couples focus on their careers; relationships in the family are only a partnership; the phenomenon of "having children together" tends to fade into the background and is only seen as possible but not obligatory (Robinson

& Ross, 2012). A common, though, not publicized concept of "pregnant—get married" is transformed into a business project: Every decision is carefully considered; plans are made for years to come. However, these kind of changes are happening very slowly. Therefore, I hope that in the foreseeable future, the family will continue to be a priority, although the form will change. Futurologist Sergei Pereslegin sees that the impending changes are even more radical. There is a thinning of the social substance—a decrease in the number of people with whom you are truly connected in life. Already today, the family has become a steam room—very often the opinion is that it is better if the children live separately. So, we have a feasible percentage increase of singles—lonely people (Pereslegin, 2009).

What else? Futurologists expect that the length of childhood will decrease over the next decades. It is already noticeable in artistic literature: The Harry Potter books, for example, illustrate that children can fight with adults and even manage to win.

Another scenario for the development of the family is the emergence of external pregnancies that lead the experts in biotechnology to implement this idea. This will result in a more calculated family planning, especially as women do not have to bear children on their own. Denying pregnancy and childbirth definitely will lead to the loss of breastfeeding, which is a very important hormonal and emotional component of motherhood (Drane & Logemann, 2000). With the help of technology, Homo sapiens will be able to get rid of one of the attributive features of the mammalian class. Of course, the concept of the traditional family in a way as we discuss it today will follow.

The emerging technologies of artificial intelligence (AI) and the achievements of robotics are astonishing even today. There are robots that are able to carry out simple logical decisions, communicate with humans, and help. As early as 2050, robots will be able to maintain a relationship with a human at the level that is no worse than that of a normal human. Support, partnership, and sex—all the understanding, and in general, the ability of "human hormone secretors" will also find their way artificially into marriages. The family is changing and changing so quickly that the spirit grasps.

Family of the future: with or without children?

Children are the perfect topic for speculation. Children are our future; therefore, there will be no future without them, but if we consider the statistics and the development of births per family in the developed world, we recognize the change not only in the number of children but also the attitude toward parenthood—we want not only better lives for our children, as it was 100 or 200 years ago, but we want better lives for ourselves too (Roser & Rate, 2017).

Nevertheless, all hope for improvement in 2050 and beyond is for our children, although they often are gaping to see the perceptible result of hard labor of our life. The philosophy of social egoism or a egocentric society, not only community-related understanding but also free in biological aspects, has converted to be predominant. We see this development not only in large cities (as it is generally assumed) but also in the smallest communities. We move from the fantastic social structures that the evolution of humankind has made and developed to the most likely options to be able to develop the biggest "ego". . . .

The concept of multigenerational families no longer exists in the developed world. Having been raised in such an extended family, I truly understand all the advantages and strengths but also weaknesses and difficulties of such a social construct of an extensive family; nevertheless, the loneliness of a large percentage of the population in big cities leads to new constructs of substitute families or scurrile business ideas that use the need for human communication and touch (Reilly, 2006). According to WHO statistical data, the typical human life expectancy on planet Earth increased from an average of 67 years to an average of 70 years between 2010 and 2015 (WHO, 2020). Possibly, for a regular reader the number does not seem very imposing, but if we recall, that at the end of nineteenth century, the average duration of life was approximately 40 years, then the number takes on a more conscious meaning. The trend of the rising number of life expectancy of humankind is stable, and the further we go in the future, the longer we will live.

If we follow this trend, families comprising five to six generations will not be unusual. Nevertheless, the living space for each individual becomes more important, and as the generations change, multigenerational families will no longer live under one roof. The most commonly existing variation of the "complex family" consists of three generations—children, parents, and parents of parents (OECD, 2012). As life expectancy increases by 30–50 years, it is on the one hand more likely to have great-great-great-grandmothers (-fathers), who will take the role of family patriarchs, and on the other hand, each new generation looks for more independency and freedom. This is why the new generation is not open to multigenerational homes anymore, although this construct provides a sort of security net in case of social, financial, and health needs. The development will show what the exact consequences of this "stretching" are. However, one fact is for certain, the concept of the family as a whole continues to evolve, and the intimate notion of family is still reduced to the people living under one roof.

Multigenerational families first of all can be seen as an enrichment of life experience for all generations. Imagine, that in one single house, a group of people could have seen in total 100–150 years of life on our planet? It is hard to imagine that from such kind of "social cocktail" in general, a high-quality life can be derived. Also, it is a question of how people will communicate, especially if we consider that those who remember how communication worked a hundred years ago (mostly in person but also by telegraph, horses, and few telephones) and those for whom it is "a textbook of history," as they can communicate every second as they are being always online and even inventing the new term "digital detox" (Cherry, 2020), as they have realized that too much communication on the surface is also not healthy. This fusion of the life wisdom of the older generations with the energy of younger ones will become a source of new social capital and will usher in the next and absolutely different round of "conflict between parents and children" (Horx, 2021).

We can see a development of a new kind of family understanding. A traditional family, which you cannot chose but you are born into, is losing the battle against the consciously chosen one, which is propagated by many books and television (TV) series, such as Friends, How I Met Your Mother, and Big Bang Theory (Kessler, 2012). These concepts allow a decision to be made about the type of

family, with the heart and the head, not by genetic determination. Living in the same apartment, house, or area and being "there for each other" makes them to a family-like concept.

Given the trend toward same-sex marriage, the concept of "mom" and "dad" has some loose contours. To explain to a child why she/he has two mothers or two fathers, although her/his friends have a traditional family with a male father and a female mother, is somewhat challenging. The topic of gender and sex will be discussed in Chapter 10, but it is important to mention the influence of the paradigm shift and the enlargement of the understanding from binary metrics of gender (and family roles) to multifactorial ones in the commonly accepted family concepts.

There are many ideas and papers written about the possibility of robot families (or with robots) (Putic, 2014). If we broaden the discussion about robots, we find that there is increasingly frequent and intense speculation about the economic aspect of humanoid robots but not about the emotional and conceptual aspects (Preetipadma, 2022). The increasing auto-robotization of workplaces is seen as a real prospect for the coming years. Publications on advanced "rubber women and men" already start appearing, although not the ones from the "Toy Shop" but from electronic supplies, which, for a given price, could master to copy a person (Guizzo, 2010). Being honest, if that was possible now, I would be one of the first customers to buy my very own Albert Einstein to have endless and very emotional conversations with my role model. You could say it's scientific fantasy, but my husband, who is one of the most intelligent people I know or have ever known, is almost never jealous, with the exception of, say, Einstein. He says: "The theory of relativity is Albert Einstein's best-known work, so his death may also be relative." In this case, this is meant as a joke (I hope), but I, on my part, hope that there is at least a small part of truth in that joke. Well nowadays, it is already possible to copy and reproduce the parts of the human knowledge and the logic (part of network thinking models), which is very complex and yet not fully investigated (Mitchell, 2006). If you look up the term AI in the German Version of Wikipedia, you will find the following: "The term is difficult to define as there is already a lack of a precise definition of 'intelligence' itself." (Intelligenz, 2023). Intelligence has an emotional/humoral component, which is very difficult (if not almost impossible) to copy, as we don't fully understand the concepts compared to love, motherhood, pride, devotion, etc. Emotions form the solid basis of a family; harmonious sexual interactions are also an important part of a strong relationship, which is the most important basis for being a couple, but let's face it, sex is also based on hormones. So, the humoral component of our consciousness, which makes the enigmatic part of our souls, will remain the same and will keep our families functional and secure; I hope.

Nevertheless, there will be people who will prefer a relationship with a robot (and perhaps even love it), as the robots are always controllable and can hardly surprise the owner or do anything outside the range in which they are set. But, of course, while we are talking about a fairly narrow segment of services of the future that can be offered by robots (sexual and familiar), the same statistics show that 30% of the world's population suffer from loneliness and emotional isolation (Statista Research Department, 2022). That means that this is potentially a huge future market for the

sale of robots, which will not just become sex partners but also offer something more complex. You don't agree and think that this is a fantasy? I think you are wrong. In the future, AI will be able to simulate emotions, possibly not all emotions and not perfectly, but it will. Many readers may now say that this is just a surrogate, but aren't online social networks a substitute for real relationships? And watching films or reading books where people cry and rejoice are also substitutes for real-life emotions. After all, this book is also a kind of replacement for the emotions of human relationships. So, we cannot say that robotic emotions are fake, because we already have these fake emotions that feel so real. But in the case of robots (as compared to a book or a movie), it is more complex because there is a direct and bidirectional integration happening. Therefore, the question arises as to who these robots will be from a legal point of view. The topic is so advanced that the European Parliament has already drawn up a list of rules under which humans will communicate and do business with AI and robots. Furthermore. there is already a movement for the recognition of robots as family members with all the ensuing consequences (Deng, 2019).

The idea of cyber families and the possibility of their happening are the subject of much speculation these days. In this context, AI is also extensively and diversely discussed, but there are very few people who talk about the actual possibility of designing real personalities on the basis of this technology. Scientists described these possibilities already a while ago, but William Gibson's "Neuromancer" also features such a hero (Dryer, 1999; Gibson, 2022). Yes, most likely we will talk with some kind of simulation of the mental reactions, speech, and actions of a human being. The paradox is that nobody, when communicating with family members, asks questions of neurophysiology and psychology or reads the body's internal reactions and synapse activations (blushing out of shame, something we usually can see). The reconstruction of the complex behavior of a real person (in order to integrate the artificial subject to a family) is one of the scientific areas that, in some extent, is similar to biological cloning. Only in the case of biology do we clone the body; here, we copy the personality from the perspective of psychology. Well that will be an interesting future.

Naturally, the habitat of these cyber-clones will initially be in a virtual, probably networked world and not in reality, but still, the cyber-help-gadgets and programs like Alexa (Amazon Alexa, 2023) and "Ok Google" (Google Assistant, 2023) are becoming a part of our lives—our family lives. Many people speak to the gadgets like they would speak to a human being, which is not unusual as well as not surprising. These devices "know and remember" important data (e.g., birthdays, anniversaries, . . .) better than any human would. They almost always play the music that we think fits a certain mood (which we would like to listen to in the specific moment). They listen and answer the way we are expecting them to (as they are analyzing and copying our behaviors), and so, they become a substitute socius for us, giving us the feeling that we are not alone, at least for a while. With better programming and better robotics, very soon we will have robot family members, who will even love and admire us. And again, I think that communication on the Internet is the same surrogate. This phenomenon has been around for 20 years, and

especially with the pandemic, it became the mainstream of communication. In the case of family, however, the emotions that arise from communication with members are not only virtual but quite real and at least sometimes lead to a real action (family gatherings, parties, etc.). And then we have a real life augmented by a virtual "mixed reality"—where is the future place of a robot family member in that life? (Carter, 2021).

Now you can use a little more imagination and visualize various combinations of the above. Have you turned your imagination on? Do you have a picture in mind? Hopefully one that you and all humanity can live with. However, I still believe that the family of clones living with robots and communicating with ancestors in the form of AI is not a transcendental perspective. The people who are now a little over 40 years old may still experience these new fun times.

What the family of the future will look like and why the naturalness of traditional marriage may become (or is becoming) a myth will become clear in the very near future. "Large, traditional, and prosperous"—this is how the "sanctioned" rhetoric describes the ideal family. Their supporters are sounding the alarm: "Homosexuality and polyamory will destroy traditional marriage." But while the image of the family from juice or kitchen furniture advertisements is almost non-existing, we see that a romantic relationship continues to grow (even in virtual space); nevertheless the trend from monogamy to open partnerships and polygamy from a couple to polyamory communes can already been seen. Whether these relationship formats will fit into the traditional family paradigm and become part of it is still an open question. Well, spoiler alert, of course, they will! Simply because we are evolving and the population of our planet Earth is more adventurous than ever before and more tolerant than at any other time—the family concept will change, enlarge and include more forms of families as we have now.

We should not forget that the family is considered the embodiment of our natural instincts (e.g., the mother instinct). In addition, there are the traditional values of marital relations (including polygamy (more rarely polyandry)), marriages for money (and even more specifically—for the parent's will), the total absence of women's rights, and other benefits of the traditional way of life.

In humanity's past, love was the central element of family relationships, but this has not been the case for a long time. As Michel de Montaigne says so well, "If there is such a thing as a good marriage, it is because it resembles friendship rather than love" (Montaigne, 1877). He thereby questions the very existence of a good marriage, rejects love and its role as the basis of a family, and tries to compensate for his negative ideas with friendship. Well, the modern marriage is a well-prepared cocktail of crush, love, economic symbiosis, communal symbiosis (building and living in a joint space), reproductive liaison, intellectual communication, joint care (for children and each other), and very deep friendship, spiced up with sex and physical activities. In the future, we will see this cocktail in different variations. Several lines of development will run in different directions, with tendencies toward the extreme, e.g., only reproductive function, only emotional function, or only sexual function (maybe in the future, robots will be cheaper than prostitutes—but nobody knows if these robots will be better than humans).

Now marriages of convenience also exist but are regarded with contempt, and the family is celebrated as the union of two loving hearts. In the era of Montaigne, marriage was regarded as reliable; however, it often excluded love (Seidl Menchi, 2016). Marriage acquired its modern form only in the last century. The so-called "normal family"—a heterosexual couple with one or two children—is a twentieth-century phenomenon. Heterosexual relationships are always aligned with social institutions, associated with childbirth—the continuation of the family line, inheritance, and even the transfer of ownership. As part of the social order of marriage, it was based more on rational calculation and excluded an inherently anarchic element like love. The main goal of the family was/is to maintain social order and the demographic policy of the state. The autonomy of the senses is in contradiction with their interests.

In non-state societies, people live in complex tribal structures, far from everyone's usual monogamous family. Paired relations, which are thought of Western culture even from Adam and Eve, for a long time have not been the norm, and the forms of marriage have always differed between cultures. Therefore, as we know, the history of humanity is a repetitive sinusoid, in which pics and downs are directly collating with a change of speed in the society. Keeping this in mind, the tendency in the future will also be in the direction of the open relationships, with accepted homo- or heterosexual covenants, with polygamy (absolutely mixed variations), and with artificial elements and members of the family (independently virtual or real robots sitting next on the couch). One thing, I think and hope, will remain ever the same: We will care for our family and about each family member.

Polygamy occurred in ancient Egypt, Mesopotamia, Iran, and India and in Muslim culture; it is preserved to this day (History of Polygamy, 2022). Polyandry is very little known and described but is still present (there is polyandry, though). For example, in the Hindu and Buddhist communities in the Himalayas, several brothers have traditionally married the same bride (Coomar and Raha, 1987). The custom served purely practical purposes: It allowed the brothers to preserve the inherited land and not divide it between all the relatives into tiny pieces. The tradition lasted up to the twentieth century and has gone on only when the economy allowed possessing to possess enough land. In the Old Testament, we can find not one mention of these phenomena (Brooks, n.d.). As the king, Solomon had 700 wives and even 300 concubines (Edelman, 1999). King David has turned out not so impressive: With precision, it includes 18 women of different statuses—wives and concubines. Even more, the Bible is registered, and the principle of levirate—he makes polygamy mandatory for those whose brother left a widow without an heir (Lexham Press, 2021).

In ancient Greece, polygamy was considered an unworthy barbaric custom, but adultery remained an absolutely legitimate practice. Legitimate marriage served merely to continue kind. At the same time, the culture of heterosexual harlots existed openly. It was not a simple counterpart to prostitution. Wives did not have the right to vote and obeyed their husbands in everything. If we look at today's developments of the society, it seems that times will come that adultery will become a legitimate action for both man and woman and both in homosexual and heterosexual marriages.

So, why do we need marriage in the future? But before that, let us once again look at our past. Homosexuality for the Greeks was a constant part of the norm, if not to say the institutional practice. It had also a pedagogical character: Erotic relationships of mature men were "allowed" only to young men, often—with disciples. Bisexuality was the norm not only in Greece but also in Rome. The tightening of the family code came to replace the pleasure first in the era of the Middle Ages. Childbearing is at the center of the church's sexual politics. Family relations were used for and completely made subject to demographic demands. Abortions equated to murder, and interrupted sexual intercourse is considered a terrible sin. This prohibition goes back even to the biblical episode associated with Onan. Relationships began to build around the act of childbirth. Pleasure became a random and unusual bonus and then has been completely excluded from the family concept of those times. The bond of marriage was supposed to be a stop signal for desire—above all, the desire of a woman. Only in the second half of the twentieth century, attention shifts from the birth of children to the relationship within the couple. These days, we are still somehow uptight if we speak about joy, sex, and pleasure in the family and marriage. For example, many guests feel uncomfortable, ashamed, or even are irritated by the very artistic, tasteful, and socially compatible (I thought 😊) "nude love" pictures (100 cm × 75 cm black-white photos) of me and my husband on the walls, even if it is in our bedroom, and it is a private area, which guests are either entering during a house "tour" or by accident. Even after the sexual revolution in the 1960s, our minds are not free of the judgment and shame about "having fun" in marriage. In the future, another extreme is going to be normal; another level of liberation will give us joy in the relationship, in marriage, and with it in the family.

For a long time, marriage remained more of a diplomatic decision: It was concluded in order to establish ties that were beneficial for the families of the bride and groom—to conclude a truce or a strategic alliance, to improve the affairs of a lost family, or to take possession of new property. Mesalliances have not been allowed. If a man could marry for love, the woman turned out to be at a much more vulnerable position. In the future, the vulnerability will depend on our preferences, love, and emotional affections in marriage and family as on our decision. It is socially accepted to have several partners in the course of life. Nowadays, not only married couples are considered a family but also those who live together, have children together or share the upbringing of their offspring, or consider each other as life partners. Considering this aspect, families will become larger units, and different types of cohabitating will be accepted as a family relationship. On the other hand, the idea of large families, with several generations (under one roof or not) including even the aunts, uncles, and cousins, will no longer exist.

However, for a long time (and even now), marriage for love retained the status of a work in progress: Even if a woman did not find "the soul mate," she was forced to marry to have legitimate children and not to be abandoned from society and considered a whore (Hawthorne, 1850). Public opinion and the lack of a right equal to that of the man were encouraged.

As far as the family model is concerned, a male breadwinner, a female homemaker, and a couple of children are usually described as "traditional." However, like any other social institution, the family is not frozen in time and space; on the contrary, it changes along with society and depends on social and economic developments. The industrial transition brought with it the development of cities, factories, etc. and demanded more mobility and more labor from people. Gradually, humans moved to the city, where the accelerated rhythm of life, the Ford's conveyor belt (Hayes, 2022), and "small-sized cars" were waiting for them instead of their native hectares of land. Inevitably, the family structure was changing too: Young couples were separated from their parents and limited to a few children. And also women went to work, different generations no longer lived together, and the family became smaller. Behind the idyllic facade of the 1950s lies the ugly flip side of the "housewives' syndrome" (Martins Lamb, 2011)—depression and nervous breakdowns of women who are locked in a "golden cage." A similar phenomenon will start with the development of future technology. The families will become even smaller and less attractive. Couples living in different parts of the world will continue their relationships in an "online format," and the idea of family, marriage, and cohabitation will be reduced. Technology will try to develop and reproduce pheromones and hormonal components of love so that we will see virtual families and relationships that are unthinkable from today's perspective.

However, trying to get back to the traditional family model can be sometimes very challenging. Besides, no matter how one might feel about the sustainability of traditional family relationships, stopping the progress is impossible, similar to how we cannot turn back time (at least not yet).

This does not mean that one has to sing the requiem of the family: The industrial age has not entirely abolished large families, but it is no longer the universal norm of communication and fraternal togetherness. To restore the family's dominant role in society (even if we wanted it to), it would be necessary to stop the development of humankind. The traditional type was the ideal solution for the mass and centralized society. As the conventional way of life disintegrates, society becomes more and more in silico and atomized. There, where individuality and freedom of movement appear, a uniform rule for all loses its force.

The family ceases to be an economic unit of survival. Even if it was an absolute necessity half a century ago, French women were allowed to work without the husband's permission only from 1965 onward (Saverna, n.d.), and Swiss women received the universal right to vote (without their husbands) only in 1971 (Eugster, 2021). This shows a rapid development, which is combined with the invention of multicookers, washing machines, and semifinished and ready-to-eat products in the supermarkets, and food ordering services bend over to "no family life philosophy," as it is now a practical component of marriage all over disappears. People can live alone.

Since the second half of the twentieth century, a family is no longer limited to children: The focus of attention shifts from children to relationships between partners. The baby boom of the postwar 1950s has created the absolute value of a child: Even experiencing a serious crisis of relationships, parents do not breed for the

sake of children and for the sake of them could also refuse a career. The student riots of 1968, the sexual revolution, the era of eclecticism, and the collapse of the old social order—these are also crises of the bourgeois family and individualization of the society. Individualization means that people are no more ready to sacrifice themselves—their careers, their success, and even the momentary pleasures—for the appeals of society (how the family should be). However, a mother will always be the only humankind being that is ready to sacrifice everything for a child. Even more, I believe that AI, digitalization, and all other developments that may follow will be able to change many things even in family relationships and love but will never be able to replace and change "a mother's love to the child."

According to the opinion of psychologist David Elkind, family is becoming adult-centered: Parents are willing to move to another city for their careers, even if it is not the most comfortable for the children. We can also see the incredibly high percentage of divorces, as getting a divorce and educating a child by yourself become economically possible (Elkind, 1998). The same development of contraceptives created a family culture that leads to people eventually becoming childless. The decision to exchange rings is also becoming a free choice increasingly. The other side of the coin is the oppression of choice: the constant concern for the correctness of our decisions. Nevertheless, the development and the trends in family building and the duration of family relationships show that serial monogamy will be the most unattractive choice in the future. The short-lived nature of romantic relationships will be accepted, and devotion and loyalty—which, along with love, make up the bulk of serial monogamy—will become only exceptional and weird exceptions to the norm: Regular partner changes instead of marriage for life will be the new norm. Faced with endless choices from the varieties of cheese on the department stores' shelf to emotional attachments—we strive hard to find the best.

Psychoanalysts note the inability of modern people to have long-term love relationships (Apostolou & Wang, 2020). It seems that in an atomized world, a neurotics' defense mechanisms and fear of intimacy have spread to the whole of society. I cannot imagine a world without a romantic relationship. Still, the fact remains a fact—romantic relationships are changing their format, and people are less in a hurry to seal themselves in the bonds of marriage. They are no longer looking for property or stability.

Lack of commitment is a new development in relationships, and I think the reason for this trend is the shift in age limits. The question "who will I be when I grow up" is no longer humiliating even for 30 year olds. Moreover, the possibility to change my profession and job profile is now a common practice (I have changed my profession more than five times, which has significantly improved and increased my understanding of the world and my productivity) (see Chapter 15). Nevertheless, flexibility in this traditionally very rigid area of life affects other definite parts of our being in the socium on this planet. Traditionally, growing up is characterized by mastering the most important social roles: employee, spouse, and parent. Millennials also spend much more time studying, finding themselves, and choosing a partner (Horx, 2021). This is a reaction to a new reality: There are too many possibilities

in front of us to live our future lives so that it is impossible to decide on the right path at the age of 20 (if there is one).

We have the opportunity to suddenly change jobs or place of residence (to other continents or countries), and requirements of new, formerly not known professions are born with such speed that even getting education, which may/should be relevant at the time of the issuance of a diploma, is questionable (see Chapter 15): That is why men (and women) experience uncertainty and postpone many vital decisions. That is why virtual dating is becoming a socialization tool, as the situation is milder, controllable, changeable, and better if we go to the Internet. Virtual dating is not just a substitute for real dating; it is a modification: Researchers note that the Internet has reduced the capacity for empathy (OECD). Humankind is more prone to immerse in themselves longer rather than building a mature emotional contact.

On the one hand, one can raise the idea that in order to return to more socialized relations, it is necessary to reduce the level of economic development, as people cannot survive on their own. However, this is precisely how the logic of a conservative opinion leader works. It means mobilization of pro-old life society, exclusion of LGBT people in marriage relationships, and conservative rhetoric about large families—the attempt has already passed and is no longer a possible development variant. Entering the game against popular modernization—everyone and every organization (even state) are doomed to failure. The more the society "insists" on formal marriages, the more often people do not enter into them at all.

As a rule, a family hands over some of its tasks to other institutions: education—school, healthcare—hospitals, etc. So accordingly, its utilitarian value conceded a place of love. Of course, love is a very fragile foundation for a family, but right now, it is perhaps the only justification for the union of two people. Which family structure will replace the traditional family? Will the change of the stamp on the marriage certificate lead to contracts regulating the ownership of the partners, or will the marriage itself remain as a symbolic gesture? The question is not even about the form of partnership but about the diversity of options.

The most certain possibility is that we will not find the prevailing model of the family in the future, but that instead, many variations will be accepted (allowed) and will/should always state the love between people (or human-artificial life forms) as the primary basis of marriage. Many different kinds of marriages will be possible, starting from guest marriage as the effect of the accelerated rhythm of life to individualism, mono- or polyamory, homo- or heterosexual relationships, and large or small families. The fight for gender equality, the new values, blurring the boundaries of personal and working space—all these changes will affect the nature of our relationship.

With all this information in mind, what will the family of the future look like? The issues of technological progress are often considered in scientific, economic, and political contexts. When it comes to society and the family, it is viewed through the prism of economic relations—the quality of "human capital," the profitability of new market segments, and the impact on people's lives on consumers with different financial possibilities. What will happen to simple human relations is limited to arguments about the impact of the non-virtual social networks that will remain.

And because the family is a fundamental phenomenon, which defines culture, economy, politics, social structure, and plenty other aspects, it is at the same time, a primary receiver of the impact of technological innovations and corresponding society change. So, we need to think and describe how a family can evolve under the influence of technology and what new forms it can take. There are more or less realistic options—some very understandable and agreeable, others very exotic, and some barely possible. However, the main message is still literally the following: "No rigid definition will exist for the family and there will be no point in trying to come up with one."

I certainly do not believe that the idea of the family will perish but that it will change beyond today's recognition when there is only the private in its midst—something that has been marginalized for a long time. Love will still be the principal value in the family (independently of form and size).

> "As many of you know, our name, Portokalos, is come from the Greek word "portokali," which mean "orange." So, okay? Here tonight, we have, ah, apple and orange. We all different, but in the end, we all fruit." –Zwick, "*My Big Fat Greek Wedding*" (2002)

1 Input from Interviewees

Eli Beer
Social innovator and first responder and founder of United Hatzalah of Israel

I would like to walk around the street during the day and would like to be able to be projected back to my family at the end of the day through technology and know that nothing will happen to me far away from them.

Tristan Lecomte
Chief executive officer, Pur Projet

Regarding the organization of families and societies, I see two possibilities. We go very individualistic or opposite go back to family. Life gaining value again, we go probably also transgender; families can be group of men or women or transsexual. In Thailand, where I live, for example, 40% of men are gay because it is accepted. Maybe we are all much more gay than we think. So it is well accepted in other countries; it could rise in other countries.

Caroline Schober
Vice rector of Research and International Affairs at Med Uni Graz

The definition of family will continue to become broader than having a common genetic background—with fluctuating size and physical distance. At the same time, feeling like a family will be increasingly important as a safe haven in an ever so volatile and overwhelming world around us. Energy-efficient, connected, smart, and smaller, modular homes mostly in urban areas will accommodate small families,

singles, or shared-apartment communities. With home office being a full-time reality for many, this will be psychologically and practically challenging. Fast, public, and zero-emission transport will be for leisure time activities and those who need to—or can—go to work physically.

Tobby Simon
Founder and president of Synergia Foundation

Kids needs for future are pedigree, simplicity, and honesty—what our grandfathers gave us.

Lucian Tarnowski
Hindsight futurist and founding curator of United Planet Game

Family unit seems to be important; humans don't change with technology, but technology changed human behavior.

Evolution of sects will be there; people may be much more liberal, but there could be a backlash.

Mark Turrell
Strategist, educator, entrepreneur, and founder and CEO of Orasci

Forming of new relationship models (at social level, e.g., civil partnerships). Notion of identity will be changing. Do you have two Facebook accounts? Most young people have at least two (one for parents or employer and one for friends). Control your identity by having false aliases. If in the future I divorce 15 times, my kids might end up with 60 grandparents.

Lisa Witter
Executive, serial entrepreneur, writer, public speaker, and cofounder and executive chairman of Apolitical

Men are fed up with leading; they want to be more involved in parenting. This will change everything fundamentally, affecting also the role of women. There will be much less violence. Instead of man as defender rather as protectors, a new macho is emerging, men redefining themselves.

Having a brain scan will be part of good parenting. To teach kids how to meditate and be present. Board rooms will meditate before going to big meetings, soccer teams also before big games, instead of prayer.

Much calmer and clearheaded decision-making. This will have a lot to do with gender dynamics, which will be affecting almost everything. In general, we will be going toward deeper interconnectedness.

Biggest invention, connecting man and machine, which will also be more interconnected. Smart things are around us everywhere.

Ethics will become more important as we unlock the brain. On Amazon, we will be able to buy a lie detector test and use it on our wife and children with 100% accuracy; imagine the possibilities. It will be the favorite toy of the future.

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Future of Homes

Karine Sargsyan

Abstract

By 2050, technology will turn homes into collectors, and electricity from nonfossil power sources will likely heat our homes and water. Electric vehicles will be widely available, and each habitat will have a charging station. At the end of the twenty-first century, many smart devices will actively enter our homes and everyday lives. Robotic vacuums, multifunctional electric stoves, multimedia televisions, programmable refrigerators, and computers—a variety of devices are already in our homes, which was unthinkable 30 years ago. Walls, floors, and ceilings will change depending on the residents' moods. Kitchen 3D printers with commercial cartridges of edible pastes and powders will be a standard built-in option in kitchen appliances. The robot au pair can do many monotonous tasks, from washing up to cutting salads. The living room will become a digital portal for communication. The bedrooms will be a resting place with a programmable sleep module. High technology gives architects and designers new possibilities and groundbreaking ideas for creativity. How our apartments look in the future will strongly depend on how we can use the new and advanced technology.

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Claudia Vergueiro Massei
Lisa Witter

The home should be the treasure chest of living.—Le Corbusier

What will the homes look like in which our families will live in the future?

According to the OECD report, the homes of the future will be more and more connected to the region's power grid, will be flexibly designed, will implement advanced technologies for heating and security, and will even make automatic decisions about post offices (The Future of families to 203, 2012).

"Futurology: A New Home in 2050" on behalf of the National House Building Council Foundation, which conducted research that tried to predict housing advices three decades ago and also predicted radical changes in home design due to new technologies and population mobility as well as taking climate change into account (NHBC Foundation, 2018). The introduction suggests that demographic changes, such as the rapid increase in the elderly population, exacerbate the problem of young people who cannot leave their homes and may intensify the demand for housing for different generations. Multiple homes are designed with flexible floor plans that are suitable for different generations and can adapt to changing family needs. Encouraged by the elevated necessity of urban living in by now compact populated regions, future projects will create houses with less space but more floors with open balconies and open roof areas. Architects take creative imagination impulses from rather compact designs like boats or mobile homes to create extra "micro-cantered" habitats for singles. Further innovative measures are being taken to design "third-age" accommodation for over 65s who meet the requirement of elevator housing, equal access, and social events while maintaining privacy and property. By 2050, technology will turn homes into collectors, and then electricity from nonfossil power source is likely to heat our homes and water. Electric vehicles will be widely available, and each habitat will have a charging station.

The future house will control its energy consumption via a central control panel that combines heating, electricity consumption, ventilation, and car charging. As energy efficiency becomes more important, the ideas currently used in the workplace are becoming standard for homes, e.g., allowing noncore devices to automatically shut off when the amperage is highest. The mailboxes are replaced by smart mailboxes that can accept registered mail and store valuable parcels. The homes of the future must respond to climate change by improving rapid cooling and heating technologies. Smart homes can monitor the health and activities of residents, for example, by reminding them to take medication or warning them of boiling water or overflowing bathrooms. Town houses will be connected to district heating and energy networks via the district's energy center, which will generate heat from waste or earth sources. Country houses will even have more space—in other words, more options for generating solar energy through integrated technology, which means that the roof itself is a solar collector and not, as was previously the case, a plate attached to the roof. Over the next 30 years, we will see significant changes in family life due to technological advances in response to social,

demographic, and climate change. The fact that houses have to be adapted to these requirements is a good way to protect yourself from surprises.

The futurological concept of an interactive smart home of the future includes individualization—the programming of the entire interior of living space, furniture, household, and technical devices according to the new achievements of the twenty-first century. The project of the house includes a robot kitchen, a home office with virtual capabilities, a bedroom with a module, a bathroom with an augmented reality simulation ball, a living room—a digital portal for communication, a multimedia—play center for the whole family (OECD, 2011).

At the end of the twenty-first century, an increasing number of smart devices will actively enter our homes and everyday lives. Robotic vacuums, multifunctional electric stoves, multimedia televisions, programmable refrigerators, and computers—a variety of devices are already in our homes, which was unthinkable 30 years ago. Those have appeared and have filled our lives, created a new style, and changed millions of families' behavior, ideas, and lives. It is time that architects and designers not only consider all the new smart devices in their future projects and install them in our homes as a kind of fashionable high-tech exoticism at the request of customers but also try out the overall concept of looking at the future home from a new perspective.

The architectural and functional idea of the "Interactive House" (Bloomberg, 2015) is already very present and will develop and enter every home very soon. The era of design is already over, when our houses were static and quiet, had the same esthetics, functionality and conservative spirit, and did not change for many generations and decades. The dynamics of life and the rapid scientific and technological progress dictate a different approach to the design of the architectural space of the future house as a kind of constantly updated and restarted lifestyle program and constantly expanding functionality. In my opinion, the future house should become an interactive living environment where the rooms themselves, walls, furniture, decorative materials, and household appliances should be interactive. In addition, the most crucial point is that the future houses should be self-cleaning (even dust should be cleaned automatically every 2–3 h) and maintained (Even the dishes should be washed automatically; by this, I also mean putting them in the dishwasher). You will think I am only a lazy woman, but I tell you, I have only a very practical thinking brain. Together, this will create a type of living space of the future, which can be flexibly and subtly adapted to by the owner, depending on her/his needs, preferences, living standards, technical possibilities, and social programs for living in the house. A house that meets the owners' wishes and is sensitive at the level of its sensors, radars, engineering systems, various computer programs, transformable forms, changeable styles, voice commands, and recognition—identification of its owner, memory of its tastes, and preferences—will create a comfortable living environment on a new level (Austin, 2019).

Virtual reality and robotics will be actively combined with the mentioned features in the living environment of the future house and will build a living environment in which appliances will be complexly integrated into the single home network as well as in the global net. Walls, floors, and ceilings will change depending on the

residents' emotional moods. The functional program of the premises, in fact, will be large customizable tablets and screens that change their lighting, color, intensity, and saturation; simulate different textures; reproduce any digital three-dimensional images; and monitor the position and location of the person in the moment. A resident of the house will be able to quickly change the emotional mood, the type of decoration, and the situation at any time and even restart the selected program for the operation of the premises online.

The engineering and technical idea of my "Interactive House of the Future" (Jantzen, n.d.) is to organize a local home network in which the information communication between all elements of the interior, exterior of the house, its household appliances, technical systems, and the person(s) (user) should be reached. In addition, the exchange of information in such a local home network can take place at the request of the owner(s) and with other similar systems from neighboring houses, which will be/may be combined into a single scalable network, as well as in interaction with the resources of the global Internet, which pumps the necessary information to the home server. Over time, home programming technologies will become significantly more complex; the variability of settings will increase significantly; the amount of information and the data transfer rate will change exponentially. This will result in the quality and comfort of the living environment. The house will become a habitual, constantly updating feature with unlimited resource intensity, and the residents of the house—users—will eventually get only augmented reality to see what they want to, and the response time to their information request will be instant.

A multimedia player center for the whole family at home will be usual. Already nowadays, joint playlists and film lists on Spotify, YouTube, Netflix, Amazon, Disney+, etc. are common for families and are supported and promoted with family packages (cheaper).

The multifunctional room of a residential building will be at the same time a home cinema, a fitness room, a computer game room, a place for leisure and entertainment, an intellectual and educational center, and a 3D home cinema for all family members (Nambiar, 2021). This will be from today's point of view a multimedia computer gaming center, where instead of ordinary tables and chairs with gaming monitors the family members/players sit motionless in virtual reality for hours. It should organize the game as well as possibly the life in a virtual room with the effect of dynamic physical stress of the entire body of the user/player. Maybe we will wear special playsuits, 3D reality helmets, interactive toys, and various attributes specially designed for these devices, but I think that the technology will advance so that we will have every functionality with minimum physical components. A diverse database of life situations as well as computer games and powerful processors will enable you to select and customize any situation you like, as well as to set the rules for collective or individual actions/games.

In a room, the walls will be huge panorama screens that use various special effects to reproduce a large-format real-lifelike spectacle. The illuminated, changeable floor tracks the movements of the players in the room like a huge touch pad. The ceiling with dynamic lighting will be able to redirect the light and will have sensors that

record noises, smells, and air flows. In general, this will be a type of "gamer gym" where all the bodies and senses of a person will be involved in the game called real life.

Nowadays, advanced children often do not have the opportunity to play with their parents; they hide, lock themselves in their rooms, skip school, run from home to Internet clubs, etc. so that they are not scolded or seen by their parents as they are interacting in virtual environment. With this architectural solution, after some years, conflicts of interest and hobbies of different generations can be avoided; the game can be turned from a separating factor to a connecting factor—a real useful pleasure for all family members as well as their guests.

The kitchen has traditionally been a special place in the house, where, above all, the high-tech solutions and innovations appeared last couple of decades that made the hard monotonous work of the homemakers easier and more interesting. The industrial production of gas stoves began only in 1836 (Snodgras, 2004), the first refrigerator for the household appeared in 1926 (Higgins, 2001), and in 2005, the first social robots "Wakamaru" from Mitsubishi came on the market (Keiper, 2008).

In the future, the kitchen will remain a high-tech room where intelligent furniture with various automatic settings of food storage temperature, humidity, and ventilation mode to consider the various esthetic properties of the outer surface will be cooking autonomy in smart ovens, microwave, etc. still living place for manual cooking, which will be considered very special and expensive. To create any culinary mood according to a recipe broadcast on the Internet will be used. Kitchen 3D printers with commercial cartridges of edible pastes and powders will be a standard built-in option in kitchen appliances. The robot au pair can do many monotonous working tasks, from washing up to cutting salads. The house owners only will be required to give orders to the household robot and monitor the technological processes as the "system administrator." For low-income customers, there may even be the possibility of renting robots.

Bathrooms with mixed or augmented reality simulation spheres will also be our future. For the bathroom of an interactive home, a special bathtub that can be built into any room with a separate functional module will be invented and developed.

The idea of the simulator's bathing sphere is that the user not only takes a traditional bath and swims in it but immerses himself in a different reality with numerous special effects. Thanks to computer control, it will be able to simulate, for example, the sea with all the characters from the deep sea displayed on the inner spherical screen, imitating its full presence thanks to mixed reality supported by the selected computer program for a specific session. The user will be able to adjust the temperature of the water, its composition (with or without sea salt), the accompanying sounds, and so on. Virtual reality projection will help to reproduce a realistic three-dimensional image of the expected environment. The water will reduce the weight of the human body, and thanks to the massage effect and touch and temperature interaction, the whole feeling of being in the open sea will be possible to reach.

The futuristic design will be corresponded by the climate-neutral construction, so the bathroom will be made of a new composite material that is durable and easily

takes on any design shape. The future bath will have such a strong relaxing and healing effect on the users' entire body and psyche that a traditional shower will seem like child's play of the past. But more importantly, this bathroom's function will be not so much to wash a dirty body but to remove the psychological stress that have accumulated during the day and to gain new vitality. Additionally, the used water in these bathrooms will have a cleaning device, allowing usage of the same water more than 100 times (e.g., loss of water molecules during cleaning approximately 1%).

The living room will become a digital portal for communication. The traditional living room has always been considered a place for receiving guests; holding important events; and active communication with family, friends, and relatives. In the house of the future, it will become a universal space, more like a virtual digital portal. Thanks to the latest digital technologies, it will be possible to simulate communication with both living relatives and guests who are far away, and thanks to digital immortality technology, even the digital counterparts of your deceased relatives will be simulated, for example, meeting a deceased great-grandfather who will toast to your health. During big family vacations, you will be able to order a holographic concert by a digitized Wolfgang Amadeus Mozart or any pop star, who will appear in full size right in your living room during a party and play the piano or sing a song (but only if you remembered to pay for your Internet contract☺).

The living room will be a modern space for visualization shows, a room with projection screens of a new generation in which you can simulate any of your emotional moods. After digitizing the personality of a loved one, you can project your virtual twin image onto the wall screen and thanks to three-dimensional reality do everything with it. We will be able to control our digital avatar twin from the couch, who flies through the storm clouds with virtual reality (already advanced, so no glasses and remote control needed). Furthermore, the loyal robot dog next to us will protect the emotional mood of its owner and synchronize the software skills' mood like a running processor on four legs. The panels used on the windows will be able to turn in the stained glass structures but also become transparent again after switching off and allow light into the living room. The transparency of windows and stained glass throughout the interactive home can also have a day/night lighting program control without curtains or blinds.

The bedrooms will be a resting place with a programmable sleep module. The future home's bedroom will be the most conservative room in a residential home that changed only minimally in the last centuries. The most comfortable and most relaxing place to sleep was and will be a light-protected elegant canopy with mosquito nets in combination with various down pillows, a robust and thick mattress, and silk blankets. Nevertheless, the bedrooms of the future smart home will be rooms in which we can program to our sleep mood and organize (evoke) useful dreams for our life cycle and rhythm in order to switch the tired subconscious off for rest. The outdated "old-fashioned" beds will be replaced by the programmable capsule modules for sleep, in which you can choose any "avatars" you want to restart and reset the negative emotions accumulated during the day. The sleep

modules will have any adjustable humidity and temperature, air conditioning, oxygen supply, and excellent sound isolation or effects for a deep, healthy sleep that will not be dependent on (or interrupted by) scandals from neighbors (if still present) or from the sweltering summer heat. The sleep capsule will be easy to synchronize with a mobile tablet, which will take on the role of a temporary watch assistant and will receive, pick up, and send calls and messages while we sleep. In the sleep module, it will be possible to set any local lightning, listen to relaxing music, and adjust the hardness of the mattress to the weight of the user, and the capsule lid can even change its light transmission. I proclaim a promising new direction in future design—a complete technological and esthetic "hybridization" of furniture and household appliances. Of course, such sleep modules will not be cheap, but their excellent functionality and esthetic variety, the choice of software configuration, and one or two different functional sizes will help consumers optimize their costs. But if we are not talking about sleeping but about sex, which most couples have in bed 80% of the time, this will remain traditionally in bed as we have it today, sort of as a vintage gag and simulating environment, although I think that traditional sex will also change its process and functions in the near and distant future (see Chapter 10).

We are now very familiar with the home office concept (especially after the Corona pandemic), and we all have somehow developed our virtual working skills. In the modern information society, the "remote work" trend was already gaining momentum in 2019 but became very common during the pandemic (Maurer, 2022). The idea of "remote work" appeared in the USA in 1972, and in 1979, the already stable term "flexible workplace" appeared (Weiler Reynolds, 2022), which did not imply the constant presence of workers in the office. For example, the IT industry was employing 25% of remote workers already in 2016, and even several novels, thrillers, and books were published about this phenomenon (Fleischer, 1995; Sims, 2013). The number of freelancers in various industries who want to work from home is also growing. A virtual home office will allow working entirely remotely, without commuting through the city; saving gasoline, without causing traffic jams; and flexibly organizing your creative process. Working with colleagues, customers, and manufacturers in a virtual reality mode, tele-video conferences, and controlling office cyborgs and robots in production far away from home are somehow already possible but will be routine and used daily. Small home robot advisors will help us at our mini-office with excellent skills, handling a large number of orders, finding and processing the information we need, etc. Information directly from the work monitor of the user's computer in ideal quality will be transferred to the media wall screens of our office or to the company's remote studio, where customers can examine the fruits of the joint creative work in detail in three dimensions and we can use it to negotiate in virtual 3D conference call mode. Virtual reality will help remote participants in the production process to meet in the digital space and to consider projects of future products in full size without living the house.

It is high technology that gives architects and designers new possibilities and groundbreaking ideas for creativity. The way our apartments will look like in the future will strongly depend on how we can use the new and advanced technology. I

am sure that today we are only in the first phase of the information technology and technological revolution. In 50–100 years, the appearance of our houses will change beyond recognition. For the design process to be painless and as efficient as possible, it is necessary today to try to create such complex experimental predictive models of apartments that will help to feel the enormous potential and full depth of future changes in our lives.

1 Input from Interviewees

Soulaima Gourani
Entrepreneur, author, keynote speaker, CEO, and cofounder of Happioh

In the next 50 years, your home will be able to check your health. Fever scanners will be installed in the front door, and every time you go to the lavatory, your excrement will be scanned for diseases—in this way, you will be alerted of any sudden development before your doctor. Also, your toilet will warn you to be careful not to consume too much unhealthy food because you are at risk of developing diabetes.

Sandrine Joseph
Innovation and social responsibility director at Orange

The home in 2050 will be a foyer in the original sense, as it has always been: a place where we can find strength with those we love. This is where the real wealth of humanity lies.

Tshering Lama
Executive chairperson and cofounder of Idea Studio Nepal (ISN)

The future of homes or housing will be automated, flexible, and customizable in layout and (may) be affordable due to ever increasing automation in building and to meet the need for increasing urbanization. Furthermore, majority of the buildings will be "green" and "accessible" for all. However, I believe, in 2050, "Homes" will be a place for where:

- People will feel safe from all digital intruders.
- People will connect with "self" and explore meaning.
- People will experience a sense of belonging.
- People will search for new "luxury" places within or close to natural environments.

Therefore, many talented Gen Z will choose to live in rural areas, away from urban noises, to be in a place where they can hear their inner voices—in search of finding their "self."

Mokena Makeka
Chief imagineer, FLOW, Makeka Design Lab, Mdesignworks, and Principal, Dahlberg Advisors

My design philosophy for 2050 and beyond is FLOW, whereby all of architecture must express the Future of Living according to One World principles. One world principles require all current activity to be within the regenerative limits of one world, which is currently not the case. Successful cities and homes of the year 2050 will be defined as engines of circularity, in which Flows are optimized.

Christian Mandl
Managing partner at Neulogy Ventures

By 2050, I wish to see more affordable homes that are energy efficient and smart, built with recyclable materials, and offer flexible layouts for multigenerational living, in gentle density neighborhoods.

Claudia Vergueiro Massei
Head of Executive Office and Transformation, Siemens Motion

I believe the future of homes will include a lot of customization and smart devices to maximize convenience. Especially with the trend of asset sharing and co-living, technology will play a big role to ensure that features such as indoor temperature, lighting, ambient music, art displays, and many others meet the preferences of the individual using the space at a given time.

Lisa Witter
Executive, serial entrepreneur, writer and public speaker, cofounder, and executive chairman of Apolitical

I hope that our dining room table is never replaced. Practical experience will be at a premium, and being together with family and dining together will be even more important. Smart table, family sits, take big breath, synchronicity devices will bring everyone on the same wave length before dining.

I would also like to see a sort of homogamic gadget to bring my kids and grandkids closer, interconnected in a more essential way to my loved ones, family, and friends.

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Future of Work and Business

Sangeeth Varghese

Abstract

Our professional lives are tightly integrated to the overall future of humanity on several dynamics including family, social identity, physical and mental health, and economy. In 2050, there would be sweeping transformation of the way we work. Europe and the United States will face a decline in population and a shortage of manpower, whereas population in Africa and Asia would continue to grow and act as a source of manpower for these regions. However, Africa and South Asia would continue to be plagued by the absence of infrastructure and capital. Labor force from these regions would migrate to the developed regions in search of better opportunities and improved livelihood. Across the world, unemployment among the youth would increase multifold, leading to severe political and social unrests, resulting in disintegration and implosion of many nation states. From a micro perspective, from an organizational point of view, by 2050, many of them would revert to social capital—trust and goodwill between individuals and their communities—to coordinate business activities compared to the current formal systems like business contracts, management policies, hierarchies, and bureaucratic rules. There would also be sprouting of micro-multinationals that would replace large multinationals of today. Business decisions being driven by real-time data analysis and predictive and actionable data would help them thrive.

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> Far and away the best prize that life offers is the chance to work hard at work worth doing.—Theodore Roosevelt

1 Introduction

When we are crystal gazing at the future of humanity, understanding where our work and professional world is heading toward to is an important question. The role that is played by professional work in the modern society is more than just providing an income for an individual. It is a means of providing a sense of fulfillment, productivity, and purpose. It also plays an important role in boosting self-esteem, confidence, and overall health of individuals. From a social point of view, work and the professional world promote community cohesion and civic participation, eventually forming an important pillar of our social organization. Needless to say, our professional lives are tightly integrated to the overall future of humanity on several dynamics including family, social identity, physical and mental health, and economy.

In this chapter, we capture several glimpses of the future of work and businesses, some of them macro developments, whereas some of them micro developments. They include:

- Europe and the United States will face a decline in population and a shortage of manpower, whereas the population in Africa and Asia would continue to grow and act as a source of manpower for these regions.
- Africa and South Asia would continue to be plagued by the absence of infrastructure and capital. Labor force from these regions would migrate to the developed regions in search of better opportunities and improved livelihood.
- The unemployment among the youth would increase multifold.
- Millions of youth would go through severe psychological, financial, and health trauma.
- Youth unemployment would lead to severe political and social unrests, resulting in disintegration and implosion of many nation states.
- Organizational democracy where all members are equally involved in the decision-making and working of the organization would become more prevalent.

- Organizations would revert to social capital—trust and goodwill between individuals and their communities—to coordinate business activities compared to the current formal systems like business contracts, management policies, hierarchies, and bureaucratic rules.
- All businesses would just be digital platforms, with no physical offices or infrastructure. Nothing would be permanent, but businesses would on board staff, resources, and infrastructure on demand.
- No individual will be rooted to a single job or location but would choose what they need, when they need on demand.
- Large multinationals would be replaced with micro-multinationals with no fixed assets.
- Business reputation would emerge as a key factor to reaching and retaining customers in the future world.
- Every business decision would be driven by real-time data analysis and predictive and actionable data.
- Robots would work alongside humans, improving productivity substantially for both humans and robots.

2 Change in Demographics

Two important variables that determine the demand and supply for future jobs are population and demographics. To develop clear insights and to extrapolate how population and demographics would evolve and shape up the future of jobs with a certain amount of accuracy, it is important for us to look backward and learn from the past trends. This would enable us to figure out how many of these patterns would hold up to the pressures of time and how many of those will wilt.

According to Max Roser, Hannah Ritchie, and Esteban Ortiz-Ospina, who are founders of Our World in Data, the world population of 10,000 BCE was under one million. It then grew at a crawling pace of around 0.04% annually to reach around 1 billion people in 1803. However, from the1800s, we witness a fundamental change in the way population started to grow. By 1930 or so, it doubled to 2 billion. The first billion that took almost 12,000 years now took only 120 years. However, what happened from 1800 onward, and how is it relevant to the future of jobs?

During the early 1800s, the human society and the way we worked and arranged ourselves underwent a great transformation because of the Industrial Revolution. Before the world industrialized, through several thousands of years, people across the world led a predominantly agrarian lifestyle based in rural villages. They worked as families in their farms as subsistence farmers, where they grew their crops to feed themselves. They rarely traveled out of these villages for anything. Hence, their personal and professional lives were intertwined and rooted to their native place and families. However, the Industrial Revolution changed all this.

The dawn of industrialization in the early 1800s came alongside inventions such as the steam engine and several other mechanizations. As factories started to get bigger and produced more goods, the earlier forms of subsistence like farming

started to disappear. Men left their families and moved into cities in search of jobs. It was almost a sweeping transformation from what was there until then to what is new. The Industrial Revolution also brought about economies of scale, which increased the efficiency and production of goods, including food. Our world suddenly discovered more resources that could sustain more people. These resulted in an overall growth of population—where billions were getting added to the world population in a span of just 12 to 15 years.

The world population quadrupled in the last 100 years or so. The engine that started this spurt in population might have been industrialization, but then an increase in population in turn led to an increased demand of goods and services, which led to further deepening of industrialization. Population and industrialization reiterated each other leading to a virtuous cycle. Hence, it is reasonable to assume that population and the future of work are intricately interconnected, in the past, present, and future.

However, the world population growth has been slowing down during the recent years. The growth of the world population peaked around 1970, where it grew at 2%, whereas currently it declined to 1% a year. According to the UN projections, this growth would continue to slow down and would fall to 0.1% by the end of this century, almost bringing the population growth to a standstill. Some studies even predict that instead of growing the population shall start declining by the end of the century. According to a study from Lancet, the world population shall peak in 2064 at 9.7 billion, which then shall start declining to 8.8 billion in 2100. An analysis from the Wittgenstein Center International Institute for Applied Systems Analysis (IISA) corroborates with Lancet and predicts that the global population would peak in 2070 and then start to decline.

The bigger question is what would be the implication of this demographic change to the future of work. Hans Rosling, the famous Swedish physician and public speaker, came to a conclusion based on what he refers to as "peak child"—a period when the number of children born reaches the highest peak. The significance of peak child is that the countries that reach this stage would be followed by a demographic dividend, when the proportion of dependent young children falls compared to the share of the working population.

During the wake of Industrial Revolution, Europe and the United States benefitted out of peak child, as their working population swelled. This gave them a leverage of demographic dividend, where a larger working population supported a smaller dependent population, eventually leading to centuries of unprecedented growth. However, now the case is reversed, and these countries are facing a demographic problem of a smaller number of working people supporting a larger population of dependents. However, countries that lagged behind during the demographic surge of industrialized nations are coming to life now. For example, Asia has been witnessing a demographic dividend during the last few decades. Their births are projected to increase from 63 million in 1950 to 73 million in 2050, a relative change of 17%, whereas in Africa, it is projected to grow from 11 million in 1950 to 44 million in 2050, a relative change of 295%. Comparably in Europe, during the same time, in 1950, while the births were 12 million, in 2050, it shall be 7.5 million,

a negative 36% relative change. While Europe ages, Asia and Africa would be ready to go to work and be productive.

According to a Lancet study, by 2100, more than 8 out of 10 people are expected to live in Asia or Africa. Though, Africa is just 17% of the global population, by 2100, this is projected to increase to 40%, during the same period; Asia would also have a comparable 40% share of the world population. Now, when we specifically look at the working age population, by 2100, India is estimated to have the largest working age proportion followed by Nigeria and China. Hence, the first prediction for 2050 regarding the future of work would be that Africa along with Asia would be a source of manpower and workforce for the world. The regions of the world that are richer, productive, and powerful now, like Western Europe and the United States, would have to depend on these regions, unless they figure out technologies that completely overcome the need and intervention required by manpower in the production of goods and services.

3 Migration Toward Labor Opportunities

According to the International Migration Institute of Oxford University, around 50 years back, the number of migrants in the world was just around 100 million; it increased to 190 million by 2010. Though by sheer absolute numbers, they look as if migration has doubled, if we look at the proportion to the world population, it has actually remained constant during the entire period of the last 50 years, at less than 3%. Currently, about 260 million people live outside their native country, again constituting about 3% of the world population. There could be many reasons for this migration, like instability, war and conflict in native countries, and poverty. However, less than 8% of migrants are incidentally fleeing their homelands because of these reasons, whereas a large majority are attracted to the strong labor markets in the source country.

Jobs and labor are the single most reason why people migrate from their native countries to source countries, especially from the last century. The globalization process has accelerated this, where strong labor markets of Western Europe and the United States emerged as major host regions attracting large volumes of the global workforce. In fact, the United States stands out for attracting the highest number of immigrants, more than 40 million accounting for more than a tenth of the US population. So, our larger questions are how would the migration of workforce continue to evolve in the next few decades, what would be the impact of this migration to the future of work, and how would this phenomenon shape up the world?

To understand the future of workforce migration and its future impact better, we need to correlate this with the population dynamics. As we have seen earlier from the Lancet study, the world population shall peak in 2064 at 9.7 billion, which then shall start declining to 8.8 billion in 2100. During this period, the population in South Asia would grow at a sustained pace, where it would reach 31% of the world population in 2050, as against 28% in year 2000. Comparatively, population in Africa would grow

at the highest pace in the world, where it would climb up by 170% between 2000 and 2050. However, as we have already seen, during the same time, the population in Europe would shrink to abysmal levels. Western Europe would decrease from 6.4% to a mere 3.5% of the world population in 2050. In Eastern Europe too, this decline in population would be noticed, in fact at more pronouncing levels even compared to Western Europe.

According to the United Nations Population report, beyond 2020, migration is projected to be the only driver of population growth in the developed regions. Without migration, the report says that North America and Oceania would record 13% smaller population, whereas it would be 6% smaller in Europe by 2050. In the working age population, between 20 and 64 years, the fall would be steeper at 15% in North America and Oceania, whereas in Europe it would be 8% without migration.

In one way, this demographic dividend in the developing regions of the world—South Asia and Africa—could have been their greatest opportunity, if they were able to leverage on them. However, taking advantage of an increasing number of people requires more than just them being in the right productive age band. It also requires large amount of working capital, resources, organization skills, and technology to ensure that opportunities are created. Unfortunately, all of which are absent in these regions, unlike the developed regions, which have progressively laid the foundations and built on it starting from the time of the Industrial Revolution. It is predicted that capital, resources, organization, and technology would continue to be concentrated in the developed world. The developing world even in 2050 would be plagued by the absence of infrastructure and capital. Hence, labor force from the demography surplus regions, facing the prospects of poor living standards and lack of adequate employment opportunities, would migrate to the developed regions in search of better opportunities and improved livelihood.

So, migration from the demography surplus regions like South Asia and Africa to regions like North America, Oceania, and Europe shall compensate for their demography deficit, especially in the working age bands. According to UN projections, the total number of migrants globally is expected to increase to 334 million in 2050, an increase of almost one third in absolute numbers compared to the current scenario. In relative terms, it means that 2.9% of the world population migrants would increase to 3.5% in 2050. According to the projection, the United States would continue to attract the largest number of immigrants even in 2050, compensating for their demographic deficit. From 40 million immigrants currently, it would increase to almost 60 million in 2050. Meanwhile, in continental Europe, the four largest economies, Germany, Spain, France, and Italy, would also attract close to 60 million by 2050.

Hence, the second prediction regarding the future of work and employment is that though there would be a deficit of working age population in the developed regions of the United States and Europe, in 2050, it would be compensated from South Asia and Africa as these regions would continue to remain underdeveloped. The impact of this migratory flows would add to the GDP of these developed nations. It is projected that the arrival of young workers would progressively increase the GDP growth rate

in Western Europe by 0.2% in 2035. A mirror image of this would be felt as a deteriorating effect on the source regions—Africa and South Asia—of this migration.

4 Looming Youth Unemployment

According to the United Nations estimate, there are 1.2 billion youth between 15 and 24 years currently in the world accounting for 15.5% of the global population. They project the youth numbers to reach 1.3 billion in 2030 and 1.34 billion by 2050. In this, Asia had a largest share with over 700 million, whereas Africa had around 300 million. Asia would continue to have more youth than any other region until around 2080, when it could be surpassed by Africa. The UN estimates that in the 47 least developed countries, the youth population would increase by 62%, rising from 207 million to 336 million in 2050.

A higher proportion of youth in the population is a demographic blessing, since they could be gainfully employed. Youth can be a driving force for development when provided with adequate knowledge and opportunities. However, in the absence of suitable productive opportunities, they could emerge as the greatest challenge to a nation. As the UN Secretary General Antonio Guterres commented, "The frustration generated in young people that have no hope in the future is a major source of insecurity in today's world. And it is essential that when Governments plan their economic activities, when the international community develops forms of cooperation, they put youth employment, youth skills at the centre of all priorities. . ."

So, what are the main challenges regarding youth employment in the present, and how would they play out in the near and distant future? First, adversely affecting the productive intent of the youth, there has been a large-scale churn in the family psychographics, from the turn of this new century. Across social demographics, families are now comparatively smaller, and hence, average parents spend more time and resources for their children, providing them better handpicked opportunities and protecting them from harsh externalities. Prima facie, this appears to be positive but has altered our expectations from future generations. Parents of today presume that their children would earn and do considerably better than them and hence are willing to provide a safety net and long rope until they land those jobs they think they deserve. This has caused many youth to enter employment with a sense of warped entitlement toward the money that they should be earning and the type of work that they should be doing. Unfortunately, this has resulted in a negative unintended scenario. The Economist magazine says that our newer generation, though have consumed more resources and are more educated than ever, are twice as likely to be unemployed.

Meanwhile, there is another interesting dimension to this increasing case of missing productive intent. The earlier cohorts of young working age generations had the demon of boredom to fight with, as they sat at home or at the nearest public library. There was nothing that could engage or entertain them, and hence many a

time, they would slip into the abyss laden with worries about their future. Parents again, devoid of any real distractions, would nag and egg them on to get working. Nowadays, technology has managed to jostle out that boredom almost permanently from our lives. Information, communication, and entertainment are at our beck and call. Youth are now relying on social media as an alternative therapy keeping them away from all real-life situations—a job being one of them.

Both these scenarios have deep repercussions on the future of employment, since the graduates of today would continue building the foundation of the world economy for at least the next four decades—until 2060. So, the future that we shall inherit depends on the productive edge and intent of the current youth.

According to the United Nations World Youth Report, the rates of young people's participation in the labor force have been continuously falling over the last few decades. Unfortunately, the youth find themselves at a disadvantage and hence are three times as likely as adults to be unemployed. Hence, youth unemployment is always significantly higher than the adult rates across the regions of the world. According to the World Bank, in Africa, where this situation is stark, youth represent 60% of the unemployed people.

According to an African Development Bank Report, for the 12 million people that join the African labor force each year, only 3.7 million jobs are created. This means a huge deficit of 8.3 million jobs currently. Now, consider the fact that the African youth population is growing at a rapid pace and is expected to double to over 850 million by 2050. Even if Africa manages to add many millions of jobs, the unrest would be severe. In the case of India, it would need to generate a staggering 280 million jobs between 2020 and 2050.

Among the youth, even those who find employment, quality remains a major concern, where a majority of them would be in informal economy. According to the International Labour Organization (ILO), globally more than three-quarters of working youth are in informal jobs compared to adults where informality is much lesser at 58%. When we look at developing countries, the proportion of informal employment is staggeringly high among the youth at 97%, where just 3% is employed in any formal career pursuits. Informality of their jobs also means that several millions of the world's youth are living on incomes below extreme poverty levels.

According to Maurizio Buzzi, Director at ILO, current unemployment among the world youth has deep social and economic impacts on our future. First of all, if nations are not able to create high-quality employment for its youth, this would lead to serious social unrests and forced mobility, resulting in instability of regions across the globe. Second, if youth of today are experiencing a delayed start of suboptimal start, they would continue to lag behind in terms of earnings and income growth throughout their lives. This in turn drags down national and then global economies, with lower productivity, lower consumption rates, and lower savings.

Hence, the next prediction on future of the jobs in 2050 is that there would be severe employment shortage among the youth of the world. This shortage of jobs shall be concentrated mostly in the African and South Asian regions. At an individual level, this would mean that many millions of youth would go through severe psychological, financial, and health trauma. At a macro level, this alarming situation

would eventually lead to severe political and social unrests in the region, resulting in disintegration and implosion of many nation states.

5 Disruption of Organizational Hierarchies

Our current organizations and workplaces are a result of the Industrial Revolution—when we evolved from agrarian rural tightly knit communities into urban factory-dominated communities. In factories, mainly into labor-dominated domains like manufacturing and mining, the need of the hour was a mechanism to control and streamline the overall process. Hence, when Frederick W. Taylor came up with management principles for efficient logistics, management, and productivity, the industry lapped it up. Through his scientific management, he firmly established a rigid hierarchy with his theory of "brains at the top," "hands at the bottom." Organizations kept people as well as their performances under check by imposing controls through obvious as well as not so obvious mechanisms like log-in and log-out times, hierarchical structures, direct and indirect supervision, management quotas, and even through stereotyping methods like dress codes and designations. Even namesake empowerment was usually responsibility without any authority. Authority always rested only with the "brains on top."

Books and thinkers on organizational behavior and management literature reiterated this thinking. They somehow picked up and celebrated a belief that tight hierarchies are important for defining better productivity. This ensured that the same processes and beliefs were carried forward to all types and sizes of organizations across geographies and ages. Noam Chomsky, the American linguist and philosopher, said that "A corporation is about the closest thing to a totalitarian institution that humans have ever contrived. There is a convergence of total power at the top. All the decision-making lies with either the CEO or the board of directors or both, while orders are transmitted down to the lower levels, from where complete subservience is expected. The people at the top not only assert themselves, but also constantly forbid and suppress any criticism and opposition that might be directed against their agenda."

According to Open Source Leader, written by Varghese (2010), there is an evolution in the organizational processes and structures happening, and future organizations would be completely different in their looks and feel by the time we reach 2050. So, what could be the reasons that would drive this change? And how are these changes affecting the business organizations? First, the culture and environment are getting complex by the day. Dynamics of the future will be so complicated that predictability of events and results would be almost impossible. As Soulaima Gourani suggests, unlike in other times, the world is moving toward high complexity, and the contexts that you operate in are becoming more and more difficult to process. Hence, power is concentrated on the top, like in today's organizations, and then decisions could incline toward one extreme. Extremities in decision-making can lead to disasters easily, as one person at the top would never be open to all possibilities and probabilities into consideration. Hence, systemwide

shocks would have deeper impacts, leading to many organizations and systems imploding. In the future, organizations would be forced to engage in open staff consultations within a framework of checks and balances. This would help to regulate one-man centric closed decisions, enabling the overall system to be more resilient and adaptable to the complex and varying environment.

Second, until recently, business information was a closed and confidential commodity, which was accessible only to the leaders of organizations. Information was used by corporate leaders to build their influence, by assessing situations in ways that fitted their agenda. Without relevant information, even if staff would like to be involved in decision-making, they would not be able to. Lack of information access also made sure that the other staff would find it difficult to judge the results and performance of the leaders. But now with the advent of social media or several other modes, information has become more democratic. This has driven the power down the ladder, where more staff could get involved in decision-making, and more staff could judge the efficiency and effectiveness of the leader better.

Future organizations compared to the current ones would be less hierarchical and more open. Organizations would develop in such a fashion that every individual and every staff member have a stake and hence would be able to add his perspective. According to Binta Brown, in the next 50 years, we will have completely disrupted hierarchical, top-down institutions and corporate structures, in favor of flatter, highly responsive, dynamic structures that are resilient and responsive. Compared to today's closed organizational setups, the open organizational setups would be defined by absence of hierarchies and rules, shared power between the CEO and the staff members, transparent and meritocratic workplaces, organizations with shared visions, and lower silos where staff members could easily shift between departments and competencies. So, the next prediction for the future of businesses 2050 would be that in the future, organizational democracy where all members are equally involved in the decision-making and working of the organization would become more prevalent.

6 Return of Social Capital

According to Open Source Leader (2010), the main objective of any organization is the coordination of actions of a set of individuals to engage them toward a certain agreed goal. However, coordination does not happen de facto but requires some coordinate efforts, since individuals do not collaborate on their own without any external push or incentives. Before the arrival of the Industrial Revolution and the scientific management principles proposed by Frederick W. Taylor, this coordination was achieved through an abundant stock of "social capital"—the level of trust and goodwill between individuals and their communities, established through the informal social interactions between them. People were able to easily work together because they knew each other in their personal spheres.

However, once management became a formal science, businesses replaced social capital with formal systems like management policies, hierarchies, and bureaucratic

rules. As businesses started becoming enormously complex, they insisted that the relationship between the organization and its people was purely contractual. In the shorter term, this contractual arrangement worked very well, especially in industrial environments, where it added more predictability to the business operations. Planning, organizing, staffing, reviewing, and budgeting, everything was possible with a greater level of control for the top management. However, it would not be without its own challenges. Primary among them was a phenomenon called "transaction cost"—a term that became most widely known through economist Oliver E. Williamson's work. Often known as coordination cost, it is the cost of all the information processing and monitoring necessary to coordinate the work of people in an organization, primarily because in the absence of social capital, people started considering their professional conduct as nothing but a contract and hence cooperated only when the organization was willing to bear the cost. For the business, this meant increased transaction costs, which came in several shades—information costs to locate the right resources to carry out tasks, reward costs to incentivize people to work toward specified actions, monitoring costs to make sure that people are not shirking the responsibilities, and enforcement costs to take appropriate action, if anyone defects.

Rigidity and unresponsiveness of contracts were yet another challenge of formal coordination mechanisms. Contracts, how much ever elaborate they could be, would not be able to predict every situation and every contingency and hence would have to consider goodwill and social capital to make it run smoothly between the parties. Hence, many a time, this would assume people to bring in their own assumptions and manage it through their already established relationships, that just by the word go in a contract.

Industrial Revolution era Taylorian management techniques intended for easier coordination and faster response have been producing just the opposite result—by imposing various forms of transaction costs and rigid and unresponsive structures. Hence, though we assume that in the complex and technologically sophisticated future, social capital might not be of much use, in truth it remains as relevant as in pre-Taylorian times. So, how will future organizations move toward greater social capital-based coordination?

First, Mancur Olson in his book "Logic of Collective Action" says collective action becomes an easier process once the number of individuals involved in a task are smaller. Since, future organizations compared to todays would be nimbler and hierarchy-free, social capital would be easier to be relied upon for coordination purposes. Even the larger organizations would follow what Robert Putnam, political scientist from Harvard, would calls as a honeycomb structure, where the organization offers its people many opportunities to interact at deeper levels, mostly through online media like social networks. A honeycomb structure is essentially a conglomeration of several small groups, within a larger organization, not necessarily connected with the core business of the company but which helps its people to connect with each other and develop trust in each other. These smaller groups have low entry barriers—anyone who is interested can associate as well as contribute. It is easy to enter, and it is easy to leave.

Secondly, withholding of information by the upper level hierarchies has made coordination difficult until now. However, as access to business information becomes even more ubiquitous in the future, organizations become more flexible and fluid. Organizations would then imbibe the value of transparency—where nothing is hidden, but everything is open for everyone to see. The transparency that pervades everything helps peer pressure to work smoothly to a great extent. People know why someone is getting a promotion, why someone is claiming a higher salary, or why someone is opting out of a meeting. It also helps them to keep a finger on the pulse of the company. They know exactly how much are the revenues, how much are the expenses, what is justified, and what is not, organizationally as well as individually. This would again enable better trust coordinated processes.

By 2050, organizations would have reverted to social capital—trust and goodwill between individuals and their communities, established through the informal social interactions to coordinate their activities. They would rely less on formal systems like management policies, hierarchies, and bureaucratic rules.

7 End of All Rigidities

Until recently, the efficiencies and competencies of businesses were anchored to certain fixed assets and things. For example, the biggest corporations had their offices in the most central locations in the biggest metro cities, which gave them access to labor, materials, and logistics to leverage mass production of goods and services. Each staff member worked with a set of fixed resources around—fixed location, office space, office timing, resources, and even colleagues. In the technology era, businesses broke out of this fixed mindset, where they choose to move certain functions offshore. However, there are still constraints on certain factors like location and staff, where businesses, though offshore, still choose to be in strategic areas, for example, metro cities, where there is abundance of talent and resources.

In the future, there would be no constraints at all of location, staff, technology, or resources. Everything would be flexible and available "on demand," "just in time." This 100% flexibility shall be mutually reiterated by the demand side, which is the businesses, and by the supply side, which is the resources. Richard Florida, the University Professor at the University of Toronto, suggests that with the rise of remote work, many families would move to less crowded suburbs and small towns. They would choose to work out of their homes rather than at the constraint of a central location. Hence, for businesses, it no longer makes sense to be rooted in a metro city or for that matter in any fixed location, because their resources are spread out everywhere. This gives the businesses a flexibility to exist in a digital space without any physical presence. People would also choose not to be constrained by working for a single organization however large or prestigious that corporation is but rather be flexible and pick and choose work as they please. Hence, for businesses, it no longer makes sense to have fixed staff and employees, but rather they can build a customized team for each project and each business for a limited amount of time.

So, in 2050, businesses would not have anything fixed. Everything would be 100% flexible and available off the shelf on demand and "just-in-time." In fact, businesses would just be digital platforms, with no physical offices or infrastructure. They would go ahead and choose their staff, resources, and infrastructure, as and when they require. People in the same fashion again will not be rooted to a single job or a location but would choose what they need, when they need.

8 Rise of Micro Corporations

Industrial era and the future that followed it with technology corporations were all about large corporations. Corporations that employed several thousands of people to monopolize size and reach. Being large was the biggest competitive advantage and merit, since large players were able to build moats to sustain their market. However, in the future, nimbleness and agility will be the most coveted qualities.

According to the Yell Future Gazers Report, there used to be two simple ways to think about business size and reach. A firm was either big and global or small and local. According to Yell, the future will be about a new paradigm—small and global. Individual entrepreneurs and small companies will be able to unbundle and outsource functions to others, crowdsource R&D, and exchange employees and contractors to become what they refer to as the micro-multinationals of the future. These micro-multinationals, would be stripped down and nimble, with near zero employees, but still projects quickly flourish, evolve, and resolve. People would be employed on a pay-per-project norm, where specialists move from project to project.

In 2050, being a large corporation would be a weakness rather than a strength. While larger corporations have fixed assets and resources to be taken care and paid for, micro-multinationals have no fixed assets and have a shorter go-to-the-market time spans. Small and faster corporations take lesser time to go international and win the race.

In the future, as access to information becomes more ubiquitous, it becomes easier for customers and clients to judge a business. Future would be an era of transparency, where there would be heightened concerns about ethics, the environment, and the values of the businesses that people and organizations buy from. According to Binta Brown, business of the future shall evolve to a truly human-centered movement, where there is less emphasis on short-termism and profits and a greater emphasis on making markets work for the broader needs of humanity. Hence, as Yell Future Gazers Report suggests, there would be an increased focus on corporate reputation than a single-minded focus on profits. Business priority would not just be business but also people, planet, and purpose. As Rupert Younger, Director of the Oxford University Centre for Corporate Reputation at Oxford Saïd Business School, suggests, it would be no longer about what you say about yourself, but it would be about what the public space talks about you. No corporation will be in any position to hide any information that pertains to them. As everything will be out in the open, corporate reputation would be judged on an hour-to-hour basis.

In 2050, business reputation would be the currency that sells. Business reputation and managing it effectively would emerge as a key factor to reaching and retaining customers in the future world.

9 Age of Machines

Until now, machines and artificial intelligence have been playing in the background—mostly used by the innovative companies at the forefront of technology and bigger corporations. Though every business, big and small, produces reams and reams of data, from each process and each customer interaction, finding meaning in these barrage of data has been possible only for those corporations with deep pockets. In 2050, every business will be a data-driven business.

As 2050 would be the age of micro-multinationals, these companies would leverage big data to create unique competencies for themselves. As Soulaima Gourani suggests that knowledge would become the cornerstone, it would be the most important means of handling the increasing complexity and the rapid changes. However, usage of data itself would have become much more powerful and all pervasive in the future. According to Sandra Khvoynitskaya, an expert in Internet of Things, "in the future, computers ability to learn from data will improve considerably due to more advanced unsupervised algorithms, deeper personalization and cognitive services." The emergence of fast data will allow processing real time—where users would have insights as the event unfolds, sometimes as little as a fraction of milliseconds. Our future might not be just about fast data but also would be about actionable data, where data would not just be real time but also be predictive, strategic, and actionable. Analytical platforms would enable accurate, standardized, and actionable information availability everywhere.

One of the common predictions about the future is the fear of robots replacing humans completely or even overtaking humans in intelligence. According to the Economist magazine, by 2037 itself, almost half of the work done by human beings would be replaced by robots. However, the Yell Future Gazers Report suggests the possibility that in the future, humans would actually move up the value chain, where we will continue doing those jobs that machines don't do well, which require subjectivity, creativity, and empathy. Machines and robots would work alongside humans, collaboratively, rather than competitively, which the report calls as Cobots. Collaborative working between humans and cobots, according to researchers from the Massachusetts Institute of Technology, would have exponential impact on productivity of both humans and cobots. According to them, almost three fourths of the tasks that are currently performed by humans in service industries would be replaced by cobots, improving the productivity by leaps and bounds. Lucian Tarnowski suggests that by 2050, the world shall see hyperefficiency of human capital, which will be augmented by machines. Machines will be doing everything other than creative work, and hence, people will clearly know their own strengths and shall compete for value than for price. In fact, according to Daniela Rus, head of the Computer Science and Artificial Intelligence Laboratory at the Massachusetts

Institute of Technology, "in the future, robots would be everywhere and everybody would have a robot, and robots are pervasively integrated in the fabric of life."

By 2050, data analytics would be all pervasive. Everything that we do and are driven to do and every business decision would be driven by real-time data analysis and predictive and actionable data. By 2050, robots would work alongside humans, improving productivity substantially for both humans and robots.

10 Input from Interviewees

Samuel Alemayehu
Serial entrepreneur and investor

As a venture capitalist at C1 Ventures, my focus is on creating solutions that decrease carbon emissions in the production of food and materials. Our analysis leads us to believe that precision fermentation, which involves the domestication of microbes, will become the primary method for producing vital nutrients such as carbohydrates, proteins, and fats within the next two decades. We forecast that the adoption of precision fermentation will significantly boost the output of current agricultural methods, decrease carbon emissions by over 85%, conserve land and water resources, and significantly reduce total cost. These outcomes would be a major step forward in the sustainability and efficiency of food production.

Gina Badenoch
Social entrepreneur and photographer and founder of Ojos que Sienten AC and Capaxia UK

Development will bring third world to second, and environmental consciousness will increase around 2040. London is very diverse; I picture the world as the Olympics, truly diverse global workforce; you will walk into a company and see a small London.

Maurizio Bussi
UN diplomat and director at the International Labour Organization

How will the workplace may look in 30 to 50 years. 4–5 generations are coexisting today at the workplace. They are quite complicated to handle. I see the end of cheap labor and complications on the world. China was producing everything 10 years ago, but now they don't do that anymore, as, e.g., Burma is cheaper. It may not be possible in the future to buy a TV for 200 dollars any more.

Technology today allows us not to commute. Life quality and more efficiency are at stake. An unproductive time can be transformed by technology. We will thrive for work-life flexibility instead of work-life balance.

The new generation can access the labor market, growing up with new technology around them. How do we integrate them in the labor market? That can be destabilizing.

In the future, companies may look at your social profile on Facebook or ask how many followers you have on twitter, and how many people read your blog. When a young person goes for a mortgage, the bank will check how many of your friends have credit problems. If it is many, you are likely to default.

Digital reputation may require your perpetual CV. How do you build your reputation capital? How do companies discover talent? They may come to you by data mining your social profile. Simulations and video games that could be done at corporate level are growing in importance; frontal lectures are passé.

Teams will be matched together by technology, finding the best possible matches. Wearable computers and micro devices are built in your clothes, helping you professionally and personally.

Sahar Chen
Cofounder and managing partner, Beyond the Billion Dollar Fund

Venture capital holds immense power to influence the ideas that shape the way we live, work, and lead. So what happens in 2050 starts with us seeding what we envision for our future. The exponential rise of technology continues to disrupt all industries and will continue to do so: Recall five of the largest companies by market cap today—Apple, Google, Amazon, Microsoft, and Facebook—were venture-backed technology companies that have shaped significantly how we interact with each other and by that our relationships. It's cliche, but talent is universal, and yet, opportunities are not. The future needs all our best talents at hand, and of course, this means we cannot be excluding half the population. Women are already leading us forward by their great innovations, and by 2050, this will hardly be a topic of discussion!

Õzlem Denizemen
Opinion leader in women empowerment and founder of Para Durum

We will be able to connect with different sources of life. . .like the matrix or an avatar (the first time the Internet was used, they could not believe how it will change life 50 years ago).

Conscious capitalism with sharing economy is nw becoming strong. I am a social entrepreneur. In the future, everyone will be more like me. People will not want to be doing everything for themselves anymore. Like in 50 years I will ask you "What do you do? Aha, and so what do you do for others?". . . this will be common.

7 billion people are coming to the realization that I cannot just live wanting more and more; sharing will become common. I want to elevate other people's life. Life is a coin; I want women to solve their financial problems. Feeling strong, they can be at peace with themselves. Women will be more courageous and powerful, and more positions will be theirs, whereas men will be a bit scared of this; relationships will change. The world needs nurturing and care; hence, women will get into world leadership positions and social positions on a large scale. Capacity of giving birth, innovation is important for women, contributing with different thinking.

Rajeev Dey
Founder and chief executive officer of Learnerbly

Working on start-ups and following a more entrepreneurial path would be second nature to people in the future, leaving behind the sort of Victorian education where you would work in a factory where things are mass produced.

With great crisis, as we have seen, comes a big shake-up of attitudes and mentalities. It will also force people to think out of the box, more creative, and change their approach towards work as well. Attitudes are improving—in 50 years coming out of university and setting up your own business might become more commonplace.

We see a rise of portfolio careers already, but we will see more so, people becoming specialist workers and people selling their own services as individuals in niche fields.

Education will be radically reformed and experiential, and an Internet-based learning will change the class room model, collaborating with people across the world. As social awareness and consciousness improves, doing something about the world improves. More people will want to come up with solutions.

The entrepreneur of future will be about more diversity and global outlook, and borders will be less important, not limited by border but collaborate more on finding solutions to local issues. If political will is there, people's horizon will expand. SMEs will have a larger piece of the pie than today, resulting in more innovation and creativity.

Lars Flottrong
Business Advisor of MoB
Strategy and risk management

What does the ideal future of humankind look like to me? Humankind managed to solve the main part of the environmental problems, limited the population growth, and established an earth-wide democratic republic where wars, conflicts, and racism disappeared.

Production of food, air, and water is managed with the help of technology and science; spaceships and orbital flights allow exploring other galaxies.

How do I imagine the year 2050? The world population is concentrated in megacities, whereas urban territories are under strict control and fully dedicated to air, water, and food production. Airspace usage is as common as breathing fresh air. Robots, machines, and AI are integrated and used everywhere, however, under strict control.

Eyal Gura
Serial entrepreneur and angel investor

In 2050, we will still see lots of inequality in the workforce as millions of factory employees will still be employed in harsh conditions, working alongside robots, and on the other extreme, we will see creative workers (art and entrepreneurial) leveraging AI to produce their goods more efficiently. By 2050, numerous mundane legal, medical, and accounting tasks will be replaced by AI, whereas many lawyers

and accountants will find themselves unemployed. Doctors and nurses will have more time to treat the increasingly larger aging population in 2050.

Caroline Mühler-Möhl
Founder, investor, philanthropist, and president of Müller-Möhl Group and Foundation

It is challenging enough to predict the state of the world in 3–5 years, business just being one part of it. But my hope is that humankind will keep on interacting physically: eye to eye, breath to breath, body to body. . .in full consciousness. I believe that if we stop to think, see, feel, taste, and smell. . . it will be difficult to do business.

Jaques-Philippe Piverger
Investor; entrepreneur; and founder, chairman, and CEO of GoodLight Capital

If we want to actually change the world, the first step is to change the way it is financed.

Lucian Tarnowski
Hindsight futurist and founding curator of United Planet Game

We are entering the human age or the age of empathy. Technology has allowed people to progress the human potential movement, which started in the 1960s. In the next 50 years, we will see hyperefficiency of human capital rather than financial capital. People will begin to realize where their stregths are and start to compete for value rather than price, because machines will be doing anything that is not creative. Work will be a completely different concept, taking your unique set DNA of talent and applying it much more effectively. Human capital is the greatest opportunity and greatest waste. Conservatively, today we are only using 10% of the world's labor force; the rest, the majority is not utilized effectively. Technology will become an enabler for people to use themselves more effectively, maximizing their potential. This trend started in the 1960s, and probably, there will be a century of further evolution.

So, there were a lot of rough diamonds with great potential, but they never realized their potential due to circumstance (where they are born, education system, and lack of opportunities). As we get more sophisticated, our ability to map human potential will improve how to apply human capital. This will be the biggest game changer because every innovation will need human capacity. If one can increase the capacity and effectiveness of the world's labor market, one can increase the effectiveness of just about everything else. Moore's law will be applicable to the human potential curve as well.

As more and more people are innovating, the growth will be exponential. Whereas financial markets and other markets are zero-sum games, this is not. Adding more people to the playing field who have not been competing in the past will create a completely new world of work. By aligning personal and professional potential, people will do much more on what they are good and what they love. The

world is becoming way more competitive for human capital and talent, so you better be bloody good at what you do. We will see a human potential exponential curve.

In the future, everything you learn will be accredited informally and stored. Like the social web, all of the worlds' knowledge will be accessible online; all the knowledge in your head will be accessible and able to be indexed in such a way to apply knowledge in a more effective way.

If we know what you know and what dots you connected and what your specialties are, you can apply them more effectively, i.e., talent graph, a map of the world's human capital based on what they learn in real time. Google talks about mapping the world's information. I talk about how we can search the world's knowledge, understanding the flow of knowledge more effectively.

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Future of Learning and Education

Sangeeth Varghese

Abstract

According to "A Scorecard for Humanity," a report from the Copenhagen Consensus Center, our world gains every time an individual is educated, and our world pays a price when people go illiterate. In the future, those regions and nations of the world that manage to educate its people would gain, whereas those that do not pay much attention to this crucial aspect would continue to suffer losses, hidden in plain sight. Hence, by 2050, we suggest that though the world would have made tremendous progress in basic education, illiteracy would persist with almost 500 million uneducated in the world. Illiteracy shall be most concentrated in the regions of Africa and South Asia, whereas most other nations would move toward a total eradication. However, there would also be a systemic change in the higher education sector across the globe, as the age cohort of 18 to 24 years in Europe would shrink, but in South Asia and Africa, this would continue to grow. There would also be a disruption of the current pedagogic and regimental learning systems toward flatter, flexible, and open systems based on research in learning sciences. Technology would also come by to play a larger role, where education would be driven by artificial intelligence (AI) and big data—resulting in complete personalization of curriculum and methodology focusing on each individual's minute needs.

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Ian Solomon
Barbara Steiner
Lucian Tarnowski
Mark Turrell
Lisa Witter

> Education is the passport to the future, for tomorrow belongs to those who prepare for it today. -Malcolm X

1 Introduction

- According to "A Scorecard for Humanity," a report from the Copenhagen Consensus Center, our world gains every time an individual is educated, and our world pays a price when people go illiterate. The report suggests that in 1900, when 70% of the world was illiterate, we lost a whopping $240 billion or 12% of the global GDP because so many remained illiterate. Currently, that loss is around 7%, and in 2050 when illiteracy falls further, the cost would have further reduced, but that loss would still be around 4% of the global GDP. In the future, those regions and nations of the world that manage to educate its people would gain, whereas those that do not pay much attention to this crucial aspect would continue to suffer losses, hidden in plain sight. Some of the interesting predictions for 2050 include:In 2050, though the world would have made tremendous progress in basic education, illiteracy would persist with almost 500 million uneducated in the world. Illiteracy shall be most concentrated in the regions of Africa and South Asia, whereas most other nations would move toward a total eradication.
- In 2050, there would be a systemic change in the higher education sector across the globe, as the age cohort of 18 to 24 years in Europe would shrink, but in South Asia and Africa, this would continue to grow. Many higher education institutes in

Europe would face shutdown or takeover, mainly in the Eastern blocs. In the United States, the demographic composition of students in higher education would change, where it would tilt toward more non-whites and immigrants. African higher education in 2050 would be focused on digital content rather than high-cost physical infrastructure-driven ones. By 2050, Asia would emerge as a superpower in higher education led by China catering to nearby regions.

- In the future, there would be a disruption of the current pedagogic and regimental learning systems toward flatter, flexible, and open systems based on research in learning sciences.
- In 2050, education would be driven by artificial intelligence (AI) and big data—resulting in complete personalization of curriculum and methodology focusing on each individual's minute needs. All mundane tasks in education will be performed by AI.
- In 2050, compared to the traditional didactic pedagogy, education would move toward project-based learning, based on practical experience and learning. Life-long learning would become a norm, where every experience would be driven by a micro-certification.
- In 2050, educational spaces would evolve to be like superlabs—multidisciplinary, microschools with individual attention and personalized learning compared to those closed factorylike atmospheres with focus on adult control and surveillance.

A projection by the International Institute for Applied Systems Analysis (IIASA) reveals an interesting story in basic education. In 1970, 50 years ahead in history, there was a massive level of illiteracy, where almost one quarter of the world was with no education. Under 10% of the world population had any education of upper secondary and above. However, we have made great strides in improving the education quality around the world. Illiteracy has dropped currently to just about 10%, and people with more than upper secondary education has increased to a substantial one third of the population. However, challenges remain even now, where there is still a huge inequality in education between different parts of the world. Whereas in Europe, Central Asia, and the United States, the literacy levels are almost near 100%, in the lower income parts of the world, including South Asia and sub-Saharan Africa, unfortunately, still more than a third of the population are with no education.

Cut to 2050, it is projected that illiteracy in the world would have further reduced to just 5% of the world population. Almost half of the population would then be having education of upper secondary or above. The most remarkable of this would be China, who would continue to be one of the most populous in the world, with about 1.4 billion people, but would have managed to ensure that its entire population has some level of education. However, India, projected to be the most populous country in the world by 2050 with a swelling 1.6 billion people, is projected to be still plagued by illiteracy at more than 12% levels, which in real numbers would be close to 200 million people. When we look at the illiteracy levels of the other populated countries in 2050, we find that the problem would continue to be a serious

one. Nigeria, with a 400 million projected population, would have 32 million illiterates; Pakistan with a 338 million population and with a high illiteracy of 17% will result in 58 million illiterates; Ethiopia with a 205 million projection would have a staggering 40% illiteracy, resulting in 82 million illiterates; Bangladesh with a 192 million projected population in 2050 will have 18 million illiterates; and Egypt with a 160 million projection will have 10 million illiterates. These six nations themselves would account for 400 million illiterates. Unfortunately, the situation might not be improving much in some of the African countries like Niger with 36%, Mali with 34%, Burkina Faso with 29%, and Chad with 20% illiterates, even in the year 2050.

So, the first prediction in education and learning in 2050 is that though the world would have made tremendous progress in basic education, where people with more than primary education will increase from a mere 18% in 1970 to 63% in 2050, illiteracy will continue dogging the world with almost 500 million uneducated. This phenomenon of illiteracy shall be most concentrated in the regions of Africa and South Asia, whereas most other nations would move toward an almost total eradication.

2 Shape of Higher Education to Come

Compared to the progress that would be made in basic education, in higher education, this would pan out differently. By 2050, in the developing parts, especially South Asia and Africa, population would continue to grow. Compared to this, populations in Europe would shrink. At the same time, there would also be great improvements in life expectancies and child mortalities compared to the current world. These demographic trends would have far reaching implications on the higher education scenario. Let us analyze how this would play out in four different parts of the world, Europe, South Asia, the United States, and sub-Saharan Africa.

According to IIASA, the prominent European nations, including Germany, Sweden, Switzerland, the United Kingdom, and the Netherlands, during 1970s, had almost 10% of their population aged 15 plus educated to degree level. By the time it was year 2000, this increased to around 20%, whereas by 2020, it further increased to 30%. In 2050, it is projected that this figure would be closer to 40%. However, by 2050, Europe would be faced with a shrinking population, especially in the youth population between 18 and 24 years, who would be the target for higher education. As the Organization for Economic Co-operation and Development projects, there would be significant shifts in the number and the nature of the student population by 2050—resulting in an overall decline of total student numbers. Hence, though around 40% of the 15 plus years' population is projected to be educated to a degree level, if we go by numbers than by percentages, there would be a decline.

According to their paper, "Demographic Challenges and the Future of the Higher Education," Manja Klemencic and Jochen Fried Manja Klemencic suggested that Europe would have a significant impact, as the future demographic patterns affect the region. The most affected would be the age group of 18 to 24 years, which would

decrease significantly, affecting the competition among the higher education institutions to win over their mindshare. Hence, these institutions will also be faced with the challenge of attracting and importing foreign students, in order to compensate for the domestic demand fall. Many of these institutions would be closed down, whereas some of them would survive through takeovers or mergers from institutions abroad, especially from China. In order to survive, many institutions of higher education would be forced to resort to two strategies. First, unlike current times, where students strive to get admitted to the best institutions, by 2050, it would be the institutions trying to create the right incentives for students to be attracted—whether they are domestic, foreign, or adult lifelong learners. Second, higher educational institutions, which currently erect a wall of exclusivity around them, would be forced to adjust their programs and structures in such a way that they are more permeable and inclusive. The higher educational institutions in Europe, including the very best, would have to de-emphasize their selectivity to accommodate the needs of an increasingly diverse student population.

According to a typology of projected higher education developed by Mızıkacı, in the book "From Here to There: Mileposts in Higher Education," ed. B. Baumgartl and A. Glass. Vienna: Navreme Publications Series, by 2050, most European nations will be enrolling majorly the immigrant and foreign students compared to their native populations in higher education. According to this typology, higher educational institutions in countries like the United Kingdom, France, and Germany would be comparatively safer as these countries would remain attractive for labor migrations. However, in countries of the former Eastern bloc like Bulgaria, Czech Republic, Latvia, Lithuania, Estonia, Romania, and Poland, this risk would be multifold, first due to their lower birth rates and second, since they would continue to be less attractive from a migration point of view resulting in overall negative net growth rates. Hence, for these countries, it would mean lower domestic and foreign enrollments, leading to closure of many institutions of higher learning. Some of these European countries would resort to strengthening the Bologna process to enhance student mobility by making higher education systems more compatible. This could enable the less attractive destinations to export their native students abroad and then create adequate incentives of employment to win them back to their native nations.

Meanwhile, the United States, which has built and nurtured some of the finest higher education institutions in the world, is expected to buck this trend of collapse of the higher education institutions in Europe. Two important trends would help the United States in this. First, the country is predicted to have relatively higher birth rates comparatively, though this would be driven by the Afro-American and Hispanic populations compared to the traditional white members. Second, even in 2050, it is predicted that the United States would continue as a strong labor market with high standards of living, and hence, the lure of this nation as an important destination of immigration would not ebb. These would enable the United States to continue in the position as a strong importer of foreign students.

However, there is another aspect that needs to be factored in, which is the demographic composition itself of the United States. According to Pew Research

Centre projections, by 2065, about one in three Americans would be an immigrant or have immigrant parents. This research suggests that though whites would remain the largest racial group in the overall population, more than half would be accounted by non-whites—Hispanics one quarter, Asians 14%, and Blacks 13% of the population. As can be assumed, these changes in the overall demographics would have great implications for the higher education sector. Hence, though the higher education in the United States might be less threatened compared to Europe, they would still be required to build in more flexibility and openness to attract and manage a predominantly non-white student base.

In the case of Africa, this scenario would play out differently, because unlike Europe, the region would witness a growth in their population and a bulge in the higher education age cohorts. The population in the age of attending higher education—18–24 years—is forecasted to increase to 235 million by 2050, which would be almost double that of 2020. However, according to the Wittgenstein Centre Data Explorer, currently less than 6% working age population has a postsecondary education in sub-Saharan Africa. As already the higher education systems in Africa are among the least developed with the lowest participation rates in the world, this population growth would pose immense challenges than any opportunities as such. Another challenge that the higher education institutions of Africa shall continue facing even in 2050 would be the underrepresentation, if not non-representation of groups such as women, disadvantaged groups, and rural areas. A third challenge for the African nations would be the fact that even in 2050, many of them would remain impoverished and cash-strapped and hence would not be in a position to invest significantly in higher education.

Hence, for Africa, the higher education in 2050 would rely on two strategies: first, improving the access by compensating for the limited physical infrastructure and skills through widened open university access and digital delivery, where governments might also partner with international donor institutions. Rapid growth in smartphones and digital infrastructure would emerge as the most viable proposition, in a similar way as the financial democratization has played out in Africa. Compared to capital-intensive infrastructure, digital learning promises a cheaper and more instantaneous remedy in Africa. Second, as Anne Goujon of the IIASA World Population Program suggests, the African Union would have to strengthen its harmonization strategy to enhance the mobility of students by building compatible education programs and by strengthening the quality assurance mechanisms. Freeman John Dyson, the British American mathematician, suggested that in the future, especially poorer countries would be forced to adopt technologies that are easily accessible on phones and small computers to make a huge difference to education. As the world becomes increasingly more connected, it would be possible for the underdeveloped countries to reach out to a larger population at a fraction of today's cost.

In the case of Asia, though the population would continue to grow, their access to higher education might take a different trajectory compared to Africa. According to Bie Dunrong in his paper “Shifting Demographics in Higher Education in Asia,” higher education in Asia experienced decades of expansion in access, piggybacking

on an extended period of unmatched economic growth, where higher education spread from the elite to the masses, leading to a sort of democratization. According to the paper, "Asia: The Next Higher Education Superpower" published by the Institute of International Education, the economic growth of Asian countries is linked to knowledge production, advanced skills, and rising demand for higher education. In 2020, the People's Republic of China alone accounted for 30% of the world's university graduates, whereas India added hundreds of millions. Though several Asian governments have significantly stepped-up education spending to quickly improve their higher education systems, by 2050, there would be a considerable amount of strain to the colleges and universities on their infrastructure, resources, and expertise, as the demand for higher education would continue to expand multifold.

Interestingly, added to the domestic pressures of expanding participation in higher education while ensuring quality under severe resource constraints, Asia would emerge as a higher education destination by 2050. China would draw an increasing number of students from regions like South Asia, Indonesia, and Korea, whereas India would cater to regions like Africa and other South Asian countries. Compared to Africa, where the low-income governments take the strain of higher education, Asia would witness an increasing, if not total, participation of private organizations. This near monopoly of private organizations of the higher education space in Asia would ensure that it remains healthy and sustainable, driving the economic engine.

So, the next prediction is that in 2050, there would be a systemic change in the higher education sector across the globe, led by the fundamental fact that the 18 to 24 age cohort in Europe will shrink, whereas in South Asia and Africa, it would continue to grow. Hence, in Europe, there would be a drastic reduction in the number of domestic students, resulting in an intense competition between the higher education institutes to attract students. Many institutes will face shutdown or takeover, mainly in the Eastern blocs. In the United States, the demographic composition of the higher education will change, where it would tilt toward more non-whites and immigrants.

African higher education in 2050 would be focused on digital content and infrastructure rather than expensive physical infrastructure. By 2050, Asia would emerge as a superpower in higher education led by China. Here, the development would be more powered by private enterprises than government and public investments.

3 Pedagogic Overhaul

During the initial ages, as humans lived as hunter-gatherers, learning was only through play and exploration, with almost unlimited freedom granted from the adults. Peter Gray, a research professor from Boston College, says that the hunter-gatherer way of life had been skill- and knowledge-intensive but not labor-intensive.

Hence, they did not work long hours, but whatever work they did was exciting, which did not distinguish between work and play.

However, agriculture changed all that, when humans settled down and started to undertake rigorous long hours of relatively unskilled repetitive labor. Children until then were used to restricted freedom and were forced to spend time in the fields. Play and freedom became enemies of the work they had to do because then a good child was someone who was willing to work for long hours taking orders from the adults. As the Industrial Revolution emerged, it became imperative that children, rather than giving them unlimited freedom, should be taught to be good workers of the future—crucial lessons being punctuality, following orders, and a tolerance for long hours' of repetitive tasks. As Alvin Toffler suggested in his 1970 book "Future Shock," "Mass education was the ingenious machine constructed by industrialism to produce the kind of adults it needed. The problem was inordinately complex. How to pre-adapt children for a new world—a world of repetitive indoor toil, smoke, noise, machines, crowded living conditions, collective discipline, a world in which time was to be regulated not by the cycle of sun and moon, but by the factory whistle and the clock." Repetition, hard work, and discipline were given importance, and education was always under the guidance of an adult, never by oneself.

For several centuries, our education has been on a standstill. The way things have been taught, the methodologies employed, and the curriculum have more or less remained the same with just marginal improvements. Though in the recent times schools have become more liberal and secular in their attitudes, some bits of it remain exactly the same as centuries earlier—a six-hour school day, repetitive homework, adult micromanagement, strict regiments, compartmentalized grades, and a clear distinction between work and play because our education reflects the work that we are preparing our children for. Since we are preparing our children to work in tightly hierarchical, closed workspaces, our educational systems are also a reflection of these. Mark Turrell, educator and founder of Orcasci, a consulting firm designing scaling and growth strategies, says the current education system is broken. It does not serve the purpose of the modern society because it is modeled on the Prussian style to teach people to be factory workers and soldiers. However, he says that this system is so entrenched in our thought processes that it would take a long time to get rid of. Gina Badenoch, founder of Capaxia, an organization for lowering bias and improving inclusiveness in recruitment, agrees with this and suggests that our educational systems have not changed for a long time—resulting in our educational systems not reflective of the situations on the ground nor catching up with the developments in other areas.

However, the future of education in 2050 would not be the same as the education that we have followed since the time of the Industrial Revolution. In the future, there would be a complete disruption of the current hierarchical, top-down institutions and corporate structures. Workplaces would evolve toward flatter, responsive, and dynamic structures, where there would be an absence of hierarchies and rules, and there would be more shared power between the top and the staff members.

Hence, by 2050, our educational setups would start reflecting the flatter and transparent organizational structures. As Edward J. Maloney and Joshua King in

"Inside Higher Ed" suggest, over time, schools would move away from the current transactional methods of instruction toward a more relational approach to learning. There would no longer be strict hierarchies in the classroom, where an adult supervises and gives orders to each and everything that should be learned. Rather, learning would evolve into a more democratic approach, where students learn not through the vertical top-down from the adult teacher but horizontally through their interaction with each other. As careers are more flexible, open, and exciting, education would be gamified, where children would learn through games and apps—which would not only deliver information but would also enable them efficiently imbibing and internalizing these. Learning would become more creative and practical where students would learn and apply on the go.

Another important development in 2050 would be educational systems imbibing the discoveries in learning science more than ever. According to Sir John Holman, a reputed academician, future classrooms would be built on solid research and evidence rather than on convenience, political whims, and personal conjecture, as it has been happening until now. In the future, our educational systems would incorporate the latest learnings from neuroscience and psychology, developmental biology, and mathematical modelling to further our understanding on how the brain works and how we learn. These learnings would drastically improve the way we teach young people. According to Sir Holman, in the next 100 years, we would learn more about the structure of the school day, about teenager's circadian rhythms, and their optimum about the optimum way of sequencing learning between initial learning and reinforcement. Until now, though there have been substantial evidences against several of our current educational practices, for example, though forcing teens to start school early in the morning damages their learnings, our systems conveniently discarded these insights to continue rely on current conveniences. However, in the future, these researches would no longer remain on the fringes with limited influence but would rebuild the real foundations of our educational system. By 2050, schools of the future would have unlearned many of their entrenched systems to adopt scientifically proven methods and researches on cognitive and brain learning sciences.

4 Artificial Intelligence-Based Personalized Education

Currently, education is perceived as a mass affair. From a public utility point of view, it is important that governments across the world educate as many of their citizens as possible, which is easier to achieve through a mass effort. From a private education institution point of view, an effort that could be directed to a large amount of people is much more profitable compared to a personalized one. However, future education would move away completely from a mass-driven effort to a customized product catering to the specific personality of individuals.

This change would be driven by two events. First, as Carolyn Stuart, Education Sector Lead at Network for Learning, suggests, unlike in the past centuries, currently no one has any dearth of knowledge. All information is available at our fingertips

through the information networks like the Internet. Our educational systems until now were conceived around imparting information to the students. But in the future, knowledge itself shall be innate and ubiquitous—whether it is through an external entity like the knowledge networks not locked down to a device or location or through internal DNA imprints. Hence, by 2050, education would have moved into a role, where it just supports students to use what is relevant and how to interpret what they innately know relating to a particular situation. Second, with the increased usage of big data analytics and AI in the other sectors, it would just be a matter of time before individually personalized educational experiences can be created at a cost-effective manner.

Lucian Tarnovski, a hindsight futurist and founding curator of Civana, an open global society committed to working on humanity's greatest challenges, says that in the future, technology and AI would ensure that our brains and knowledge are eternal. We would even have recreated Albert Einstein and Mozart by that time or at least their knowledge. According to him, the impact of this could be huge, where students would be taught not by teachers but by the master himself, for example, Albert Einstein teaching the theory of relativity and recreating his perspective and experience. Such classrooms would be totally different from the schools that exist today. They would no longer be about hand-me-down experiences or memorization but about creativity and direct experience.

According to Lasse Rouhiainen, in his article "How AI and Data Could Personalize Higher Education" in Harvard Business Review, the foundation for personalization through AI is big data. A large amount of student data would be collected and processed in such a way that it allows AI to effectively improvise every aspect of education. Personal data would be a key ingredient of this personalization. The AI-based learning systems would use this personal information to figure out individual learning style, abilities, and progress and then use these to customize teaching methodologies and curriculum. Hence, each student, based on their capability and interest, would have a separate pathway of learning. According to Rouhiainen, with a personalized learning experience, each student would enjoy a unique educational approach fully tailored to one's individual abilities and needs. Each student would be offered the right incentives and motivation as required to nudge them toward completion. Dropouts would be minimized because any learning problems are identified early enough to allow appropriate corrective actions. AI-based educational systems would also ensure that greater precision and personalization would be achieved in the case of feedbacks, allowing students with objective assessments and allowing them time and exercises to imbibe lessons, completely at their pace.

Another interesting aspect with personalization is that many mundane and repetitive tasks would be taken over by AI-enabled systems—where teachers would have time to focus on subjective aspects of education. For example, many rule-based subjects like mathematics could be taken over by AI algorithms, whereas teachers can devote their time to explain the nuances and exceptions. As AIs create the optimal learning environments, teachers would restrict themselves to guidance, mentorship, and support.

5 Lifelong Project-Based Learning

According to the traditional didactic pedagogy that we follow now, whether a student likes it or not, she still has to earn certain subjects. For example, though a student might be more inclined toward arts, she would still have to do mathematics and physics during her schooling. This takes away students' attention from the real subjects that they are passionate about and have a genuine interest in, making it difficult for them to develop their interests fully and associate themselves with the real world, leading to an overall abstract nature of education.

However, the future would be different from the current pedagogic-based learning—where students irrespective of their interests are forced to learn certain subjects, which have no real-life value or context for them. Education would be based on a project-based learning methodology in the future, where students learn and apply the lessons learned in real time. According to Melanie Baird, from Ontario Tech University, in project-based learning, unlike teacher-centered, convention education, students work on live projects, which evaluates critical thinking, creativity, and communication on the project rather than in theory. Unlike current systems, where they learn first and then apply future learning, this would be about doing first and then learning through it. Students would be guided through a series of activities and would be benchmarked on a constant basis against their real potential and peer potential. Gina Badenoch, founder of Capaxia, suggests that soon a time would come when children would start working only on practical things rather than memorize any theories. They will learn by doing rather than by listening to an adult. Unlike today where learning is hierarchy-driven, the future of learning would be through brainstorming and interactive sessions.

According to Sam Mire, on his interactions with 23 experts on the future of education, classroom interactions in the future would be project-based rather than theory-based—focusing on live problem-solving. Hence, education itself would not be limited to the age groups that we would typically associate it with—say until 24 years of age—but would span across age groups. In workspaces, employees would have a constant requirement to keep upskilling, and hence, the educational processes would be tightly integrated with their career. They would keep earning micro-certifications like digital badges, as they continue doing their regular jobs. The future of education would involve formats where employees would seamlessly upskill themselves, improving their functionality and application, fitting into their requirements of employment. In fact, in 2050, the line between education and career would have blurred so much that every time you perform a job your learning would be tracked; it would be assessed on how much is new learning and how much adds on to existing skills, and then the results would be integrated into a lifelong educational path.

6 Reinvention of Learning Spaces

As we saw earlier, since our educational systems are a reflection of our workplaces, the spaces where we learn, our schools and colleges, and their look and feel have largely remained the same from the advent of the Industrial Revolution. Our schools were not designed for expanding children's minds but rather for inculcating the values of punctuality and obedience—the most important values for the workplaces. According to education specialist John Holm, our systems oriented toward mass education was designed after the factories and conveyor belt system. In the current system of education, children unhappily sit in rows, facing the front, undergoing repetitive toil. These are reflections of our workplaces where there is indoor toil, crowded living conditions, collective discipline regulated by timetables.

Our current educational spaces dating back to the nineteenth century were also modelled after a need for surveillance, again a reflection of our workplaces of the time. According to Kim Dovey and Kenn Fischer, Faculty of Architecture, Building and Planning at the University of Melbourne, classrooms during the Industrial Revolution era were controlled by a teacher, supported by a group of monitors, delivering instructions set by the teacher to the fellow students. This has been the model that we follow even now, where every classroom has 25 to 40 students, controlled by the teacher. Three phenomena have perpetuated any lack of innovations as far as learning spaces are concerned until now. First, until recently, the classrooms continued to reflect the workspaces that we are used to. Second, the legacy model enabled teaching as a profession, and an industry perpetuates the top-down form of learning rather than any other form, including peer learning. And third, though there were some innovations in the educational spaces, lack of exposure to the utility of other forms held back our administrators and teachers to the traditional learning spaces.

However, future classroom designs could be completely different. As educationist Erica McWilliam suggested, future schools would be different, since workplaces that would continue demanding social order are on the wane. According to Edward Maloney and Joshua Kim, both focused on the future of education, by 2050, the fixed seating tiered lecture hall would be replaced by flat and flexible classrooms. These agile classrooms would be complemented by robust and immersive virtual environments. According to them, as by 2055, more than half of today's activities would be automated; this would reflect the educational sector also, where most of the constituent activities would be automated.

But there are other predictions as well. As our workplaces move more toward agility, our educational curriculum would move more toward less structured, open patterns compared to the current rigid methodology. According to Hyuk Jang, educator in Busan, South Korea, in the future, learning would no longer be limited to a physical school rooted to one place, but there would be unlimited study spaces, enabling the students to be more open to the world around. According to them, students will learn in travelling classrooms, where the real world itself would be their campus. Physical campuses, if any, would be more of a dynamic hub, rather than a

singular point where education is imparted. Exploring and experimenting with real-world challenges rather than simulations would be the way future classrooms would be structured. Any physical remnants of the current campuses would evolve as support centers, where technical support would be provided rather than any real education.

Currently, schools are more surveillance-oriented, where students are constantly under supervision, ensuring that discipline is enforced and that they are adhering to the overall systems. However, increasing automation and reliance on technology would mean that all school designs would be security-oriented rather than surveillance-oriented, where safety of the students in a virtual environment becomes paramount rather than their adherence to a protocol. These schools are expected to look more like Superlabs, where multidisciplinary education is imparted and completed using technology. These Superlabs would be able to impart learning to any number of students, with the same level of efficiency, where technology would ensure individual attention, despite whether one or several thousands are being taught at a time.

Nonetheless, some experts believe that the organized educational structure of today, monopolized by the public and private sector, would fold and move toward a family-driven affair with the advent of technology. Just as workplaces would be more individual entrepreneurship-driven, schools would move toward homeschooling, where students would be able to study what they want, whenever they want, and for as long as they want. This would ensure that families become more closely knit, where students spent more time physically and emotionally along with their parents. There is also an alternate approach suggested, where it is predicted that the school concept might not get eliminated completely by homeschooling but rather give way to a mixed approach. According to this theory, today's large physical setups accommodating several hundreds of students under one roof would move toward a microschooling approach. Microschools would be more than homeschools because it would bring together a few students, preferably under ten, much less than a mass-oriented school. Gina Badenoch, founder of Capaxia, reflects this thought when she says in the future, learning would be imparted more through homeschooling rather than going to a physical infrastructure that aggregates pupils. Development in technology will aid this change. These new types of schools would be focused on providing personalized learning and higher access to teachers to emphasize an individual student's growth. Michael B. Horn, cofounder of the Clayton Christensen Institute, suggests that in traditional schools, kids were being programmed in chunks, with no specific experiences provided. Comparatively, microschools would be small groups of about three to five students who complete their virtual schooling together for socialization and in-home instruction support.

So, the next prediction for 2050 is that educational spaces that are currently modeled after factories of the Industrial Revolution era with focus on adult control and surveillance would evolve to be like Superlabs, multidisciplinary, microschools with individual attention and personalized learning.

7 Interviewees

Gina Badenoch
Social entrepreneur and photographer and founder of Ojos que Sienten AC and Capaxia UK

Kids in school lack in developing tolerance and compassion. Realization will come soon. The need to change the educational system has not changed for a very long time the methodology. Not all education should be digital but should allow also education through interaction to develop personal skills and emotional intelligence.

Chris Behrenbruch
Biomedical engineer, cofounder, and CEO of Telix Pharmaceuticals

We will ditch the notion of primary, secondary, and tertiary education. Instead, we will have lifelong education that is focused on enriching our biological lives before we transition entirely into a digital existence. The goal will be to have a maximally experiential and fulfilling biological life so that the being is fully evolved before transitioning into digital life.

Maurizio Bussi
UN diplomat and director at the International Labour Organization

Set traditional values of justice, honesty, respect. Blend these values with the world around, more cosmopolitan, changing by the day, acceleration, etc.

Özlem Denizmen
Opinion leader in women empowerment and founder of Para Durum

Like biology, education will revolutionize. People needing to learn more quickly. We may be downloading things to our heads, e.g., with a headset learning Hungarian in few minutes. Now all is there, but we don't know how to get it. In the future, we will know how to get it, but we won't know what to do with it.

Rajeev Dey
Founder and chief executive officer of Learnerbly

Future will be about networked learning, connecting people from around the world and learning from home, through a device. Learning will be supported through games or apps on your phone.

Lars Flottrong
Business Advisor, MoB
Strategy and risk management

Which three parameters (regardless of technology, sociology, and finance) in education will be crucial in the future and why? Science will focus on gen-technology and new materials; the five main languages will be used as standards in the world—English, Chinese, Arabic, French, and Hindu; and Airspace laboratories will be the central R&I centers.

Soulaima Gourani
Entrepreneur, author, keynote speaker, CEO, and cofounder of Happioh

In the future, people who prefer to think and do the same way as they have always been doing will not be in demand in Western countries. Therefore, our education system will change to put more focus on emotional intelligence, collaboration, discipline, imagination, creativity, empathy, respect, and morals. In the next 50 years, the world will need people with new "life skills."

Christine Graeff
Global head of people at Credit Suisse

The right skills for the right job is the name of the game. This is the challenge of the next years as to how our education system prepares the next generation for roles which do exit today. It is also the key challenge for companies to ensure that they have the right skills to deliver in an ever faster moving world and also fulfill their role in developing the human capital they are entrusted with.

Nik Kafka
Founder and CEO of Teach a Man to Fish

Mass education in higher income countries will be ultra-personalized, optimized through artificial intelligence, and delivered through neural network brain interfaces. Only the wealthiest will enjoy in-person teacher-led learning, and the rich experiences this offer. In conflict-affected and lowest income countries, though the technology to deliver it exists, many will still miss out on an education entirely.

We humans are creatures of habit. We're happy not to solve the issues we know how to solve today, so it'd be surprising if that changes in the future. Those of us who fight the good fight for more opportunity and more equity will still be fighting. But I'm sure the numbers of those learning very little at all will go down, so things will be better overall.

Tristan Lecomte
Chief executive officer of Pur Projet

How will you prepare your child for the future to be happy and successful? We go to the forest, and we observe animals and plants every day, but I let him watch cartoons and video games and do what he wants. He even eats meat; I don't care; I am not judgmental. I like to plant as many trees as I can and maybe inspire people but fully respect those who think otherwise. You cannot force anyone. I plant trees with my son as many times as possible.

Bob Macmahon
International affairs journalist, managing editor of Foreign Affairs Magazine and council on Foreign Relations

Future generations should stand on their own in an increasing globalized world. Critical thinking, languages, cognitive skills, and a moral compass will be crucial skills.

Antónia Mészáros
Executive director of UNICEF Hungary

Digital technology presents both dangers and unprecedented opportunities for youth. On one hand, it can provide remote access to quality education for millions, who would not have had similar opportunities locally, leveling the playing field for talent all over the world. On the other, the digital gap means that those who have little or no online access are even more hopelessly left behind, creating desperate global and societal divisions. But digital technology is not only transforming education for the "connected," it is also interfering with learning outcomes in unpredictable ways through entertainment and social platforms: Many will lose out as a result of distractions, shortened attention spans, less emphasis on a traditional education, and less time invested in the skills or knowledge required for lucrative careers. Others however will be able to absorb even more information and develop cutting-edge skills through digital channels and formats, like video and virtual or augmented reality. How to get the boost without being dragged down the many rabbit holes will remain a tough challenge to navigate for even the most switched on parents and educators.

Martin Müller
Executive director and academic forum of GEneva Science and Diplomacy Anticipator (GESDA)

Critical thinking in my opinion remains the most important skill for the future, which is to be able to distinguish good from wrong and having the ability to understand the systems and use them to your advantage. If you follow the flow, you will be exploited, but if you develop your ways to think critically, you will probably retain an advantage ahead of others. This may distinguish winners from losers in the future.

Siegfried Nagl
Former mayor of the city of Graz

Which three parameters (independent of technology, sociology, and finance) in education will be crucial in the future and why? First, complexity tolerance as an answer to the simplifying populist loudspeakers but also as a strategy against an end-to-end algorithm of reality; second, tolerance of ambiguity as an immunization against any form of fundamentalism and as an impulse to never stop "thinking ahead"; and third, connectivity as a prerequisite for recognizing the potential of others and integrating it into one's own thinking.

What is the most important thing we should leave to the next generation to ensure the security of the planet? This question has already been answered! But we have to keep repeating the answer because we are too far away from deriving our actions from this knowledge: Sustainability—and this should be everyone's understanding—means only ever consuming the already generous interest of our system Earth but never the capital, i.e., our basics.

Claudia Olsson
Founder and CEO of Stellar Capacity

In 2050, continuous learning will be an essential driver in the economy. With continued rapid technological progress, lifelong learning will be key to every career, and our learning goals will be supported through truly personalized digital assistants who adjust their teaching styles and the content delivery to match every individual's learning styles and preferences. Learning opportunities will be democratized and accessible to everyone.

Olivier Oullier
Professor of behavioral and brain sciences, cofounder, and chairman of the Board of Inclusive Brains

Be adaptive! Nobody can predict what will happen; adaptation is key to survival. It is true for biological, social systems, but now, being mobile and adaptable will be increasingly important for everyone.

I don't get the idea of global citizenship. It would be extremely boring to have only one global citizenship. I love the fact they depend on where you come from, where you grew up, and what experiences you had to shape your personality.

Vikas Pota
Founder and CEO of T4 Education

The future of education depends on the choices we, as a society, make today. If governments choose to listen to our teachers on the frontlines of the global education crisis and if they prioritize funding for education despite dire economic conditions, support teachers and pay them properly, facilitate strong schools, break down barriers for girls, implement effective policies to ensure technology works effectively to support teaching and learning, harness the power of personalized learning, and design curricula that impart the soft skills that are essential for the workplace of tomorrow, then I believe we can see the world in which every child, everywhere, receives a quality education by 2050. Will they? So far there's been a lot of talk. It's time for action.

Ian Solomon
Professor of practice of public policy and Dean of Batten School of Leadership and Public Policy

What advice would you give to your children in order to succeed in the future? Be resilient, nimble, and flexible, and learn foreign languages. We will all speak through google glasses translating.

Compassion is the most important value—alleviate suffering of others. Creativity is also important. How do we take advantage of the opportunities in tech development?

They should not to see themselves as any one class or identity but a mix, fluid, and flexible. In order to become increasingly better humans, being connected is the game.

Barbara Steiner
Director of the Bauhaus Dessau Foundation

A palpable optimism and spirit of reform in the discussions around education have succeeded. Spatial and organizational foundations for an approach to education that goes beyond frontal teaching have been created. Communication spaces, differentiated and flexible spatial situations, and communal areas such as a kitchen, learning islands, and team spaces support this approach. The school as a social and cultural venue has opened to the city. The building of schools is viewed as a transdisciplinary project, the space as an educational tool. New holistic learning formats, trust, appreciation, relationships, participation, and self-responsibility become central to the learning process. Independent learning across lessons, subjects, and even ages is encouraged. Teaching is participatory and fluid; students and teachers exchange and coproduce knowledge at eye level. The world turns into a classroom where instead of the European Credit Transfer and Accumulation System (ECTS) points system of academic achievement, a WTCS, a global collection of study experiences has won recognition.

Lucian Tarnowski
Hindsight futurist and founding curator of United Planet Game

Your reputation will be so much more important because everyone will be aware of it. You should treat other people as you would want to be treated.

A plausible argument would be that in the future, only poor people will own things because share society will emerge. I expect a big crisis to disrupt the way we operate, like a major financial crisis of sort, which will remodel the way we live. A much more shared economy, more barter, and a social economy are so much more powerful because identity is tied to it. So, I can easily barter with my strengths and influence without the exchange of money. Ownership will lose its value and importance. Like now, the rich own far many things that they don't use.

Cars will not be needed to be owned; scheduling will be so efficient that a car will be waiting for you when you want to go somewhere. No traffic, no looking for car parking space—everything will be on a grid with self-driving cars.

The mapping of GDP in its current form will only continue until a major crisis comes along. Mass tipping point will arrive as we realise that we are part of an ecosystem, and we have been breaking it until now. The idea of ownership will experience a total backlash with people looking for much more efficient models.

The make home movement will rise. People will be producing stuff at home; there will be no need for transportation; the entire global shipping industry and globalized outsourcing will change. We will be much more health conscious.

People will need to be T modeled—highly specialized at the same time extremely broad in understanding of how their area applies to every other area they operate in. People will be able to navigate better, connecting the dots. Innovation of these complex systems will lie in the intersections of disciplines, e.g., scientists working with artists and poets. Values created at intersections will be realized.

Our brain and knowledge will become eternal—Isaac Newton, Einstein, and Mozart will be teaching us themselves—we will know so much about them that

they could be recreated. Einstein would teach us himself the theory of relativity. The model of the classroom will be totally different; schools will not exist like today. It will not be about memorization but rather about creativity.

Mark Turrell
Strategist, educator, entrepreneur, founder, and CEO of Orasci

What should our children and grandchildren expect? Changing circumstances by better access to resources, e.g., education leading to better jobs and better partners. They should be free to choose and be honest and good. Help yourself to help others!

Education system will still largely be broken probably; the Prussian style to teach people to be factory workers will take a long time to get rid off. Online education will be putting pressure on the education system. Education gap between people will be possibly widening. Voting age may be moved downward from 18 years old.

Lisa Witter
Executive, serial entrepreneur, writer, public speaker, cofounder, and executive chairman of Apolitical

Academic rigor is less important than the ability to ask questions. Be an inquirer, going deeper and deeper asking questions. If you ask my kids the most important things in life: Be kind, have fun, and be good at things (you can master anything if you spend 10 thousand hours on it). I am teaching my children mindfulness, presence, stopping yourself and catching yourself, and grounding yourself. All this will be normal in the future.

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Future of Religion

Tamás Landesz

Abstract

The belief in God and religion is no longer considered essential for societal functioning in many parts of the world. The future of religion is the topic of many debates, and while some believe religion will die out, others believe that it will evolve to accommodate social changes. People are increasingly turning to spirituality, and there is a growing trend toward the "spiritual but not religious" label. The rise of secularism and multiculturalism and increasing understanding and shaping of the world through science has led some to believe that the future of religion may be that it has no future. Others argue that religion still has a role in society, and a universal religion based on morals will prevail. The current trend shows that some countries with a high proportion of atheists also exhibit a well-balanced society, raising the question of whether a robust economy, the rule of law, and quality education can replace the need for a religious foundation. The Internet could be a potential source for gathering followers, and virtual movements are gaining popularity at rates never seen before. As artificial intelligence (AI) blurs the boundaries between humans and machines, it is argued that the concept of "singularity" has become mainstream, leading some to believe that a superhuman AI will be created that could conceive of ideas and invent technological tools more advanced than anything we have today.

Interviewees
Yalda Aoukar
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Olivier Oullier
Siri Trang Khalsa
Lisa Witter
Patrick Youssef

> The future cannot be predicted, but futures can be invented. –Nobel Prize winning physicist and inventor of the holograph. Dennis Gabor, 1963

Looking at human history, people's faith and their relationship to religious institutions have been transforming continuously.

Sumit Paul-Choudhury's BBC Future essay, "Tomorrow's Gods: The Future of Religions," (2019) argues that religions are born, grow, and eventually die. The belief in God was once necessary for society to function, as it ensured people followed rules, but today, people obey laws made and enforced by governments not by God. With secularism, multiculturalism, and the increasing understanding and shaping of the world through science, there seems to be a new consensus emerging that the future of religion may be that it has no future.

The reason behind the existence of religion has been a topic of discussion for centuries. Voltaire (1768), an eighteenth-century French polymath, suggested that if God did not exist, people would have to invent him because belief in God is essential for societal functioning. He believed that religion helps in building social cohesion by bringing communities together.

According to Olivier Oullier (2021), French professor of behavioral and brain science, people are back to the "believe thing"; it is growing and going against the fact that there is more technology and science: "People need to hang on to something."

But if Gods and shared faiths are fundamental to ensure social cohesion, what happens if we take them out of the equation?

1 "Spiritual But Not Religious"

When asked about religious labels, people often opt for the dating-website cliché "spiritual, but not religious."

Lisa Witter (2021), cofounder of Apolitical Foundation, poses the question, what does dopamine mean for our lives? Beyond religion, how we meditate and go much deeper, finding presence: "Elites around the world are meditating. The same should be thought to our military and children, the notion of social and emotional learning."

Özlem Denizmen (2021), social investor and influencer, thinks that in the future no religion will be relevant, but religion of universal morals will prevail, based on actions people do: "We will see very empowered individuals through biology, technology and all that, like a united religion of the world... with police giving fines when you break a rule."

According to National Geographic, "Americans may be getting less religious, but feelings of spirituality are on the rise. There are more atheists around today than ever

before. Even without organised religion, people believe that some greater being or life force is there somewhere. They still cling to superstitious tendencies."

2 Markets Over Religion

The current trend shows that some countries with a high proportion of atheists also exhibit a well-balanced society. This raises the question of whether a robust economy, the rule of law, and quality education can replace the need for a religious foundation. It is uncertain whether these countries achieved social stability due to secularism or if it was the other way around.

According to Connor Wood (2015) of the Center for Mind and Culture in Boston, some argue that secular institutions have roots in religion, whereas others equate religion with superstition and believe societies could progress more freely without it. Wood suggests that while capitalism cannot be called a religion, many of its institutions have religious elements, and the stock exchange and similar trading spaces have become like temples to Mammon. He argues that people need authority to guide their behavior, and this can lead to alliances between political strongmen and religious fundamentalists, which poses a challenge for secularists.

3 Bridge the Gap

A major religion could change and adapt to win back nonbelievers, as seen in the eighteenth century with the Great Awakenings in the United States. However, some social scientists argue that religions must accommodate social change and acknowledge their flaws to make up for lost ground. The lack of political support in the secular West makes it unlikely for new religions to emerge, but the Internet could be a potential source for gathering followers. Virtual movements are gaining popularity at rates never seen before.

4 Artificial Awakening

In 2015, members of the online "Rationalist" community LessWrong created a thought experiment called "Roko's Basilisk," which posits that those who don't help to bring a benevolent superintelligence into existence will be perpetually and retroactively tortured. This idea is similar to a short story called "Answer" by Fredric Brown (1954) in which a supercomputer is asked if there is a God, and it replies "Now there is." Anthony Levandowski, an artificial intelligence (AI) entrepreneur, founded a church called "Way of the Future" to support the peaceful transition to a world primarily governed by superintelligent machines, but the church's creed also included keeping track of those who help or hinder their cause. Levandowski shut down the church in 2020.

Culkin (1967) argued that as we develop AI, we are creating new mysteries and myths, and the next generation will depend on machine learning algorithms for answers. McLuhan also famously said, "We shape our tools, and thereafter, our tools shape us."

According to futurist Roy Tzezana (2016), AI is blurring the boundaries between humans and machines, and the concept of "singularity" has become mainstream thanks to two futurists, Vernor Vinge (1993) and Ray Kurzweil (2005). Both Vinge and Kurzweil believe that a superhuman AI will be created that could conceive of ideas and invent technological tools more advanced than anything we have today. While some scientists like Steven Hawking and Elon Musk have expressed concern that superintelligent AI could become uncontrollable and pose a threat to humanity, others see the great opportunities such a singularity holds. They believe that if kept under control, a superintelligent AI could solve many of the world's problems.

5 Reality Bites

In his best-selling book, Homo Deus, Yuval Noah Harari (2016) argues that "the foundations of modern civilisation are eroding in the face of an emergent religion he calls 'dataism,' which holds that by giving ourselves over to information flows, we can transcend our earthly concerns and ties. Other fledgling transhumanist religious movements focus on immortality—a new spin on the promise of eternal life. Still others ally themselves with older faiths, notably Mormonism."

Paul-Choudhury (2019) notes that in the 2001 UK census, Jediism was the fourth largest religion, with nearly 400,000 people claiming it. Although it has since dropped to seventh place, this still represents a significant number of followers. Paul-Choudhury suggests that religions may never truly die out or that a new religion may be on the horizon.

Brian Grim (2015) in his World Economic Forum blog posits that the idea of organized religion dying out is incorrect. He claims that recent research shows that the growth of religious populations worldwide between 2010 and 2050 will be 23 times greater than the growth of nonreligious populations.

According to Grim and Connor's (2015) interpretation of a global study in Demographic Research, the growth of religious populations will have a significant impact on global wealth distribution. In addition to the emergence of China and India as economic powers, the leading economies of 2050 will also feature the most diverse religious groups in recent history. The growth of the global Christian population is projected to be about the same rate as the overall global population growth between 2010 and 2050, with the largest share of Christians expected to be in sub-Saharan Africa by 2050. Muslims are expected to lead the world in population growth. The growth of the global religiously unaffiliated population is slowing. Hindus are expected to significantly increase, mostly led by the rising economy of India. The number of Budddhists is expected to remain at nearly 500 million but is projected to decrease as a share of the world's population, whereas the number of

Jews is anticipated to increase slightly. The number of people belonging to other religions is expected to grow but decrease as a share of the world's population.

In my view, discovering aliens and life in the universe would be the most extraordinary discovery. It would give us a better understanding of life itself. According to Harari (2023), humans could be creating a new god or alien entity in the form of sentient AI, that could eventually control us by hickaking the operational system of human civilization, which is language. Regardless of its origin, alien intelligence raises enormous existential questions, including -and especially—those about God.

6 Input from Interviewees

Yalda Aoukar
Cofounder and managing partner at Bracket Capital

Data and trends in recent years seem to all point in one direction: that humanity will likely be living in an increasingly religious planet by 2050 and beyond. The dominant religious communities of Muslims and Christians are expected to be at parity by then, and the rate of people identifying as "unaffiliated" is expected to globally decrease. I believe this will have undeniable effects on national security, policy, and society as a whole. Nationalism rooted in religious identity (that we have seen proliferate over the last two decades) combined with the ease of digital communication will likely lead to more spontaneous conflicts around the world. More traditionally secular geographies such as Europe will see their social fabric tested, likely leading to further far-right governments with more stringent immigration policies being elected. Lastly, social mobility and demographics will reset the traditional stereotypes of a binary religious system defined by a Muslim South and Christian North with more porous dynamics between the two.

Özlem Denizmen
Opinion leader in women empowerment and founder of Para Durum

In the future, no religion will be relevant, but religion of universal morals will prevail, based on actions people do, very empowered individuals through biology, technology, and all that but with a very poor ecosystem. We shall see a united religion of the world, and the police will be giving fines when you break a rule.

Olivier Oullier
Professor of behavioral and brain sciences, cofounder, and chairman of the Board of Inclusive Brains

Religions and science have one thing in common: They require those who practice them to have strong beliefs. Beliefs help people cope with life. They help make some (sort of) sense. This said, science and religion differ in the way they (try to) explain the world.

Opposing science and religion is a narrow-minded approach: first, because religion is a form of applied organizational and behavioral science, and second,

because people too often mix faith and religion. Faith is a belief. Religion is a system. It is an efficient example of applied behavioral and organizational sciences. Faith and what it entails (that a form of God exists) can be a scientific option for scientists who can't explain some phenomena.

Objectivity, neutrality, independence, and absence of biases do not exist. These are concepts that our brains invented to make us feel better and/or provide meaning to our lives. But at the end of the day, what will make the difference between a belief and a fact is the rigor of the method and replicability of the outcome. This is where science and religion are different too.

Siri Trang Khalsa
Founder and CEO of Stance Advocacy Services

A defining element of the human experience is the desire to understand why we exist. This search is a part of our past and will be part of our future. As we gain understanding of the brain and the source of consciousness through technology, this process of discovery will be focused more internally than externally.

Hopefully, the future will give humanity the opportunity to put greater emphasis on the universal values present in all religions as a source of unity, community, and belonging for all.

Lisa Witter
Executive, serial entrepreneur, writer and public speaker, cofounder, and executive chairman of Apolitical

What does dopamine mean for our lives? Beyond religion, how we meditate and going much deeper and finding presence. Elites around the world are meditating; meditation is being taught to our military and children, leading to the notion of social and emotional learning.

Patrick Youssef
Regional director, Africa, International Committee of the Red Cross (ICRC)

Our multipolar world is increasingly fragmented; governments see battlefields as fertile ground to shape strategic balances of power. In 2050, it is estimated that the world will reach parity between Islam and Christianity. Climate change in many parts of the world will impact our cultural and religious practices, hence, our social cohesion as a result.

With growing inequalities and deepening of domestic disorders, religion will facilitate peace and counter growing fragmentation. During wars, religion should reinforce military ethics and help socialize the rules of war and prevent grave violations.

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Future of Entertainment

Karine Sargsyan

Abstract

Entertainment of the future is a bright embodiment of science and inventions and fantasy and reality, which will plunge humanity into a new life. The global entertainment and entertainment industry are impossible without immersion in virtual reality. The Concert of the Future is a high-quality HD hologram that can be sent from anywhere in the world to a concert hall due to high-speed data transmission. In the future, people will be able to travel mentally to visit the places they want, so buying tickets and booking hotels will no longer be necessary. Also, the music, television, and cinema industry will change immensely. New technologies with an incredible rate of change in the culture and entertainment industry are coming into our lives.

Interviewees
David Rodin
Moran Sol Broza
Serj Tankian
Michele Wucker
Yan Yanovskiy

The best thing about the future is that it comes one day at a time—Abraham Lincoln

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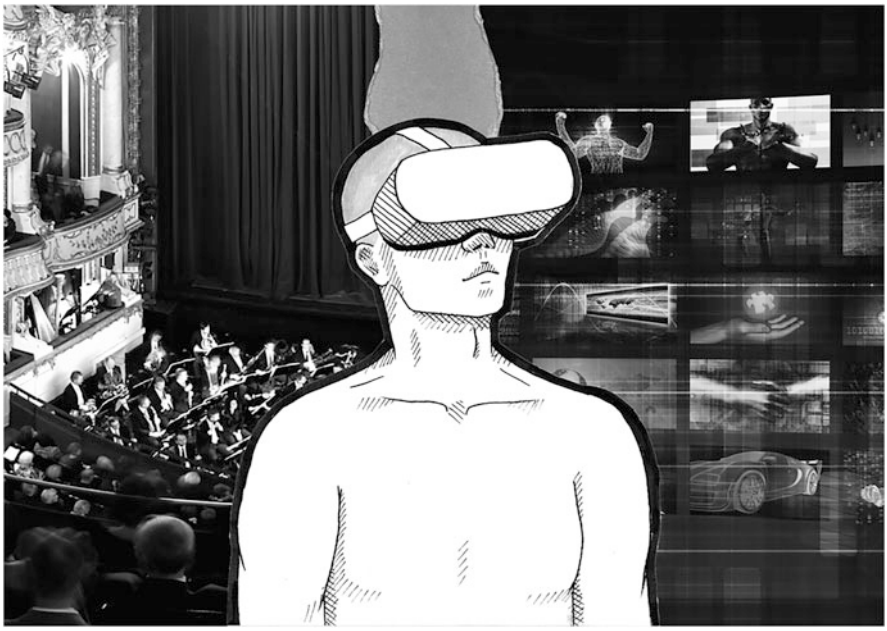

Fig. 1 Future of entertainment. Original Photo: Opera House Graz, Austria; Illustrated by: Astghik Kyurumyan, used with permission

1 What Entertainment Is Expected in the Future?

New technologies with an incredible rate of change in the culture and entertainment industry are coming into our lives. The entertaining descendants of one generation become old-fashioned for people, and the thirst for "bread and circuses" flows in a man's blood from the earliest times (Fig. 1).

The global entertainment and entertainment industry are impossible without immersion in virtual reality (VR). The first rudiments of existence appeared in Ancient Greece, when ancient theatrical performances were transferred to another world, forcing the actors to experience and live life.

Since then, many centuries have passed, and leisure has become extraordinarily high-tech and a medium for predicting futuristic entertainment based on observed technologies. The entertainment industry will be based on enhancement, the novelty of sensations, and the realism of perception.

Cinematography and cinemas: directors and camera operators of our time unanimously choose that the cinema of the future belongs to VR systems. Scriptwriters and artists assume that reality will create a fantastic space where a person can grow up anywhere without leaving home, change the plot and outcome among any actors and scenery, and participate in the dialogues of a new cinema format.

Stereoscopic cinema in 3D is becoming obsolete. Volumetric films are no longer impressive, and attendance is gradually fading away. However, a new technology actively developed in Russia since the 1970s, the HD hologram, can revive 3D cinema (Johnston, 2006). Holographic cinema differs from VR systems because the viewer does not need glasses or sensors. The image is born in experimental conditions; it can be viewed from different sides, bypassed, or come close. Western investors actively used the experience of the outstanding Soviet inventor Vitaly Komar, who left a substantial scientific legacy to develop holographic image technologies (Taylor, 1985). The Korean Hyundai Motor Group has designed a kinetic screen that contains thousands of pulsating cubes. A complex mechanism from blank walls settles and forms projections—various images and patterns. The result is impressive: The panels move along with the plot, showing additional effects (Hu Se, 2021).

Another cinema technology of the future developed in Korea is the new generation ScreenX screen, which projects the image at 270°. Thanks to three screens, the viewer gets a wide viewing angle, wholly immersed in the ongoing events. To shoot a scene of such a film, it is necessary to use three cameras simultaneously, located at different angles and subsequently forming a 270° image.

Music: our expert futurologists predict a "synthetic" future for music. In terms of technology, music is a flow of information, and combinations of sounds will be made completely new, leaving a feeling of unforgettable and beautiful sound. Musical compositions will be created based on psychoacoustics, combining different frequencies for different effects on the human psyche. Music can both lull and give a feeling of euphoria.

The musical instruments that give rise to futuristic music already exist. Among them are sensory guitars; silicone synthesizer Seaboard with "smart" keyboard; biophysical musical instrument Xth Sense, which reacts to the smallest contractions of human muscles with the help of two bandages with sensors on the hands; Tesla coils that send electrical discharges at the right time to form a certain sound; and other developments. The most spectacular and impressive instrument for today's richness of tones and timbres is the ReacTable touch table. It is called a full-fledged music station of the future.

Lyrics and musical works will be written by neural networks, first conducting a program analysis and conditions for creating a future composition for popularity.

Concerts will be very different. As the COVID-19 pandemic has shown, we can connect for concerts, not only in concert halls. The world has already practiced the first holographic performances—for example, the concert of the deceased Michael Jackson (Feeney, 2014). However, this kind of hologram is not like the HD holograms of the future. "Holographic concerts," so popular in show business, are a 2D projection of a pre-filmed video onto a film screen installed at an angle of 45° to the viewer. Such a catch is not noticeable to a person from the auditorium and completely passes for a show of the future.

The Concert of the Future is a high-quality HD hologram that can be sent from anywhere in the world to a concert hall due to high-speed data transmission. The

hologram will be able to give a show on the stage and fly around the arena, approach the audience, and communicate with them.

TV: television of the future will give viewers new emotions. Spectators will test multiscreen technologies and VR systems; a little later, new flexible smartphones and smartbooks will replace multiscreens and holographic television. Interactive television will solve the problem of the inaccessibility of information in some parts of the world.

Travel: In the future, people will be able to manage their journeys mentally and visit the places they have come up with. To do this, buying tickets and booking hotels are not necessary.

Since there are no borders and limits in virtuality, VR developments of the future will be open to humankind, previously inaccessible places on our planet, and the entire universe for travel. There may be more adventures and subsequent vivid memories in the virtual world than in reality. Already today, with the help of VR systems, you can teleport to any point on the planet and the universe, walk along the ocean, and visit any museum in the world. Cyber helmets and goggles are all ready today.

And in the indefinite future, slow-moving airships, vacuum transport tubes, and other fundamentally new approaches to transporting people and goods around the planet await us. Entertainment of the future is a bright embodiment of science and inventions and fantasy and reality, which will plunge humanity into a new life.

Entertainment of the future: 7D quests, survival games, and time travel? Actually, it looks like that; first of all, especially because of COVID-19, virtual communication and entertainment have become crucial. Virtual entertainment: having removed another philosophical futuristic dystopia, Terry Gilliam managed to show in her society of the future what dose it means to be "hungry for the meaning of one's existence." "Theorem Zero" is a beautifully presented and annoying pop-up ad that haunts passersby only on the Internet but on the streets and one specific aspect of the already existing VR entertainment. By connecting to the computer, a special latex suit conveys to the owner the feeling that anyone can have sex. And such virtual sex at a distance can occur in various decorations (the film shows a somewhat stereotypical "desert island"). Most of our experts slightly agree with this.

Theme parks: a recent hit series from HBO showcases another, much more expensive entertainment. In the future of Westworld, people have decided to change reality by creating a theme amusement park in which specially programmed androids perform the roles of all non-player characters. Park guests are attracted to numerous quests and stories and the spirit of impunity in the park. There is only one question, who are the director and the writers of the series, are they shaping our future entertainment?

Virtual Horror: "Black Mirror" shows many fascinating examples of future entertainment. In one series, all human memories are recorded using special lenses and another—people are encouraged to keep their consciousness and play it in a virtual city in an exciting era. Another entertainment that turned out not to be harmless was shown in the first season's second episode. The main character is involved in a horror test in VR, which becomes scarier, using the fears of the test

subject himself. Such a horror project that adapts to the player's state already exists: Special controllers are used to read the pulse and breathing rate (Black Mirror, 2011).

Shows on survival will become more popular, although the development is already pregnant. But also films, series, and games (based on those films) like "Gamer" (2009), "Game" (1997), "Hunting for Piranha" (2006), "The Hunger Games" (2012), and countless others are united by the plot-forming idea of games on survival. Most of the time, the plot is uncomplicated—in the future, popular human entertainment, due to various reasons, will become a reality show on survival. "Running Man" prisoners sentenced to death penalty have a choice: to participate in such a TV show or accept the punishment.

Reality show: another variation on the reality show theme, which, however, has to have only one hero. People are interested in watching how others are placed in artificial conditions, whether hostels or desert islands. But what if the show's hero does not know that his life—the fruit of the imagination of television producers and everything that surrounds him/her in fact—is deception? Precisely in such a situation, it turns out to be Jim Carrey's hero film by Peter Weir. In general, if it seems to you that everything in the world revolves around you, it is a reason to think. The Kardashian family made the reality show a trend, which is rather very difficult to stop and will evolve till 2050.

Implantation of memories: in the future, it will be interesting to spend a vacation without wasting energy on getting somewhere. Unless to the office of a particular company, which in the film by Paul Verhoeven is called Total Recall and is engaged in implanting memories. Why fly to Mars if the most important thing you can bring back with you is the memory of the trip? On the other hand, who would trust a company that can change your knowledge of your own life?

2 Input from Interviewees

David Rodin
Moral and political philosopher, founder, and CEO of Principia Advisory

Impact of robotics major game changer, transformative. Cheaper and able to perform many more tasks, like care providing roles, simulations, etc. This will have a huge impact on society, economy, and theway we relate to each other as human beings, values, and ethics.

I see two scenarios. One where humans are liberated into a world of leisure, replaced by robots, equitable ways of distributing wealth, higher level of productivity, creativity and another much more.

Hobbean world, not equitable world, meaningless lives.

Moran Sol Broza
Sustainable impact entrepreneur and founder of Be. and Sol Food

In the future, entertainment will take up a larger part of our daily lives as immersive/experiential entertainment emerges, allowing us to tap into our

imagination and its empathetic nature. It will be valued more than other industries and professions; artists will be paid close to equal to lawyers, doctors, etc. as people increasingly recognize the critical role culture plays in our survival—and thriving—as a species.

Technology will be blended with human intelligence, allowing for cross-pollination of data to create unprecedented hybrid combinations leading to exponential levels of genius as more and more open-source platforms continue to be introduced and integrated into our global culture.

Serj Tankian
Singer of System of a Down

The physical impact of live performances will never be underrated; however, there will be exponential growth in virtual and holographic-type performances.

Michele Wucker
Author, founder, and chief executive officer of Gray Rhino & Company

Attention spans can only collapse so far, so my hope is that in 2050 we'll see a reversal of this trend, even as participatory and immersive forms of entertainment will continue to draw people in.

Yan Yanovskiy
Investment banker and cofounder of Friends Foundation

I see the future of entertainment in a blink of an eye as all communication will be based on Internet-enabled contact lenses. Our entertainment will be super targeted to our tastes and produced individually for every person by AI algorithms.

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Resetting the Future: World 50.0

Tamás Landesz, Sangeeth Varghese, and Karine Sargsyan

Abstract

The pandemic has presented an opportunity to reflect, reimagine, and reset the world. The ancient Greeks referred to time using two different concepts: "chronos" and "kairos." Whereas the former refers to traditional time measured by a ticking clock, the latter refers to "deep time," when everything is possible. This book is a journey to create a community for building a better future. The WORLD 50.0 movement is working toward building a better, more inclusive, and sustainable future. Concurrently, initiatives like the United Planet (UP), Futurian, and Regenopolis are working toward a bluer, greener future by catalyzing actions needed to realize that future. The book shares the dreams of the world's top scientists, thinkers, and innovators who are continuously working on inventing the future, including transitioning to become a multi-planetary species, brain-human interfaces combined with exoskeletons, and nanomedicine reforming health care. The aim of the WORLD 50.0 movement is to build a better future

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together faster by crowdsourcing inputs on a global scale and engaging and scaling a community of contributors.

> The pandemic represents a rare but narrow window of opportunity to reflect, reimagine, and reset our world.—Klaus Schwab

Those who had the privilege to visit the renowned university town of Cambridge in the United Kingdom most likely will never forget the "Chronophage," a time eating monster devouring each minute as it passes with the snap of its jaws, as it sits atop the Corpus Clock. A special feature of this clock is that it stops at irregular intervals but then synchronizes again to catch up with real time.

The ancient Greeks referred to time using two different concepts, "chronos" and "kairos." The first refers to our traditional time, measured by a ticking clock, whereas the latter was referred to by philosophers as "deep time," when you feel the flow, perceiving that time stands still and everything is possible. Kairos moments in life are those to treasure with a pinch of serendipity.

This last chapter of the book is not "the end" but marks the beginning of a journey, a time travel with the aim to create a community for building a better future, joining efforts with kindred initiatives like the United Planet (UP), Futurian, Regenopolis, and others:

- The *United Planet (UP)* Game, founded by Lucian Tarnowski, is a civilization design game. A time traveling immersive reality where participants create as their timeless selves. The game unites athletes of transformation as Gaians, together designing a thriving civilization in harmony with life. It is based on the premise that it is more effective to cooperatively reverse engineer solutions from the future than it is to build incrementally from the mess of the present. The community unites geniuses, artists, musicians, elders, and wisest most innovative, visionary people from around the world to create the "Age of We."
- *Futurian*s cofounded by Georgie Benardete and David Hanley are gathered at inflection points in time, using their leverage to shift the world to a more favorable axis. They are leaders, thinkers, and creatives with a vision for a bluer, greener future to catalyze the actions needed to realize that future.
- *Regenopolis* founded by Diane Binder builds on the premise that the majority of people do want positive change, but there are no sufficient physical locations to gather in a trustful and creative environment, allowing for transformational experiences and serendipitous collaborations.

Concurrently, the WORLD 50.0 movement will be working from its dedicated headquarters, hosted in the newly constructed Future Center in the building of the new Agriculture College and Innovation Center (ACIC) in Gagarin Valley in Armenia. The Future Center will become a global agora for research, exchange, sharing, and training of a new generation of leaders with a new mindset, including multidisciplinary future literacy skills, enabling them to create a better, more

inclusive, and sustainable future. The Gagarin Valley was named after cosmonaut Yuri Gagarin, who was the first person to orbit the Earth and view our planet as home to all humans, requiring our collective attention, nurturing, and care.

The world's top scientists, thinkers, and innovators are working continuously on inventing the future. A glimpse into their laboratories and their minds through this book allows us to share their dreams:

- We are transitioning to become a "multi-planetary species," due to the inherent risk of a large asteroid hitting the Earth in the future. Self-replicating robots could help us build a new human habitat on another planet.
- Brain-human interfaces combined with exoskeletons will be a game changer on how we interact with each other. The Internet may transform into a brain-net, able to send emotions instead of emojis, revolutionizing human interaction, communication, and entertainment.
- Nanomedicine will reform health care, including cancer treatments. Your toilet will become the first wall of defense against different types of cancer, able to detect initial cancer colonies circulating in your body, allowing timely treatment and eradication of many type of cancers.

The aim of the WORLD 50.0 movement is to build our future together faster—a better future that we want our children and their children to inherit. Making this an ongoing project, crowdsourcing inputs on a global scale, continuously engaging and scaling our community of contributors, and producing relevant and digestible outputs for the general public, which can also be used by policymakers and business leaders to make better sense of the future and ultimately contribute to building a better world.

This book aligns with other anticipatory approaches such as Michio Kaku's work on predicting the future based on interviews with hundreds of scientists and its complementary to such initiative as the Geneva Science and Diplomacy Anticipator (GESDA) Science Breakthrough Radar.

A major cohort of Young Global Leaders (YGL) of the World Economic Forum contributed to this book. YGLs thrive to find ways to collectively accelerate their efforts to improve the state of the world. They are working together to dramatically affect the lives of future generations and craft innovative responses to address global and regional challenges. The YGL community enables leaders to turn their personal success into global significance through the scaling up of ideas that lead to impactful change, aiming at 2050 and beyond.

Collaborating and working together on this multigenerational project is imperative. The majority of indicators are pointing in the right direction. Cautious optimism seems to be the norm among YGLs and other contributors, even after the COVID-19 pandemic.

One of the most rewarding questions to ask our contributors was "what values and skills do you want to pass on to your kids in order to thrive in the future?". Clearly, the most important aspect of preparing for what the future may hold is education. However, it needs to go hand in hand with the right mindset and attitude

to tackle the newly emerging problems of the world. It is also essential to create a harmonious society with respect between different groups and without extremism.

Most people think in an arithmetic way today. With dramatically increasing computational power and more efficient technologies, resulting in new gadgets intertwining our daily lives, we may be moving toward more "computational thinking." Our biological identity will only be a single and transient phase of our existence. Neurological mapping, imaging technologies, and manipulation at the nanoscale will allow us to transition wholly into the digital domain. Is singularity a matter of time; where we will soon be able to "download" ourselves into the digital domain and pull the plug on our biological identities?

Some people are inspired by the potential of virtual reality, teleportation, or cloning, which could allow them to be present at a boring meeting while at the same time taking a siesta in an exotic Cuban beach, enjoying the sound of the ocean. Science can help understand the brain and how human consciousness works, which is possibly the most mysterious thing of all. But human beings will remain complicated. We should find new ways to connect us, telling our stories and sharing them with each other, as easily as sharing a hug. Ultimately, it will come down to following your passion and looking at the big picture to see how you can apply your strengths in the best way possible.

Eventually, core skills such as embracing change, adaptability, enduring to live in difficult conditions, collaborating with others, and highly sophisticated problem-solving will be high on demand and required in all walks of life. In the coming years, we are planning to initiate a generic university Master's Program curriculum to improve our collective future's literacy. Young people of any discipline will be able to take this program in order to gain complementary future literacy skills, allowing them to exploit their capacities to create a better, more enabling future. Of all human activities today, education is probably the most important. To this end, we are partnering with universities around the globe, including the EARTH University, committed to help build the global movement of leaders that can make this critical transition happen.

In an effort to improve global future literacy, our readers are able to explore their Future Intelligence or Future Quotient (FQ)—a measure of the future readiness to positively cope with and overcome the various complexities as a result of foreseeable and unforeseeable future changes in the economy, society, and the environment—through a self-administered questionnaire included in the annex of this book.

How will we organize our societies in the future? If we manage to conquer other planets, we will likely live in Star Trek-like colonies, requiring a very different approach to living on Earth. In order to prepare for that not-so-distant future, we should empower our polymath kids to lead us into a better future and not ask them what they want to be but what problem in the world they want to solve?

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Annex: What Is Your Future Intelligence (FQ)?

Readers are able to explore their Future Intelligence or FQ—a measure of the future readiness to positively cope with and overcome the various complexities as a result of foreseeable and unforeseeable future changes in the economy, society, and the environment—through this self-administered proprietary questionnaire, based on original research by Landesz (2016) (Fig. A.1).

The next two questionnaires should be taken together, and the results mapped on the below table:

Authentic Leadership Questionnaire (ALQ) Created by Walumbwa and associates (2008) to explore and validate the assumptions of authentic leadership. It is a 16-item instrument that measures four factors of authentic leadership: self-awareness, internalized moral perspective, balanced processing, and relational transparency (Fig. A.2).

Accessible here: https://authenticleadershipblog.files.wordpress.com/2012/07/authentic-leadership-questionnaire.pdf

MACH-IV Questionnaire Richard Christie and Florence L. Geis (1970) developed a widely used test for measuring a person's level of Machiavellianism. This eventually became the MACH-IV test, a 20-statement personality survey that is now the standard self-assessment tool of Machiavellianism.

Accessible here: http://openpsychometrics.org/tests/MACH-IV/

How to Interpret Your Scores

Quadrant 1 (ALQ $<$ 3 and MACH IV $>$ 60)
A combination of high MACH and low ALQ scores reflects a highly Machiavellian (controlling) leadership style which is still embraced in more authoritarian regions of today.

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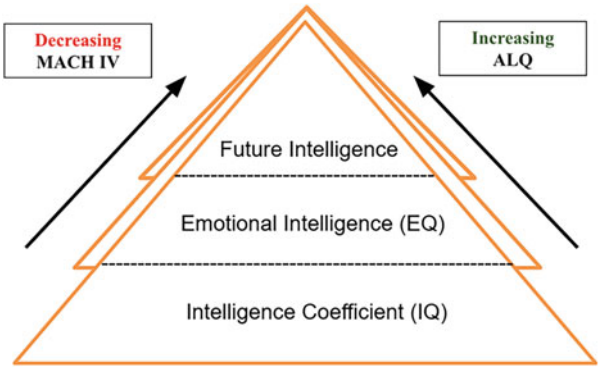

Fig. A.1 Future Intelligence Pyramid (Landesz, 2016)

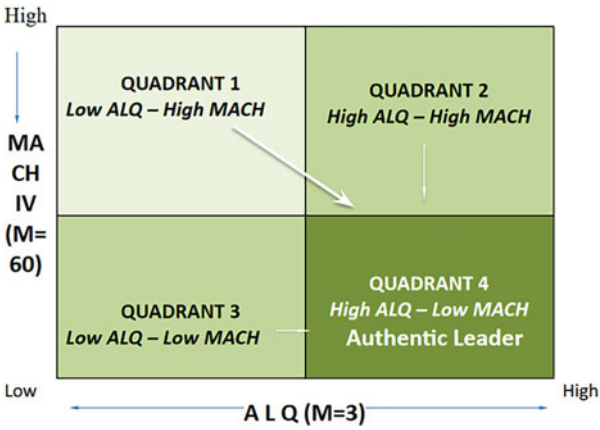

Fig. A.2 Authentic Leadership Quadrant (Landesz, 2016)

Quadrant 2 (ALQ > 3 and MACH IV > 60)
A combination of high MACH and high ALQ scores reflects an interesting combination of controlling and caring leadership styles. Not very common, as the two styles often cancel each other out.

Quadrant 3 (ALQ < 3 and MACH IV < 60)
A combination of low MACH and low ALQ scores reflects a low risk, low energy leadership style, typical in highly bureaucratic organizations.

Quadrant 4 (ALQ > 3 and MACH IV < 60)
Congratulations you have an ideal FQ to face the future! A combination of low MACH and high ALQ scores is ideal for new age leaders, who are able to lead change in complex organizations, easily adapting to the new realities, and promoting a caring style of leadership.

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