4IR – A distillation by Mark Herr

The following summary is my personal distillation of the contents within & concepts of 'The Fourth Industrial Revolution,' (4IR) written by Klaus Schwab.

Doing so helps me personally understand and retain the deeper concepts found in his published work. My effort is in no way meant to substitute or detract from the original published work – it is entirely meant for personal use as a means of my participation in this important global, national, and local discussion.

Throughout his work, Schwab asserts that significant and accelerating 4IR opportunities and challenges need to be addressed by the human family at large. He suggests that global cooperation and collaboration, concerning 4IR, is critically needed to (1) raise awareness, (2) develop positive, common, & comprehensive narratives, and (3) restructure economic, social, and political systems.

My personal fascination and growing concern with the implications of AI being perceived, collectively by humankind, as either human or non-human sentience drove my distillation efforts. In some small way, I hope my distillation of '4IR' inspires you to (1) purchase and read it in its entirety, (2) join the 21st Century debate on AI, and (3) discover solutions to the numerous challenges AI will, not may, bring to you, your family, and the human family at large.

In my personal conclusion, I suggest clear private and public definitions of Personhood, Parenthood, and Religion are discussed and debated, by humans, and inevitably, legally or constitutionally agreed to. Nonetheless, what will be humanity's fate – that is up to humanity to discover during the 21st century!

Most Humbly Yours,
Mark Herr

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Chapter 1 – The Fourth Industrial Revolution

1.1 Historical Context

Revolution means "abrupt and radical change" and occur when "new technologies and novel ways of perceiving the world" incite change in "economic systems and social structures."

The world has gone through several of these changes.

1. Agrarian Revolution – transition from hunter/forager to farmer – made possible through "domestication of animals". Combining animals with humans increased "production, transportation, and communication." With improved food production, increasing populations, and larger human settlements, the rise of cities and urbanization led to a series of Industrial Revolutions
2. 1st Industrial Revolution (1IR) Mechanical Revolution – occurring between around 1760-1840 due to railroads and steam engines. 1IR took nearly 120 years to spread across Europe.
3. (2IR) Mass Production Revolution – occurring between around the mid-19th and early 20th centuries due to electricity and assembly lines. 17% or 1.3 billion people have yet to experience the 2IR.
4. (3IR) Digital Revolution – occurring between around the mid-1950s to the end of the 20th century due to semi-conductors, mainframes, personal computers, and the internet. Nearly 50% or 4 billion people have yet to experience the internet. In contrast to 1IR, 3IR took less than a decade for the internet to spread across the globe
5. (4IR) Artificial & Spontaneous Intelligence Revolution – beginning at the start of the 21st century and "building on the Digital Revolution, 4IR is "characterized by a much more ubiquitous and mobile internet, by smaller and more powerful sensors that have become cheaper, and by artificial intelligence and machine learning."
    a. 4IR is transforming societies and global economy.
    b. 4IR will manifest through automation and the making of "unprecedented things."
    c. 4IR enables "smart factories" where virtual & physical systems of manufacturing globally cooperate with each other in a flexible way…allows "absolute customization & creation of new operating models."
    d. 4IR breakthroughs will include gene sequencing, nanotechnology, renewables, quantum computing
    e. 4IR is fundamentally different from other IRs as the fusion of these technologies interact within the physical, digital, and biological worlds

Schwab's concerns implementing 4IR

1. The extent to which society embraces technological innovation is major obstacle to progress.
2. Required levels of leadership and national & global institutional frameworks are low, inadequate, if not, absent altogether to rethink economic, social, and political systems to govern diffusion of innovation and mitigate the disruptions.
3. The world lacks consistent, positive, and common narratives outlining the opportunities & challenges of 4IR. A narrative that empowers a diverse set of individuals & communities and avoids popular backlash against the fundamental changes underway…

1.2 Profound and Systemic Change

Major technological change is inevitable. The speed of this change is extremely fast (Uber, Amazon, etc.) and returns to scale are 'equally staggering.' For example, contrast Detroit (1990) with Silicon Valley (2014):

	Capitalization	Revenue	Employees
Detroit (1990)	$36B	$250B	1,200,000
Silicon (2014)	$1.09 Trillion	$246B	137,000

Reason for stark contrast is digital business have marginal costs near zero.

In addition to speed & returns to scale, harmonization and integration of technology with biological realms allows designers and architects to "make and grow" integrated digital & biological things that are "continuously mutable and adaptable" (hallmarks of the plant&animal kingdoms)

"Our devices will become an increasing part of our ecosystems, listening to us, anticipating our needs, and helping us when required – even when not asked."

4IR will generate great benefits and big challenges.

One challenge is inequality – especially between consumers & producers. Consumers seem to gain the most in terms of computing power and access (i.e. ordering a cab, streaming a movie, etc). The devices we use today are equivalent to 5000 desktop computers just 20 years ago. The cost of storage is near zero compared to $10,000 for the same 20 years ago.

Another challenge, on the side of work & production, is supply of labor in terms of GDP. The rising gap between owners of capital and those who provide labor is growing rapidly. Schwab devotes a section in Chapter 3 to this challenge.

The concentration of innovation, capital, etc in the hands of a few is exacerbated by the "platform effect" – digital networks that connect buyers & sellers increasing returns to scale. This effect concentrates power & value in the hands of a very few people raising societal risks of closed platforms and limiting participation in innovation.

The question for all people, industries, and companies is NOT "am I going to be disrupted" but "when?"

It is critical/crucial we participate in developing common values to develop policy choices and enact changes that will make 4IR an opportunity for all…

Chapter 2 – Drivers of 4IR

The following is compiled based on WEF & its Global Agenda Councils:

2.1 Megatrends

Development of technology leverages the power of digitization & information tech. For example, advancements in gene sequencing are possible through computing power and data analytics.

The following are organized into 3 clusters: Physical, Digital, and Biological

2.1.1 Physical

Autonomous Vehicles

Driverless cars are fairly well known. However, autonomous DRONES, trucks, aircraft, and boats are advancing at a rapid pace due to advancements in SENSORS and AI. Will result in: (1) lower costs & commercial availability and (2) ability to accomplish tasks that were formerly human.

3D Printing

Also known as "additive manufacturing" – creating an object by adding layers. Is contrasted with "subtractive manufacturing" – creating an object by subtracting layers.

AM uses digital templates & easily customizable. Currently, application is limited to automotive, aerospace, and medical industries.

Future AM will include electric circuit boards, human cells & organs. It will also include 4D printing where objects are self-altering responding to heat & humidity – such as footwear or clothing and implants designed to adapt to the human body.

Advanced Robotics

Until recently, AR was confined to highly specialized industries. However, AR is being used in other sectors such as precision agriculture and nursing. Soon collaboration betw Humans & Robots will become an everyday reality.

Robots are becoming more flexible & adaptable as structural and functional designs mimic nature's strategies and patterns. Sensor advancements allow robots to access information remotely, connect with other robots, and handle a broader variety of tasks (i.e. household and yard work).

Next Gen robots will emphasize human-machine collaboration. Schwab explores ethical/psychological implications in Chp3.

New Materials

NM are lighter, stronger, recyclable, and adaptive. Smart materials are now self-healing & cleaning, metals with memory reverting original shape, ceramics & crystals that turn pressure into energy, etc.

For example, 'Graphene' 200x stronger than steel, 1 million times thinner than a human hair, and efficient conductor of electricity and heat…when this material becomes commercially cost effective (currently, $1000/gram) it will disrupt manufacturing and infrastructure industries.

Another example, thermoset plastics may create a circular economy where recyclables are regenerative and decouples growth and resource needs.

2.1.2 Digital

Main bridge between physical & digital is the Internet of Things (IoT) – the relationship between things (products, services, places, etc.) and people, made possible by connected tech and various platforms.

This interconnectivity will alter how supply chains are managed and enable monitoring and optimizing assets & activities at a granular level…whose impacts will be felt in manufacturing, infrastructure, and healthcare.

Consider monitoring both things & people…Things can be monitored any where along the supply chain by both the producer and the consumer. In the future, similar systems will be used for the same purpose with people…

Trust amongst people who do not know each other is being revolutionized by "blockchain" – a shared, programmable, cryptographically secured trusted ledger that not one single person controls and can be inspected by everyone. Besides coin, blockchain will be used for birth&death certificates, titles, registrations, licenses, degrees, insurance claims, etc…

On-demand or Sharing economy are creating entirely news ways of consuming goods & services. Uber is disrupting traditional models such as laundry, chores, parking, etc. These platforms create trust…This economy raises the **fundamental question: is anything worth owning – the platform or the underlying asset**?

Uber owns no cars, AirBnB owns no property, etc…these platforms have reduced transaction & friction costs, offering economic gain for all parties involved in the transaction. The marginal costs for producing additional products tends towards zero…Schwab will explore these implications in Chapter 3

2.1.3 Biological

Genetic sequencing, activating, and editing are advancing at rapid pace due to low cost and high computing powers.

Synthetic biology will allow for customized organisms enabled by the ability to write DNA, which will have profound & immediate impact on medicine, agriculture, and biofuels.

All diseases have a genetic component. The ability to determine individual genetic make-up, empowered by increasing data analytics, will revolutionize customizable health care…

The ability to edit biology is less hampered by technological advancements than by existing legal, ethical, and regulatory vacuums…

One immediate & challenging Question: How will genetic engineering alter medical research & treatment?

For example, Cows producing milk altered for hemophiliac's, pigs producing organs, bioprinting tissues and layering liver cells for organ creation. New ways to embed and employ devices to monitor activity, blood chemistry, and brain activities are two of the most highly funded research areas.

New questions around social norms and regulations as to what it means to be human, what data about our health & bodies can or should be shared with others, and what rights & responsibilities we have with modifying the genetic code of future generations…

Designer babies – those who possess certain traits and resistance to diseases present realities & consequences that need to be resolved or at least addressed.

The Dynamics of Discovery

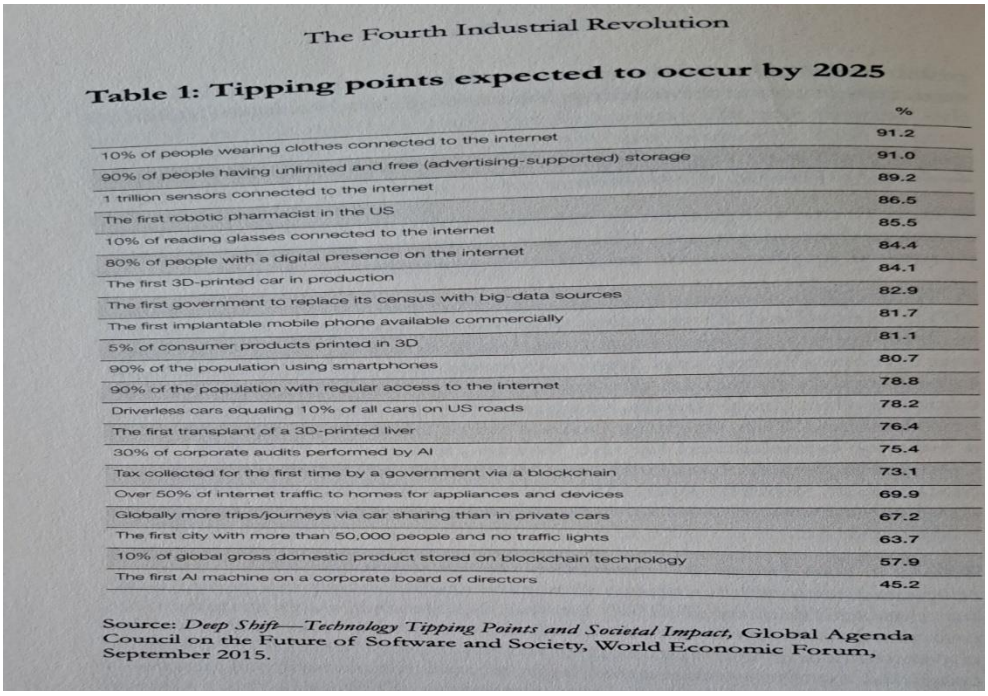
It is important that we ensure such advances continue and directed towards best possible outcomes.

One challenge is that university based research conservativism limits bold fundamental & innovative technological adaptive research. Three possible solutions exist: (1) Commercial funding, (2) Governments funding ambitious research and (3) public-private partnerships

2.2 Tipping Points

WEF 2015 report outlines 21 tipping points and when 800 executives believe specific technological shifts will hit mainstream society – shaping our digital and hyper-connected world. The "Deep Shift" appendix, in the book, further outlines each tipping point. (See Table 1)

Navigating these transitions begins with understanding the shifts going on and those to come, as well as, each shifts impact on global society.



The Fourth Industrial Revolution

Table 1: Tipping points expected to occur by 2025

	%
10% of people wearing clothes connected to the internet	91.2
90% of people having unlimited and free (advertising-supported) storage	91.0
1 trillion sensors connected to the internet	89.2
The first robotic pharmacist in the US	86.5
10% of reading glasses connected to the internet	85.5
80% of people with a digital presence on the internet	84.4
The first 3D-printed car in production	84.1
The first government to replace its census with big-data sources	82.9
The first implantable mobile phone available commercially	81.7
5% of consumer products printed in 3D	81.1
90% of the population using smartphones	80.7
90% of the population with regular access to the internet	78.8
Driverless cars equaling 10% of all cars on US roads	78.2
The first transplant of a 3D-printed liver	76.4
30% of corporate audits performed by AI	75.4
Tax collected for the first time by a government via a blockchain	73.1
Over 50% of internet traffic to homes for appliances and devices	69.9
Globally more trips/journeys via car sharing than in private cars	67.2
The first city with more than 50,000 people and no traffic lights	63.7
10% of global gross domestic product stored on blockchain technology	57.9
The first AI machine on a corporate board of directors	45.2

Source: *Deep Shift—Technology Tipping Points and Societal Impact*, Global Agenda Council on the Future of Software and Society, World Economic Forum, September 2015.

Chapter 3 – Impact of 4IR

This chapter discusses & analyzes the impact 4IR will have on economy, business, governments, and countries, societies, and individuals. 4IR disruptions on existing political, economic, and social models will require 'empowered' individuals to recognize they are part of a distributed power system requiring more collaboration in order to succeed.

3.1 ECONOMY

Schwab focuses on growth & employment since it nearly impossible to disentangle one effect (i.e., GDP, investment, etc.) from the next

3.1.1 Growth

What effect 4IR will have divides economists into techno-pessimists & optimists.

Pessimists argue digital gains are almost over and productivity gains will slow. Optimists argue digital gains are no where near realized and that surges in productivity are just getting started.

Since the 2008 Market crash – Global GDP has slowed not increased – Scwab explores Aging & Productivity

Aging

Replacement rates are falling and longevity rates are increasing – these two trends affect workforce and retirement pressures. Many countries struggle with this discussion, amplifying how the world is not prepared for the forces of impending change.

Productivity

Despite technological progress, Total factor productivity (TFP) remains sluggish over the past decade – the reason for this is unclear. One explanation might be that traditional statistical models need to be upgraded as 4IR innovations may mean we are producing & consuming more efficiently. Three reasons may explain the disconnect:

First, 4IR offers opportunity to integrate unmet needs of 2B people, driving further demand for products & services.

Second, 4IR expands our ability to address negative externalities potentially boosting economic growth. For example, green projects relied heavily on government subsidies – however, that is changing with new technologies while addressing the negative externalities of climate change.

Third, governments, businesses, and civil society leaders are struggling to transform their organizations to realize digital capabilities. 4IR will require entirely new economic and organizational structures to realize its full value.

Competition rules of 4IR will be different than previous periods. Companies & countries will need to be at the frontier of innovation in all its forms. Traditional models of reducing costs will be less important than offering products & services in new innovative ways.

Established businesses are facing immense pressures from emerging disruptors & innovators from other industries…

The combination of structural & systemic factors will force economics to be rewritten…4IR has potential to increase growth and alleviate global challenges. However, inequality, employment, and labor markets negative impacts need to be recognized and managed.

3.1.2 Employment

Concern about technological impacts on jobs is not new. 1931, Keynes warned of widespread unemployment – turned out he was wrong…but this time what if it were true?

Evidence of Computers substituting human labor is observable – i.e., bookkeeping, cashiers, telephone operators, etc.

The reasons for this upheaval are (1) speed of change, (2) breadth & depth of change, and (3) transformation of entire systems.

What is certain is that tech will change the nature of human work across all industries & occupations. What is uncertain is what extent automation will substitute human labor, how long this will take, and how far it will go…

2 competing effects technology has on employment

1. Destruction effect – "technology disruption & automation substitute capital for labor – forces humans to become unemployable or reallocate their skills elsewhere."
2. Capitalization effect – accompanies D-effect where demand for new goods&services increases leading to creation of new occupations, businesses, and industries.

Key to human adaptation is "timing & extent to which C-effect supersedes D-effect and "how quickly the substitution will take effect.

2 opposing views of these 2 competing effects:

1. Happy ending – displaced will find new jobs and tech will unleash unprecedented prosperity
2. Armageddon – displacement on a massive scale

History indicates will land somewhere in the middle – foster more positive outcomes & help those caught in the transition.

Labor Substitution

Mechanical labor is already automating. Sooner rather later, professions such as lawyers, doctors, journalists, etc., may become partly or completely automated…

Evidence: 4IR is not creating more jobs in new industries, demonstrating that information innovations and other disruptors raise productivity by replacing existing workers, rather than new products needing more labor to produce them. (See Table 2)

Research concludes that about 50% of US workforce is at risk of automation within the next 20 years. Employment will grow in cognitive & creative jobs and manual occupations but will greatly diminish for routine & repetitive jobs. Job Simplification enables algorithms to replace humans.

Leaders need to prepare workforces, develop education models to work with, and alongside connected & intelligent machines…resisting the temptation to think humanity faces a 'man versus machine dilemma.

Impact on Skills

Future jobs will require social & creative skills, in particular, decision making under uncertainty and development of novel ideas. However, this may not last – narrative generating AI may constitute up to 90% of news – apart from the designer of the algorithm.

Ability to predict future employment based on knowledge skills needed is increasingly critical to all stakeholders. Complex problem-solving, social & systems skills will far outweigh physical abilities & content skills. (See Figure 1)

Table 2: Examples of professions most and least prone to automation

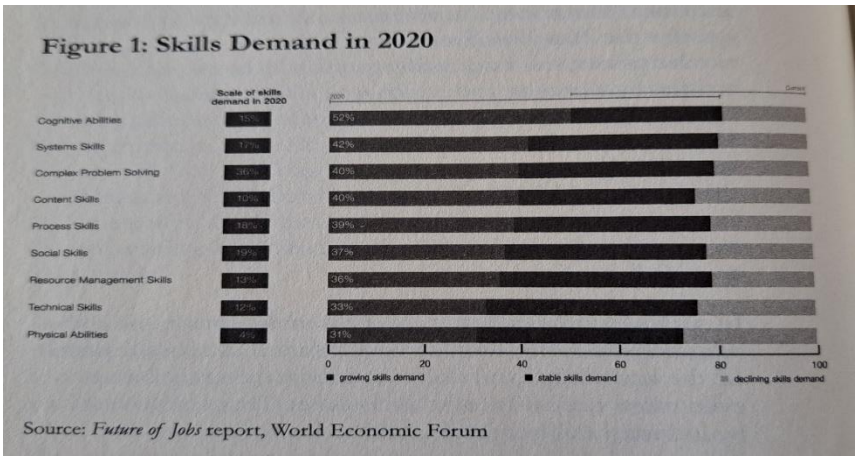
Most Prone to Automation

Probability	Occupation
0.99	Telemarketers
0.99	Tax preparers
0.98	Insurance Appraisers, Auto Damage
0.98	Umpires, Referees, and Other Sports Officials
0.98	Legal Secretaries
0.97	Hosts and Hostesses, Restaurant, Lounge, and Coffee Shop
0.97	Real Estate Brokers
0.97	Farm Labor Contractors
0.96	Secretaries and Administrative Assistants, Except Legal, Medical & Executive
0.94	Couriers and Messengers

Least Prone to Automation

Probability	Occupation
0.0031	Mental Health and Substance Abuse Social Workers
0.0040	Choreographers
0.0042	Physicians and Surgeons
0.0043	Psychologists
0.0055	Human Resources Managers
0.0065	Computer Systems Analysts
0.0077	Anthropologists and Archaeologists
0.0100	Marine Engineers and Naval Architects
0.0130	Sales Managers
0.0150	Chief Executives

Source: Carl Benedikt Frey and Michael Osborne, University of Oxford, 2013



Box A: Gender Gaps and 4IR

Job security is expected to worsen in half of industries surveyed. Women & men will be affected differently – exacerbating gender inequality. How will accelerating pace of tech changes in physical, digital, and biological worlds affect role of gender in the economy, politics, and society?

Demand will increase for skills that enable workers to design, build, and work alongside technological systems, or in areas that fill the gaps left by tech innovations.

A possible negative 4IR outcome is that further divergence may develop between men and women's roles. Take the opportunity to redesign labor policies and business practices to ensure both men & women are empowered to full extent.

Talent, more than capital, will represent the critical production factor. Scarcity of skilled workforce may limit innovation, competitiveness, and growth – leading to growing inequality & increase in social tensions as middle is hallowed out.

4IR will place more emphasis on ability of workers to adapt continuously and learn new skills within a variety of contexts. Main barrier to companies adapting is:

1. Lack of understanding of disrupting changes,
2. Little or no alignment between workforce strategies & firms innovation strategies,
3. Resource constraints and short-term profitability pressures

Organizations need:

1. a new mindset to meet talent needs & mitigate undesirable societal outcomes.
2. to address mismatch between marginal actions taken to mitigate magnitude of change coming.

Impact on Developing Economies

4IR will affect developing countries, even those that have not caught up to the previous 3 industrial revolutions.

Q: Does 4IR risk (1) widening the gap that was shrinking developed and developing countries or (2) hastening leapfrogging?

Ensuring developing countries are not left behind is a critical goal to ensure global stability.

If due to 4IR, low-cost labor pathways close to developing countries then leveraging 4IR opportunities are critical that people are secure in the belief that they can engage in meaningful work to support themselves and their families…

Q: what happens if there is insufficient demand for labor, or if skills available no longer match the demand?

3.1.3 The Nature of Work

A series of transactions between a worker and a company, rather than an enduring relationship, is accelerated by technological innovations.

Employers are using the 'human cloud' to get things done – the on demand economy is creating a virtual world of workers located anywhere in the world, who are no longer traditional workers but independent workers who perform specific tasks (i.e., you work as an Uber driver, an AirBNB host, etc…).

This model frees up companies from minimum wage, employer taxes, social benefits, etc.

For those in the 'human cloud' the advantages are freedom to work or not and mobility to work in a global network – offering lots of freedom, less stress, and greater job satisfaction.

Q: will the development of the 'human cloud' accelerate automation of human jobs?

The challenge is to come up with suitable new employment contracts and prohibit increasing isolation, fragmentation, and exclusion.

The importance of purpose

People want to feel as though they are part of something bigger than themselves. With combination of increased complexity and hyper-specialization, purpose is becoming a major issue, especially among younger generations.

Q: will such harmonious work-life balance be fulfilled by a small minority?

3.2 BUSINESS

4IR technologies impact are changing the speed and scale of how companies are led, organized, and resourced. Symptomatically, lifespans of companies have shrunk from 60 years to 18 and new entrants are dominating markets in less than 10 years compared to decades.

Successful 4IR business leaders will continually learn, adapt, and challenge their conceptual and operating models of success as the deluge of information, the velocity of disruption, and the acceleration of innovation become harder to comprehend or anticipate. It is critical that businesses understand its ability to operate with speed and agility.

Q: is there evidence of leadership and organizational capacity to learn and change?

Q: is there a track record of prototyping and investment decision-making at a fast pace?

Q: does the corporate culture accept innovation and failure?

Sources of disruption

Introduction of new technology is creating new ways to serve existing needs while disrupting existing value trains.

Innovative competitors can disrupt well established incumbents faster by improving quality, speed, and price.

Large incumbents can disrupt traditional industries boundaries by leveraging customer bases, infrastructure, and technology.

Increasing transparency, consumer engagement, and new patterns of consumer behavior (based on access to mobile and data networks) is forcing companies to adapt how they design, market, and deliver new products & services.

Business leaders & executives must understand disruption effects of demand & supply sides of their business, compelling them to challenge the assumptions of their operating teams and find news ways of doing things – they must continuously innovate.

Four Major Impacts

1. customer expectations are shifting
2. products are being enhanced by data
3. new partnerships are being formed by new forms of collaboration
4. operating models are being transformed into digital models

3.2.1 Customer Expectations

At heart of 4IR, is the individual and business CUSTOMER and how they are served and what they experience.

Traditional segmentation is shifting from demographic focus to customer willingness to share their data – especially important related to shift in ownership to shared access model.

Customer focus will be tested by (1) access to data/analytics, (2) refining products & experiences, (3) resulting in new models targeting & customer service. Transparency in real time is empowering customers while forcing companies to continually adjust and refine themselves and their products.

'Millennials' are setting consumer trends – on demand world, a world about the 'now', is centered on peer2peer and user generated content. The 'now' world is forcing companies to respond in real-time.

This new model is not merely confined to high-income economies due to mobile technology.

3.2.2 Data-Enhanced Products

Data & Technology are changing asset depreciation models (i.e., tesla live updates to car – improving value).

New materials are more durable & resilient and data & analytics are changing role of maintenance…sensors allow constant monitoring which in turn allows for proactive maintenance (i.e. air traffic control can know before a pilot when a performance benchmarks are outside the norm, instruct the pilot, and have maintenance crews standing by.)

Predicting performance of an asset enables new business models and new opportunities to price services with end goal of increasing uptime & utilization.

3.2.3 Collaborative Innovation

Customer experience, data based services, and asset performance requires new forms of collaboration. Incumbent business and young dynamic firms are equally affected. Incumbents lack specific skills & lower sensitivity to customer needs, while young lack capital and mature data generation.

Q: should incumbent and young collaborate to capitalize on maturity & innovation and think about how offline & online worlds work together in practice?

3.2.4 New Operating Models

Hallmark of 4IR is the appearance of global platforms connected to the physical world – which is both profitable and disruptive.

This is causing companies to shift from selling products to delivering services. Increasing numbers of consumers no longer purchase and own objects – instead pay for a service received from a platform (i.e., books, music, movies, cars, lodging, etc.)

This model challenges notion of ownership.

As a result, businesses will need to invest heavily in cyber- and -data security.

One of the most important drivers of competitiveness is 'talentism' will drive the need to develop flexible hierarchies, attracting and retaining talent, and measuring and rewarding success.

Companies will shift from hierarchies to networked & collaborative models. Motivating will intrinsic – driven by collaborative desire of employees & mgmt. for mastery, independence, and meaning.

Companies will organize around distributed teams, remote workers, and dynamic collectives, who continuously exchange data & insights about things or tasks being worked on. One indicator of this trend is wearable technology combined with Internet of Things.

It will important for humans and their skills to keep pace with cloud-based software updates & refreshed data assets through the cloud.

Combining the digital, physical, and biological worlds

Ability to combine D-P-B worlds enables disruption of entire industries and related production, distribution, and consumption systems

Combination business models disruption occurs because digital assets plus digital platforms reorganize physical assets…(shift from ownership to access). The competitive advantage occurs with a superior experience and reduced transaction & friction costs.

This erodes position of incumbents and dismantles boundaries between industries. Once trust & confidence in the platform is established it is easy for the digital provider to offer other products and services. Amazon is a perfect example – from bookseller to retail conglomerate. Google entering the car market demonstrates tech company can transform into car company.

Finance Blockchain will reduce settlement and transaction costs. The development of diagnostic and therapy with push to digitize patient records and capitalize on data gathered from wearable & implantable devices is challenging the healthcare industry.

Large & small businesses & corporations will face continuous 'darwinian' pressures to 'always evolve' through speed, agility, and adaptability to disruption & innovation. Large corps will absorb smaller for self preservation and sustainability.

Regulatory & legislative ecosystems will shape investment & adoption, while facing challenges from widespread unemployment, increased inequality, automated weapons systems, and cyber risks.

Box B: Environmental Renewal and Preservation

Resource use & efficiency depends on convergence of P-D-B worlds – which accelerates the transition to the 'Circular Economy', produces less impact on natural world, and potentially restores & regenerates the natural environment through technologies and intelligent systems design.

Requires a shift from the linear 'take-make-dispose' model to new model where flows of materials, energy, labor, and information interact and promote restorative, regenerative, & productive economic systems.

4 pathways to reach this goal:

1. track materials & energy flows to achieve huge efficiencies the entire value chain
2. democratize information & transparency so that citizens can hold companies & governments accountable. (i.e. hold landowners accountable to deforestation)
3. information flows & increasing transparency can shift citizen behavior on LARGE SCALES – path of least resistance towards business & social norms needed for a sustainable CIRCULAR ECONOMY system.
4. New business & organizational models promise innovative ways of creating & sharing value – leading to natural world benefits…

4IR will:

(A) enable firms to (1) extend the use-cycle of assets & resources, (2) increase utilization, (3) create cascades that recover & repurpose materials & energy for further uses, (4) lowering emissions & resource loads along the process and

(B) help companies, governments, and citizens (1) become aware of and engaged with strategies to actively regenerate natural capital, (2) allow for intelligent & regenerative uses of natural capital to guide sustainable production & consumption, and (3) give space for biodiversity to recover in threatened areas

3.3 NATIONAL & GLOBAL

4IR disruption changes compel (1) Local, Regional, and National (*note: not Local, State, & National*) governments to reinvent themselves and find new ways of collaborating with citizens & private sector and (2) how countries & governments relate to each other.

Q: what 4IR role should governments assume as traditional perceptions of politicians and their role in societies change?

At a time when governments should be partnering in shaping the 4IR transition to new scientific, economic, technological, and social frameworks, growing citizen empowerment with greater fragmentation & polarization of populations will make governing and government less effective and more difficult.

3.3.1 Governments

Using digital technologies to govern will help public administrations modernize structures & functions (boundaries & controls). Power is shifting from state to non-state actors and established institutions to loose networks.

Influence will be exercised in ways inconceivable just a few years ago. Policymakers are finding it harder to govern and effect change – facing multiple power centers simultaneously (i.e., transnational, provincial, local, and individuals).

Digital age has circumvented many boundaries formerly used to protect public authorities.

Key point is: Technology will enable citizens with (1) new ways to voice their opinions, (2) coordinate their efforts, (3) possible circumvention of government supervision. However, the opposite may be true – new surveillance technologies possibly giving rise to super powerful authorities.

Government survival will depend on its ability to adapt. Embracing exponential disruptive change and subjecting structure (boundaries) to transparency & efficiency will support competitive advantage. Doing so, will transform government into leaner, efficient power cells – within an environment of new & competing power structures.

Governments will be forced to change approach to (1) creation, (2) revision, and (3) enforcement of regulations. Previously, decision makers had enough time to study a specific issue and create response or regulatory framework – this is no longer possible.

Agile governance means regulators must find ways to adapt continuously to new, fast changing environments by reinventing themselves to understand better what is being regulated. This will necessitate closer collaboration with businesses & civil society to shape Global, Regional, and Local transformations (note: not Nation, State, County)

4IR requires a regulatory and legislative ecosystem that produces more resilient frameworks (boundaries & controls – structures).

Governments need to create rules, checks and balances to maintain justice, competitiveness, fairness, inclusive intellectual property, safety, and reliability.

Governments must blend two approaches: (1) everything not forbidden is allowed and (2) everything not explicitly allowed is forbidden. Governments must let innovation flourish while minimizing risks.

Achieving this requires engaging citizens more effectively and conduct policy experiments that allow for learning and adaptation.

Governments & Citizens must RETHINK how they interact with each other and what their roles are, while allowing for failure and missteps along the way.

Box C: Agile Governance Principles in an Age of Disruption

Job Market

Traditional concepts of work & pay are severely disrupted by Digital technologies & Global communication.

On-Demand economy makes new types of jobs extremely flexible & inherently transient. Simultaneously raising concerns about reduced protection within on-demand economy (i.e., worker is contractor without benefits from job security & longevity).

Money & Taxation

On-Demand economy raises concerns with tax collection – as workers operate in the black market. Decentralized payment systems make it harder for public & private authorities to trace origin & destination of transactions.

Liability & Protection

Government issued monopolies (i.e., taxi, medical, professional licensure, etc.) are being disrupted by technological advancements allowing people to engage in peer2peer and novel intermediaries coordinating peers & facilitating interactions.

Security & Privacy

Data rights & protection are heavily fragmented. User profiling through big data analysis & inference techniques opening pathways to new, customizable & personalized services. This raises concerns for user privacy & individual autonomy. The balance between surveillance and freedom is rapidly tipping towards monitoring…

Availability & Inclusion

Moving towards a Globally connected information society, necessitates reliable internet infrastructure to optimize internal operations and widespread deployment. Digital exclusion (Digital Divide) becomes pressing, as it is increasingly more difficult for people to participate in the digital economy & new forms of civic engagement without internet access or access to a connected device or sufficient knowledge to use the device.

Power Asymmetries

Asymmetries of information may lead to asymmetries of power. Whoever has the knowledge to operate the technology also has the power to do so. Entities with root access are nearly omnipotent. Inequalities will emerge between the tech-savvy and less knowledgeable.

3.3.2 Countries, Regions, and Cities (not Nations, States, and Counties)

Digital technologies no know borders (boundaries).

Q: What will define Countries, Regions, and Cities roles in the 4IR?

Q: will we see bettering or fragmentation of societies?

Q: will those who can afford goods & services, where low-skill/low-pay workers are replaced by automation, congregate in countries with strong institutions & proven quality of life?

Innovation Enabling Regulation

Countries that succeed in establishing (i.e., 5G comms, commercial drones, internet of things, digital health, advanced manufacturing, etc.) will reap considerable economic & financial benefits, versus countries that do not, who will become isolated from global norms, risking becoming laggards in the digital economy.

Legislation & compliance will play the determining role in shaping ecosystems that disruptive companies operate. This reinforces the importance of innovation ecosystems as key driver of competitiveness.

Key question will be whether an economy can innovate – not whether low or high cost or emerging v mature markets.

Further reinforced by North America remaining at cutting edge of (1) tech-fueled innovation in energy production, (2) advanced &digital manufacturing, (3) life sciences, and (4) information technology.

Other parts of the world are catching up however (i.e., China). Policy choices will ultimately determine whether a country or region can capitalize fully on the technology revolution.

Regions and Cities as hubs of innovation

Historically, Cities are the engines of economic growth, prosperity, and social progress and are essential to future competitiveness of Countries & Regions. Today, more than half of the world's population live in urban areas – and is rising.

Competitiveness of Countries & Regions – innovation, education, infrastructure, and public administration are under the purview of the City (not the County).

Ability of Cities to deploy technology, supported by policy frameworks, making it more efficient & livable, will determine ability to attract talent.

Closing the 'data deficit' gaps: (1) existence, (2) access, (3) governance, (4) usability will enhance abilities to track outbreaks of infectious diseases, better response to natural disasters, enhance the poor's access to public & financial services, understanding migration patterns of vulnerable populations.

Countries, Regions, & Cities can invest in launchpads for digital transformation – encouraging entrepreneurs & investors in innovation start-ups while ensuring established businesses orient with 4IR opportunities.

Doing so, will empower cities to become sites of experimentation & powerful hubs for turning new ideas into real value for local & global economies.

Cities that act like entrepreneurs rather than bureaucrats, are open by default, and find creative ways to effect change outside formal policy environments are "best in class."

4IR is driven by global network of smart cities, regions, and countries, who understand & leverage top down/bottom up opportunities.

Box D: Urban Innovations

Digitally reprogrammable space

Cities would get more from less by shifting building purpose and minimizing urban footprint

Waternet

Sensors in water pipes monitoring flows leading to sustainable water for human & ecological needs

Adopting a tree through social networks

Increasing Cities green area by 10% would compensate for temperature increases caused by climate change. Tree canopies & root systems can reduce storm water flows & balance nutrient loads.

Next Generation mobility

Sensors, optics, & embedded processors, etc. will lead to GREATER adoption of public transportation, reduced congestion & pollution, and better health & commutes.

Co-generation, co-heating, and co-cooling

Using heat to warm or cool through tri-generation systems

Mobility on-demand

Leveraging unused vehicle capacity through dynamic optimization algorithms

Intelligent Street poles

Next-gen LED street lights host sensing technology that collects data on weather, pollution, seismic activity, movement of traffic & people, and noise & air pollution. Linking these into a network it is possible, in real time, to understand what is happening across an entire city & provide public safety or identify where free parking spaces are located.

3.3.3 International Security

4IR will profoundly affect state relations & international security – topics not sufficiently discussed in the public domain & in sectors outside governments & defense industries.

Conditions for VIOLENT EXTREMISM, such as (1) increasing fragmentation, (2) segregation, & (3) social unrest may be fueled by a hyper-connected world of rising inequality.

The prospect of establishing a 'common platform' for collaboration around 'key international security challenges' is hampered by the rise of armed 'non-state actors.'

Connectivity, fragmentation, and social unrest

Widening social exclusion, searching for meaning in the modern world, & disenchantment with 'established elites & structures' motivates EXTREMIST movements & enables them to recruit for a VIOLENT struggle against existing systems. Decreasing fragmentation requires hyper-connectivity that leads to common ground based on greater acceptance and understanding of differences – bringing communities closer together.

Box E: Mobility & the 4IR

Q: how will human mobility affect 4IR?

Realizing Life Aspirations

Amongst young people, mobility is seen as a life choice to be exercised at some point.

Redefining Individual Identities

Identities are becoming fungible – people are much more comfortable with carrying & managing multiple identities rather than with a place, group, or culture/language.

Redefining Family Identities

Traditional family is being replaced by transnational family network, reinforced by low-cost digital means and migration patterns.

Remapping Labor Markets

Worker mobility versus talent mobility, if not managed effectively may produce wage distortions & social unrest in developed countries and deprive origin countries of valuable human capital.

The changing nature of conflicts

4IR will affect character & scale of conflict – distinctions between war & peace and who is or is not a combatant are becoming uncomfortably blurred.

Battlefields are becoming both local & global. Modern conflicts are hybrid in nature – combining traditional battlefield techniques with elements of armed non-state actors (i.e., militia?).

4IR offers individuals increasingly diverse ways to harm others on a grand scale. On the other hand, 4IR brings greater possibilities of precision in warfare, combat protection gear, capacity to print parts/components on the battlefield, etc.

Cyber Warfare

Cyber warfare presents the most serious threat – as serious a threat as air, land, or sea – threat to sensors, communications, and decision-making.

This type of threat blurs the lines between war & peace – one may not know who is attacking or whether you have been attacked at all. (i.e., shadow-banned, algorithm slow down, etc.)

The aggressor can come in indefinite forms and numbers – from criminal acts, espionage, other destructive attacks, as well as, underestimated & misunderstood attacks (i.e., Stuxnet, etc.)

Discussions about this type of warfare are in their infancy and the gap is widening between those who understand cyber warfare and those who are developing cyber warfare policies. Part of managing this is to define what data travels across borders.

Autonomous warfare

Deployment of military robots & AI powered automated weaponry will be transformative in future conflicts. Seabed & Space are likely to become militarized. Use of off shelf drones to spy on & track rivals. Autonomous weapons firing without human-intervention challenges the laws of war.

Box F: Emerging Technologies Transforming International Security

Drones

Flying robots – US leads, however, becoming more affordable

Autonomous weapons

Combining drone & AI has potential to select/engage targets without human interaction

Militarization of space

50% of satellites are commercial – increasingly important for military use. Space will play a crucial role in future conflicts – current regulation mechanisms are insufficient.

Wearable devices

Optimizes health/performance under extreme stress. Exoskeletons enhances performance – allowing soldiers to carry 90KG easily.

Additive Manufacturing

Revolutionizes supply chain – battlefield manufacturing with digital designs using local resources. Enables development of new kinds of warheads – greater control of particle size & detonation.

Renewable Energy

Revolutionizes supply chain – battlefield power enables capacity to print parts in remote places.

Nanotechnology

Leads to 'metamaterials' (smart materials) possessing properties that do not occur naturally – making weaponry better, lighter, more mobile, smarter/precise, systems that self-replicate & assemble.

Biological Weapons

Biotechnology, genetics, and genomics are a harbinger of new highly lethal weapons – designer viruses, engineered superbugs, genetically modified plagues – form basis for doomsday scenarios.

Biochemical Weapons

Assembly is easy as do-it-yourself task – drones could be employed to deliver.

Social Media

Digital channels can be used to spread both information & organizing action for good and to spread malicious content & propaganda – Young adults are especially vulnerable if lacking stable social support networks.

New frontiers in Global Security

For each innovation there is a positive & negative side. E.g., brain devices implanted to treat Alzheimers could also be implanted into soldiers to erase or create new memories. "The brain is the next battlespace."

Current trends suggest rapid & massive democratization of these innovations – previously limited to governments and very sophisticated organizations. Hence, existing legal & ethical frameworks are highly challenged.

Toward a more secure world

Q: how do we persuade people to take the security threats from these challenges seriously – can cooperation between public & private sectors on a global scale to mitigate these threats?

A proliferation of potentially lethal actors could undermine equilibrium compared to the limited few nuclear powers that were contained through Mutually Assured Destruction – LOYAL OPPOSITION DOCTRINE. This doctrine is less relevant when destructive capacity is not limited to a few…

4IR actors with very different perspectives & interests need to be able to find some kind of modus vivendi & cooperate in order to avoid negative proliferation. Stakeholders must cooperate & create legally binding frameworks and self-imposed peer-based norms, ethical standards, and mechanisms to control damaging emerging technologies – without impeding on innovations & economic growth.

Regulators will find themselves significantly behind the speed & scope of change – hence, educators & developers need to shape ethical standards & embed them into society & culture. With governments & government-based structures lagging it may be up to private sector and non-state actors to take the lead.

However, gene-based medicine & research should not become isolated from public discussion, understanding, and management.

3.4 SOCIETY

Science, commercialization, & diffusion of innovation unfold as humans exchange meaning with each other…making it hard to discern technological impact on society.

The challenge is how to embrace both (new) modernity & traditional (old) value systems. 4IR tests fundamental assumptions, exacerbating tension between religious & secular worldviews. Greatest threat to Global Cooperation & Stability will come from radical groups fighting progress with extreme ideologically motivated violence…

People, companies, and institutions, feeling depth of technological change and overwhelmed by it, should avoid being overwhelmed by ignorance.

4IR will impact society on numerous fronts – including, rising inequality pressures middle class & integration of digital media changes how communities form & relate to each other.

3.4.1 Inequality & the Middle Class

4IR contributes to rising inequality – (1) robots & algorithms substitute capital for labor & (2) building business in digital economy is less capital intensive.

Labor markets are biased towards limited technological skill sets & globally connected digital platforms & marketplaces are rewarding a small number of "stars". Winners will those who provide new ideas, business models, products, & services RATHER THAN those who offer low-skilled labor or ordinary capital.

The world is unequal – 1% of population control 50% of the assets while lower half of world population owns less than 1% of global wealth.

Unequal societies experience more violence, higher imprisonment, mental illness & obesity, segregation, and lower life expectancies, trust, and educational outcomes.

Higher connectivity & expectations creates significant social risks when populations feel they have no chance of attaining prosperity or meaning.

A modern middle-class job does not guarantee a middle class lifestyle (education, health, pensions, & house ownership).

3.4.2 Community

Digitization enhances a 'me' centered society - belonging to a community today is centered on 'personal projects' and 'individual values' rather than the local community, work, and family.

4IR digital media (1) drives individual & collective views of society & community, (2) connects people across time & distance, creating new friendships, interest groups, and like-minded individuals, (3) enables interaction across social, economic, cultural, political, religious, and ideological boundaries, and (4) gives individuals a voice in civic debate & decision-making.

4IR can also disempower citizens.

Non-state actors, with harmful intentions to spread propaganda and mobilize followers for extremist causes, can use 'democratic power' of digital media.

What we read, share, and see on social media shapes our political & civic decisions, which poses a risk to CIVIL SOCIETY.

Box G: The Disempowered Citizen

Citizens empowered by technology find it easier to (1) gather information, communicate, and organize and (2) participate in civic life.

Citizens disempowered by technology find themselves (1) increasingly excluded from meaningful participation in traditional decision-making, such as voting & elections and (2) decreasingly able to influence & be heard by the dominant institutions & sources of power in national & regional governments.

Very real danger is governments employ combinations of technologies to suppress or oppress actions of civil society organizations & groups of individuals who seek to create transparency & change in government & business activities.

4IR tools enable new forms of surveillance & other means of control, shrinking the space for civil society and their restricting independence and activities.

Digital media platforms markedly influence offline behavior and open opportunities to blend traditional forms of civil engagement with more direct influence over decisions affecting their communities.

Critical to gather more and better data on both benefits and challenges to community cohesion.

3.5 THE INDIVIDUAL

4IR doesn't merely change what we do, but **WHO WE ARE** (i.e., our identity, notions of ownership, consumption patterns, time devoted to work & leisure, how we develop careers, cultivate skills, how we meet people, nurture relationships, hierarchies we depend on, our health, forms of human augmentation – causing us to question the very nature of our human existence)

Humans will need to adapt continuously due to radical systemic change – may result in increasing degrees of polarization between those who embrace change & those who do not. Inequality will separate those who adapt and those who do not.

Winners will benefit from human improvement generated by 4IR genetic engineering versus losers who will be deprived.

Risks are class conflicts & other clashes. Generational divide will exacerbate ethical issues such as, self-reflection, empathy, and compassion.

3.5.1 Identity, Morality, and Ethics

4IR are redefining what it means to be human – pushing thresholds of life span, health, cognition, and capabilities beyond what used to science fiction.

Having moral & ethical discussions are critical. We have to think individually & collectively about how humans respond to issues such as life extension, designer babies, memory extraction, and many more.

4IR innovations can be manipulated to server special interests rather than public good – for example, short-term impact of AI depends on who controls versus can it be controlled at all.

Q: what can we do to reap benefits & avoid the risks?

4IR impacts empowering potential catalyzed by fusion of new technologies.

The impact of AI or synthetic biology is harder to grasp compared to internet & smartphones and poses the greatest ethical & spiritual questions we face as humans beings.

Box H: On the Ethical Edge

Technological advances are pushing humanity into new ethical frontiers.

Q: should we only cure disease & repair injury or should we focus on making ourselves better humans (heal the sick versus upgrade the healthy). Accepting the latter may lead to PARENTHOOD becoming a consumer society – where children become 'made-to-order' objects (i.e., live longer, smarter, run faster, certain appearance, etc.).

A. Q: what happens if AI thinks ahead of us or out-thinks us? Do we trust the advice of an algorithm or that offered by family, friends, or colleagues? Would we consult AI, with near 100% diagnosis rate, or our human physician?

B. Predictive power of AI & Machine Learning will figure out human behavior – how will that affect personal freedom & will human behavior become robotic? How do we maintain our individuality, the source of diversity & democracy in the digital age?

3.5.2 Human Connection

Due to 4IR, the need for human touch, nurtured by relationships & social connections may negatively affect social skills & ability to empathize. Empathy among young people is declining rapidly as a result of not 'unplugging' – while playing sports or eating with family.

Face2face conversations are crowded by online interactions. Young people are struggling to listen, make eye contact or read body language.

Connection to mobile technology deprives humans of one our most important assets: the time to pause, reflect & engage in substantive conversations that are not aided by technology or intermediated by social media…the mere presence of a phone on the table between two people or in their peripheral vision changes both what they talk about & their degree of connectedness.

The more time is spent immersed in digital world – the shallower our cognitive abilities become due to giving up control of our attention span. The digital world is geared towards dividing up attention – frequent interruptions scatter our thoughts, weaken our memory, and make us tense & anxious. The more complex the train of thought the greater the impairment the distraction causes.

Wealth of information causes a poverty of attention.

> **In this age of acceleration – nothing is more exhilarating than going slow.**
>
> **In this age of distraction – nothing is more luxurious as paying attention.**
>
> **In the age of constant movement – nothing is so urgent as sitting still.**

Digital instruments risk putting humans in a perpetual motion machine of unremitting frenzy.

3.5.3 Managing Public & Private information

Privacy is one of the biggest concerns of 4IR. Humans are willing to trade privacy for convenience. Global debate about meaning of privacy in world of transparency that promotes both liberation & democracy VERSUS enabled unfathomable mass surveillance.

Q: why does privacy matter so much? When individuals are watched their behavior changes. The debate over loss of our personal data will only intensify in the years to come.

Box I: Wellness & the Bounds of Privacy

Insurance companies are considering making wearable devices as part of their coverage. If one wears the WD, you will receive a discount.

Q: should we welcome this because it encourages healthier living or resist this because of the mass surveillance – from government to companies alike?

Q: what if an employer requires the wearing of the device as a term of employment? What was an individual's choice now becomes a social norm that non-conformance may be deemed socially unacceptable.

When one's life becomes fully transparent and when indiscretions big or small become knowable to all, who will have the courage to assume top leadership responsibilities?

4IR requires each of us to ensure that we, as humans, are served and not enslaved by technology. Collectively, we need to ensure that the technology challenges are fully understood and analyzed. Only in this can we ensure 4IR enhances, rather than damages, our well being.

The Way Forward

4IR drives disruptions, but challenges are of our own doing. It is up to humanity to address those disruptions & challenges by enacting changes & policies needed to flourish & adapt within this emerging environment.

By nurturing & applying the following 4 intelligences humans can adapt, shape, & harness disruptions & challenges:

1. Contextual (mind) – how we understand & apply our knowledge.
2. Emotional (the heart) – how we process & integrate thoughts & feelings and how we relate to ourselves & others.
3. Inspired (the soul) – how we use sense of individual or collective purpose, trust, and other virtues to effect change – acting for the common good.
4. Physical (body) – how we cultivate & maintain our personal health & well-being and that of those around us in order to apply energy required for both individual and systems transformation.

Contextual Intelligence – the mind

To survive in 4IR, one must have a sense of context – the ability & willingness to anticipate emerging trends & connect the dots.

To develop CI – one must understand the value of diverse networks. Confronting significant levels of disruption requires being highly connected & well networked across traditional boundaries. Leaders must possess a capacity & readiness to engage with all those who have a stake in the 4IR.

Obtaining a holistic understanding of 4IR requires working together with business, government, civil society, faith, academia, and youth.

Boundaries are artificial and increasingly counter-productive – dissolve these boundaries by engaging the power of networks to forge partnerships. Entities that fail to do this will fail to adjust to the disruptions of the digital age.

Leaders must change their mental & conceptual frameworks, and their organizing principles. Thinking in silos and having a fixed view of the future is fossilizing.

Leaders approach to disruptions & challenges must be holistic, flexible, and adaptive, continuously integrating many diverse interests & opinions.

Emotional Intelligence – the heart

EI complements and does not replace contextual intelligence, and allows leaders to be more innovative & agents of change. Self-awareness, self-regulation, motivation, empathy, and social skills are critical 4IR skills for leaders. The "digital mindset," institutionalizing cross-functional collaboration, flattening hierarchies, building environments that foster a generation of new ideas, is highly dependent on EI.

Inspired intelligence – the soul

II is the continuous search for meaning & purpose, focusing on nourishing the creative impulse and **lifting humanity to a new collective & moral consciousness based on share sense of destiny**.

Critical that humanity develop a shared sense of destiny & purpose if we are to navigate the benefits and challenges of the 4IR.

Collaborative innovation is the core of 4IR which requires trust. Ultimately, all stakeholders have a role in ensuring innovation leads to common good. Trust, in the 4IR, becomes the most valuable attribute. Trust can only be earned & maintained if decision-makers are embedded within a community, and making decisions always in the common interest and not in pursuit of individual interests.

Physical Intelligence – the body

PI involves supporting & nourishing personal health & well-being. The need to keep fit & remain calm under pressure is critical as the pace of change accelerates, as complexity increases, and as the number of players involved in our decision-making process increases.

The importance of sleep, nutrition, and exercise (Epigenetics – where genes can be turned on or off due to environment) influences how we think & feel, work, and our ability to succeed. Leaders require 'good nerves' to navigate the challenges & harness the opportunities of the 4IR.

Toward a New Cultural Renaissance

The Human Age, the Anthropocene, marks the first time in history of the world that human societies are the primary force in shaping all life-sustaining systems on earth.

Humans find themselves at the start of the 4IR – possessing the ability to alter its path. Knowing what is required to thrive is one thing – acting on it is a completely different thing. We should not be naïve to think we fully understand 4IR – but to be paralyzed with fear & uncertainty is unacceptable. The 4IR pathway will be determined by humanity's ability to shape it in a way that unleashes its full potential.

The challenges are as daunting as the opportunities are compelling. Humanity must work together to transform the challenges into opportunities by preparing for its impacts & effects.

First and vital step.

Raise awareness and drive understanding across all sectors of society. Stop thinking in compartmentalized ways when making decisions, particularly as challenges are increasingly interconnected. Collaborative & flexible structures, taking an inclusive approach, an account of all stakeholders, bringing together both public and private sectors, and the most knowledgeable minds in the world will engender the understanding required to address the many issues raised by 4IR.

Second.

Building on shared understanding develop positive, common, and comprehensive narratives about how humanity shapes the 4IR, including (1) making explicit the values & ethical principles that our future systems must employ, (2) evolving progressively higher degrees of perspective taking, from tolerance and respect to care and compassion, and (3) empowering and inclusive, driven by shared values that encourage this.

Third.

On the basis of share narratives & raised awareness, humanity must embark on restructuring our economic, social, and political systems to take full advantage of 4IR. The first 3 Industrial Revolution systems are no longer equipped to deliver on the current and future generational needs in the context of 4IR. This will require systemic innovation & not small scale adjustments or reforms at the margin.

Humanity cannot get there without ongoing cooperation & dialogue at the local, national, and supra-national levels – with all interested parties having a voice. As evolutionist Martin Nowak said "cooperation is the only thing that will redeem mankind."

The principle architect of 4 billion years of evolution, COOPERATION has been the driving force because it enables us to adapt amid increasing complexity & strengthens political, economic, and social cohesion through which substantial progress is made.

With multi-stakeholder cooperation, humanity can, through the 4IR, address the major challenges the world faces. We (?) must ensure that all people understand the need to master the 4IR & its civilizational challenges. Remind ourselves (?) to put people first and that these technologies are tools made by people for people.

Let us (?) take collective responsibility for a future where innovation & technology are centered on humanity, the need to serve the public interest, and drive us all toward more sustainable development.

The new technology age could catalyze a new cultural renaissance, enabling us to feel part of something much larger than ourselves – a true GLOBAL CIVILIZATION.

CONCLUSION:

4IR had the potential to robotize humanity and compromise our traditional sources of meaning – work, community, family, identity.

OR

…we can use the 4IR to lift humanity into a new collective & moral consciousness based on a shared sense of destiny – it is up to humanity to ensure the latter is what happens…