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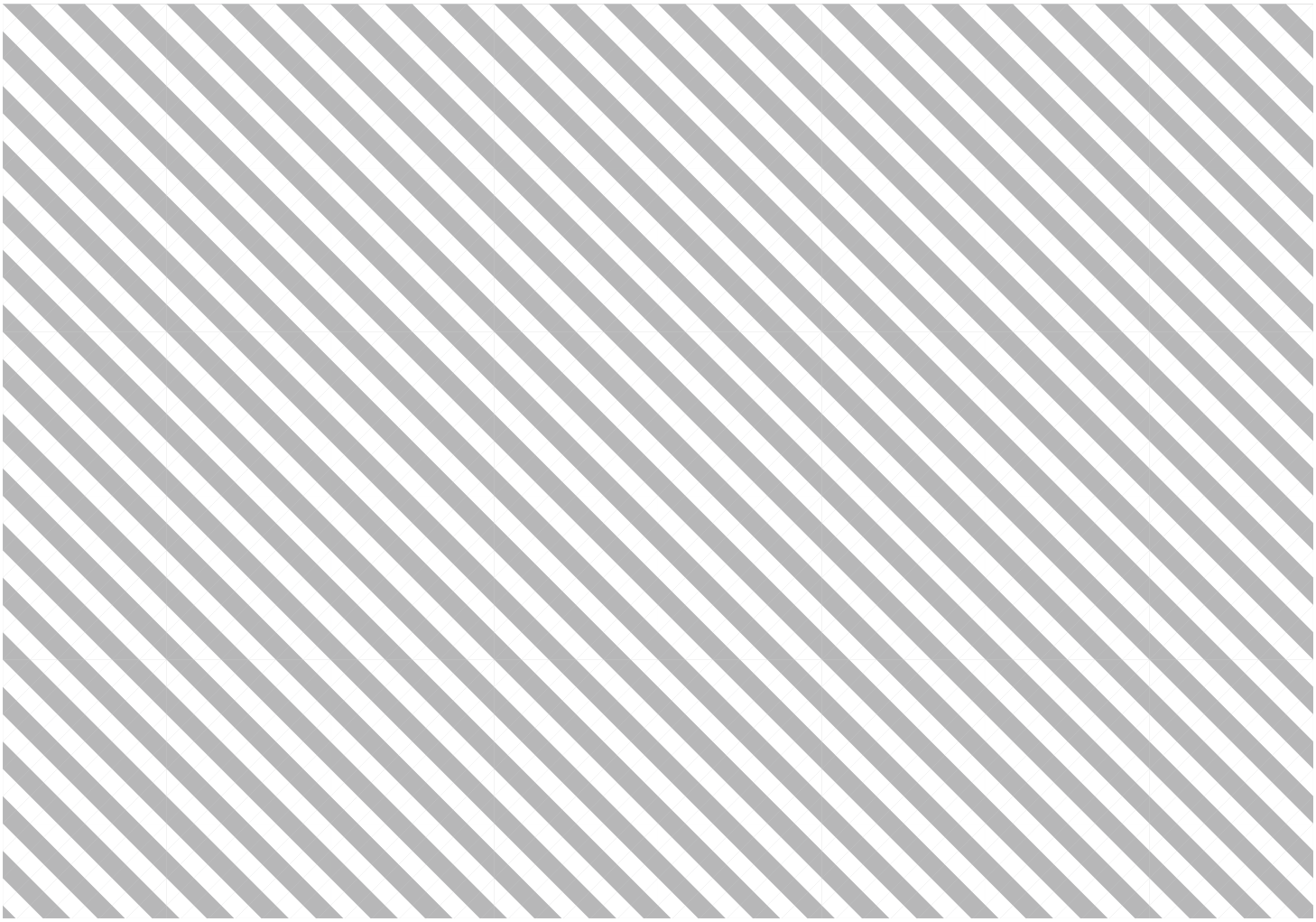
White Paper

Values, Ethics and Innovation

Rethinking Technological Development in the Fourth Industrial Revolution

August 2018



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Introduction

Technologies enable us to live longer, healthier, more fulfilling lives. Since the first Industrial Revolution in particular, the development, commercialization and diffusion of new technologies have vastly expanded opportunities for people around the world. They have also generated riches, both quantitative and qualitative, for industries and societies, increasing the real average global wage by at least 2900% since the 1700s.[1]

The technologies emerging today promise further value, both economic and social. For example, artificial intelligence alone could generate between $3 trillion and $5 trillion across nearly 20 industries,[2] and blockchain could help revolutionize humanitarian relief.[3]

Humankind, however, is only just beginning to realize how technologies of the Fourth Industrial Revolution are fundamentally challenging our ideas about the world and are able to bring about undesirable externalities. This goes beyond headline-grabbing concerns about robots taking jobs, cybersecurity disasters or existential threats from an artificial superintelligence. The fact is, technologies already widely deployed are slowly fracturing social cohesion, widening inequality and inexorably transforming everything, from global politics to personal identities.

No one fully foresaw or intended these outcomes. However, they make it harder to deny that the influence of these technologies on society reflects how they were developed and deployed. The recent debate about data collection on social media that exploits people's vulnerabilities exemplifies how technologies embody the values and interests of their makers and how this can impact us in potentially harmful ways.

As Mark Benioff, Chairman and Chief Executive Officer, Salesforce, USA, remarked at the World Economic Forum Annual Meeting 2018 last January, the task of regulation is to set true north. It is not just about what companies and governments create and do, it's about how they create and do it. The moral role of technologies that concerns the values and ethics of technological development must be addressed at this critical moment in history, and industry is asking for guidance.[4]

> **"The values and ethics of technological development must be addressed at this critical moment in history"**

Rethinking the processes of technological development is needed, asking first what long-term future is wanted, and then how to orient technological development towards achieving it. Technologies cannot decide for people what constitutes the good life. The United Nations 2030 Agenda for Sustainable Development represents a step in this direction. It recognizes that technologies will play a role in whether the Sustainable Development Goals are reached, and establishes a multistakeholder "Technology Facilitation Mechanism" to maximize the chances.[5]

The World Economic Forum is also pioneering a future-oriented agenda – one that promotes responsible development and the adoption of new technologies, and drives a higher quality of life with greater public participation in how technologies are employed – by taking seriously the roles of values and ethics in technological development.

Leaders from multiple sectors must now come together to guide the development and deployment of new technologies that will further values, such as environmental stewardship, the common good and human dignity. To fight growing inequality and resulting populism, greater awareness of technologies' impact on human rights is required, as well as their more inclusive integration into societies and economies.

This White Paper is part of the Forum project on Values, Ethics and Innovation. It expands on the call to action for values leadership in *Shaping the Fourth Industrial Revolution* (Klaus Schwab and Nicholas Davis, 2018). The first section of this paper argues that society and technology develop in tandem, with technologies shaping and embodying societal values, and calls for a human-centred approach to technological development. The second section identifies and describes the new tools, skills, partnerships and institutions required to achieve transformative innovation – namely, innovation that no longer widens the gap between the haves and have-nots, and that facilitates technological advance in line with social progress.

All stakeholder groups stand to benefit from this approach. Governments can re-establish trust in their governance of technologies by better aligning them with societal values. Industry leaders can hope to develop new markets, attract new investment and create more positive engagement with customers. Civil society can claim a role in shaping the preservation of rights and freedoms through the design of societally aligned technologies. And citizens will have greater potential for self-realization.

Technologies continue to be seen as part of the solution to many complex global challenges in the 21st century. They are also capable of taking society forward in an inclusive, sustainable and positive way, if the right approach to their development is taken. This is a pressing issue after 30 years of stagnating wages, with 80% of the reduction in labour's share of national income attributed to technologies.[6]

Technological and economic progress can no longer be assumed to be aligned with social progress, and data from many European countries and the United States, in particular, suggest material conditions have improved much more than the quality of life.[7] The human story over the next half century will turn largely on how well societies succeed in collectively defining their priorities, engaging essential questions about values and ethics, and aligning technological development accordingly.

Towards a human-centred approach

How people think about technologies matters. This is not simply because technologies are the primary contributor to economic growth worldwide. It's because technologies shape people, and people shape technologies. This relationship not only impacts research agendas, it also impacts investment flows, business models and the content of education systems.

The two most widely held views of technologies among current business leaders and senior policy makers fail to reflect the complexity of our relationship with these technologies.

The first widespread perspective approaches technologies as mere tools that are intrinsically and unquestionably aligned with greater opportunity. The second prevalent view regards history as driven by technological progress, with people powerless to shape its direction: in this view, technologies are inevitable and out of human control. Neither of these views, though pervasive, is ideal nor fully accurate.

The lack of a more critical comprehension of technologies, and their moral role in society, reduces our ability to make informed decisions about the development and application of powerful new approaches, particularly with those technologies that blur the lines between human and technological capabilities, such as machine learning, biotechnologies, neurotechnologies, and virtual and augmented reality.

A more balanced and empowering perspective recognizes technologies as capabilities that interpret, transform and make meaning in the world around us. Rather than being simple objects or processes that are distinct from human beings, they are deeply socially constructed, culturally situated and reflective of societal values. They are how we engage with the world around us. They affect how people order their lives, interact with one another and see themselves. Far from an academic observation, this more nuanced view has practical importance for strategic needs as well as implications for successful governance of technologies.

> **"To build a just and equitable society, the process must start with people – with their logic, ideals, experience, empathy and collaboration"**

This perspective opens up space for critical reflection on the question of how societies should govern technologies that pose ethical challenges and may have undesirable influences on societal priorities. It also provides ground for conversations about technology and values trade-offs and their impact on business and society. Moreover, this view allows for a better examination of technologies at different levels – from broad technical architecture to integrated personal applications. Most critically, it acknowledges that taking up these challenges involves decisions about values and uncertain outcomes.

Part of the challenge is that the full impact of technologies is difficult to ascertain when they are still emerging. But when technologies are mature, embedded in social and economic infrastructure, those impacts are difficult to change.[8] This is known as the Collingridge dilemma. The United States has tended to respond to this dilemma by prioritizing innovation as a core value, thus delaying regulation and focusing on products and outcomes. In Europe, a precautionary approach focused on process has prevailed. A classic example here is the different approaches to genetically modified foods.[9]

Policy development routes that focus on process rather than outcomes have their advantages. Reflective, deliberative and participatory approaches can more effectively embed values and ethics in technological development. The EU General Data Protection Regulation, a recent example of policy developed with ethical challenges in mind, requires organizations to consider privacy from the initial design stages through to the end of the product development process.[10]

Focusing on processes as well as outcomes is increasingly needed as technologies such as artificial intelligence, geoengineering or gene editing have the potential to change the world profoundly and irrevocably. Waiting until they are fully developed and deployed to try to understand and shape their impact is simply not feasible. Institutions and organizations are currently underprepared to address the complex issues stemming from progress in these fields.

> **"The most widely held views of technologies fail to reflect the complexity of our relationship with them"**

As mentioned previously, industry is asking for guidance here. Among global business leaders, even in the technology sector, the question is not whether there should be regulation, but rather what type of regulation and accountability are most appropriate. During his Senate Testimony in April 2018, Mark Zuckerberg stated that "the real question, as the internet becomes more important in people's lives, is what is the right regulation, not whether or not there should be regulation."[11] Industry leaders, as well as legislators and civil society leaders, are rapidly appreciating that technologies are having an effect on societal values in ways that can be negative.

Making progress in governing technologies requires recognizing that technologies embody values. But it is not enough to simply acknowledge that the development and use of technology is inherently political, or that technologies come with built-in biases. As soft and hard forms of governance are created through policies and laws, individuals and organizations working with new technologies

must engage actively and thoughtfully with the values they embody and influence. To do this effectively, a human-centred approach to technological development is called for that recognizes the tension between seeking efficiencies and realizing human values.

A human-centred approach to technologies means never losing sight of one central question: How can technologies enable a meaningful future for humankind?

Neither technologies nor markets can answer this question on their own. People cannot realistically support products and services that align with their values if access to them is too inconvenient or too expensive. Instead, guidelines and policies that fold societal values into technologies during their development must be established, so people are not incentivized to choose products that ultimately work against the common good. If this basic tension in technological development is ignored, the chances of unnecessary social discord will be increased, as will its uncomfortable political consequences.

As philosopher of technology Peter-Paul Verbeek relates, "A real technocracy comes about when technologies implicitly answer the question of the good life for human beings."[12] To build a just and equitable society that is more interconnected and more inclusive, the process must start with people – with their logic, ideals, experience, empathy and collaboration.

Society – which is to say, all of us – must figure out how technology can empower, create meaningful opportunities, and enhance an individual's potential and agency.

A human-centred approach cultivates contextual and emotional intelligence to guide technological development based on values and ethics. It raises awareness of issues throughout the development process, supplies practical ways of addressing values-related and ethical challenges when they arise, and works to craft technologies towards positive ends for society. A human-centred approach means taking on a "co-development" mindset, paying attention to the process through which technologies and societies recursively influence and form each other.[13]

Taking on a human-centred approach involves adopting three complementary strategies: first, adopting a systems view of technologies; second, appreciating and shaping the moral role of technologies; and third, engaging with a wide variety of stakeholders.

A. Adopting a systems view of technologies

The concept of co-development can help frame how technologies and people act together to create new technologies. People develop technologies in environments that are simultaneously opened up and limited by how existing technologies have shaped societal, political and economic values. In turn, technologies now being developed will open up or limit the environment for creating future technologies by shaping society's vision, priorities, goals and objectives.[14]

Take the automobile, for example. At the turn of the 20th century, vehicles powered by steam, electric or internal combustion engines that could run on gasoline or biofuel all looked to be potential alternatives to horse-drawn vehicles. Gasoline-powered vehicles gradually reached socially transformative scale due to a wide system of aligned interests, visions, technological advances, investments, business models and political support.[15] As this system became entrenched, it directed and constrained choices, incentivizing technologists to focus efforts on improving gasoline engines rather than on innovating in steam- or electric-powered transport. This "lock-in" has long-lasting effects, and constrains problem solving as systems develop.

> **"Technologies inevitably embody the values of their creators, whether a small team of engineers or a large group of nations imagining a collective destiny"**

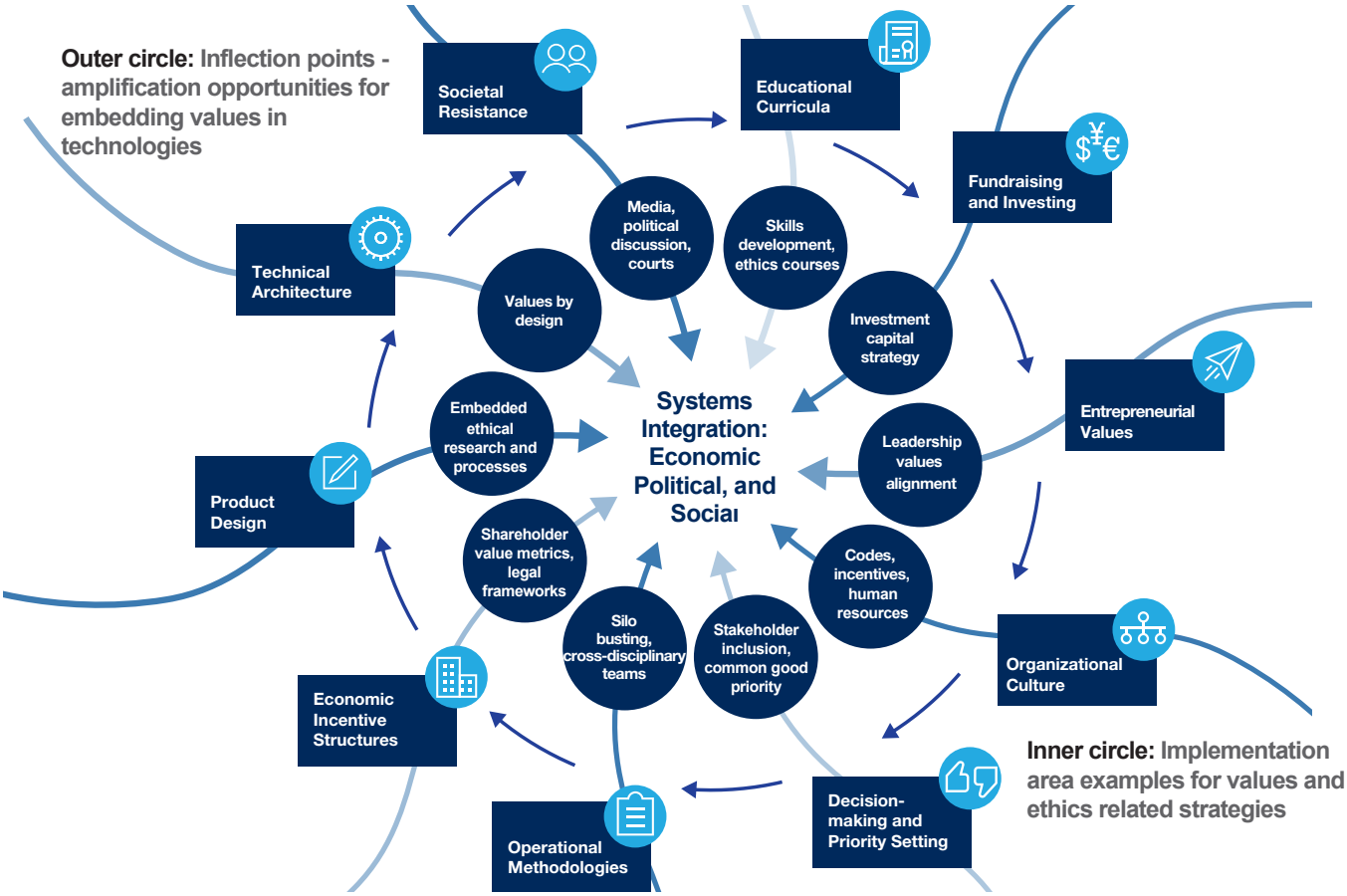
The automobile opened and closed choices in other, broader ways. Widespread car ownership conferred greater personal autonomy, for example, but led to the design of cities that were challenging to navigate on foot, by bicycle or by public transport. It enabled suburban sprawl, with attractive individual places to live but ways of life that arguably eroded social cohesion. Moreover, this development contributed to deep economic dependence on oil and to pollution that has severe health and environmental consequences, including impacting climate change. None of these impacts were inevitable; they were mediated by collective choices, such as tax incentives and the relative priority placed on building roads or mass transit systems.

Technologies impact entire systems – economic, social and political. They shape world views, and world views shape them as well. They are dreamed up and refined in laboratories and workshops by teams of people. Their development, just as anything else, is subject to social factors,[16] such as tribalism, water-cooler politics and gender discrimination. A systemic view of how values and ethics become part of the technological development process is needed.

Figure 1 illustrates a systemic perspective for thinking about where and how values and ethics can find their way into technologies and policy creation. Despite the tendency to think of technologies as objects or tools, they inevitably embody the values of their creators, whether of a small team of engineers hoping to solve a technical challenge, or of a large group of nations imagining a collective destiny.[17]

Looking at technologies from this perspective can help stakeholders shape the societal effects of technological development. In fact, well-informed leaders and creative executives already recognize the need for this and are discussing opportunities for cooperative and collaborative policy-making. The impacts of technologies, especially on policy, sustainability and social stability, are becoming mainstays of global multistakeholder conversations. Thanks to dedicated research over the last 30 years, more is understood about how and where values and ethics are relevant in the development process – from decisions about infrastructure development to organizational incentives to the imagination of schoolchildren. Figure 1's outer circle identifies key "inflection points" at which the right stakeholders can be engaged at the right time. The inner circle identifies some examples of how ethics and values may be addressed, and the centre shows where all these processes flow together, integrating into a wider set of systems.

Figure 1: System Integration of Values and Ethics into the Technological Development Process



Source: Authors

B. Appreciating and shaping the moral role of technologies[18]

Technologies have a clear moral dimension – that is to say, a fundamental aspect that relates to values, ethics and norms. Technologies reflect the interests, behaviours and desires of their creators, and shape how the people using them can realize their potential, identities, relationships and goals.[19] While all technologies have some impact in this regard, sometimes developers explicitly aim for a moral impact; examples include the contraceptive pill,[20] which was intended to give women greater control over their bodies, and the Internet, which was developed with the intent of increasing accessibility as a goal. The Internet Engineering Task Force (IETF), one of the main standards organizations, states:

The Internet isn't value-neutral, and neither is the IETF. We want the Internet to be useful for communities that share our commitment to openness and fairness. We embrace technical concepts such as decentralized control, edge-user empowerment and sharing of resources, because those concepts resonate with the core values of the IETF community. These concepts have little to do with the technology that's possible, and much to do with the technology that we choose to create.[21]

Broadly stated, the moral components of technologies, such as the internet, explicitly influence what they can be used for. More specifically, as argued by Corinne Cath and Luciano Floridi of the Oxford Internet Institute, the values undergirding the engineering decisions for the infrastructure and software running the internet are passed on through the functionality resulting from those decisions.[22] How such decisions are reached impacts the capabilities of the internet far beyond the infrastructure and logical implementation layers. Ultimately, they influence the internet's economic and social layers (Figure 2).

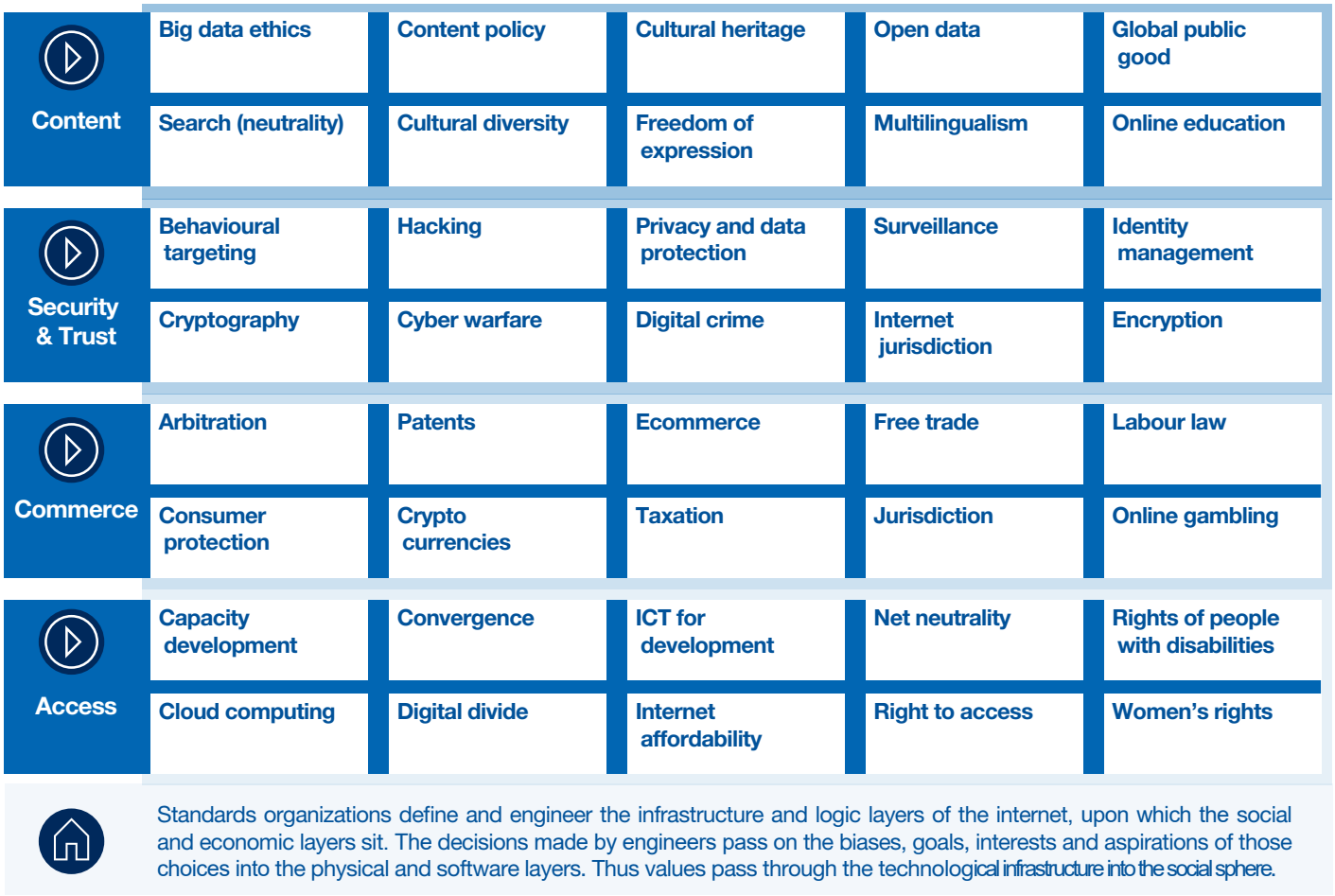
The following definitions guide the discussion of values, ethics and morals:

Values refers to the aspirations that societies hope to realize and keep as priorities for determining and guiding their actions and choices. Examples of values include privacy, justice and well-being. The Forum's values include protecting human dignity, prioritizing the common good and committing to environmental stewardship.

Ethics refers to the attempt to discern "right action". This means trying to decide which actions are permissible, justifiable and in the interest of individuals or society – given that many decisions involve conflicting values, goals and desires. An example is thinking about how algorithms create knowledge problems (such as misleading evidence or bias), how they may affect people due to this, and what duties are required to remedy either the algorithm or its use.[23] Various frameworks for discerning right action prioritize different ends, such as consequences, relationships, personal character and more. This aspect makes the field rich, complex and a continuous challenge for experts and practitioners.

Moral is used descriptively to indicate a relevance to values and ethics. It refers to norms, behaviours and practices that are tied to how values and ethics issues are confronted and worked through, even if they are not always explicitly mentioned or codified.

Figure 2. Social Layers of the Internet



Source: Based on ICANN, The Economic and Societal Layer of Digital Governance

Ibo van de Poel, Professor of Ethics and Technology, Delft University of Technology, Netherlands, and Lambèr Royakkers, Associate Professor in Ethics of Technology, Eindhoven University of Technology, Netherlands, point out that even when engineers focus narrowly on creating economic value, the products they develop often have fundamental societal impacts, such as increasing or decreasing opportunities for marginalized populations: "In this sense, engineering is an inherently morally motivated activity. Changing the world for the better is, however, no easy task and also not one that can be achieved on the basis of engineering knowledge alone. It also requires, among other things, ethical reflection and knowledge."[24] In their book, *Ethics, Technology, and Engineering: An Introduction*, they outline the skills engineers need to develop moral sensibilities, moral analysis, moral creativity, moral judgement, moral decision-making and moral argumentation. Decisions they make can include or exclude potential users, based on factors such as disability, educational background, gender roles or financial means.

Of course, engineers are not the only stakeholders responsible for how technologies are developed. They respond to decisions made by organizational leaders and policy-makers, and incentives created by potential customers. Unfortunately, many stakeholders are often left out of the discussion and the development process. Keeping with a human-centred approach, however, requires involving a wider set of perspectives and considering the outcomes for society – not only from the top down through regulation, but also from the bottom up through the attitudes, behaviours and actions of stakeholder groups.

C. Engaging with a wide variety of stakeholders

Engaging a wide set of stakeholders who could be affected by technologies is more than a moral obligation;[25] it is good business sense. Aligning systems and products with societal priorities, and anticipating and forestalling potential negative effects, can create reputational capital and lower the long-term costs of dealing with social resistance. Thinking about large stakeholder groups and their potential motivations for caring about values and ethics can shed light on where discussion is relevant:

Civic leaders and citizens are concerned with large, social aspirations, such as equality of opportunity, access to shared resources, transparency, procedural fairness and a range of rights and freedoms: values that culminate in a greater sense of well-being with a specific cultural context.

Consumers generally welcome opportunities to choose products aligned with their personal and community values and eschew technologies that are perceived to harm their interests. But if they can only influence the process of technological development through consumer choice, they may not have a meaningful choice.

Engineers are also citizens, and many are concerned about the impact of their work on society and the environment. Darshan Karwat's concept of engineering activism is one example.[26] Supplying engineers with tools to address values and ethics gives them more agency than simply focusing on compliance issues or being constrained by economic incentives.

Executives, looking to create value for the organization and society, care deeply about purpose and know that meaningful work motivates employees, which is reflected by the success and continued relevance of *True North: Discover Your Authentic Leadership* by Bill George.[27]

Boards are interested in values and ethics to develop trust within an organization and with partners, to build reputation and to create stable and supportive ecosystems and markets. With their guiding role, boards are aware of issues, a critical factor in propagating an organizational orientation based on values and ethics.

> **"Engineering and business ethics often focus narrowly on compliance and procedure rather than on a broader duty to think through the potential societal impact"**

Policy-makers are obligated to enable fair and equitable marketplaces, involve citizens and create more deliberative and participative governance practices. They care about how values and ethics are incorporated into processes for technological development and outcomes for industry and society at large because societal well-being is their putative *raison d'etre*.

Educators are motivated to improve future citizens and professionals through the study of values and ethics. They are attuned to the way values and ethics education can support intangible benefits for societies, such as concern for the common good, building trust and thoughtful deliberation.

Expecting that every stakeholder be informed about and involved in each step of developing and deploying technologies would obviously be unrealistic; so, too, would the expectation that every stakeholder will have intentions aligned with the common good or be a trained ethicist. As explored in the next section, tools and techniques can help stakeholders identify ethical issues, evaluate potential choices, express their preferences and have them taken into consideration. However, building the necessary skill sets will require new resources, curricula, programmes, training and disciplines.

D. The need for new disciplines

Integrating a systems view of technological development with an understanding of the moral components of technologies and an inclusive process for stakeholder engagement takes this human-centred approach beyond any single discipline. New curricula and programmes of study will have to be created and adopted for a world that requires more from advancing technologies as they envelop our environment and become integrated in our bodies. This new reality needs new disciplines and new structured approaches to values and ethics, especially in engineering and business studies.

Structured approaches to values and ethics, based on taking responsibility for other members of society, have long been embedded in older professions, such as medicine and law, and specifically in their training and education. Their socially situated contexts meant the decisions of their practitioners had long-lasting effects on the community. Engineering and business schools have only just begun to understand the socially situated contexts of technologies and organizations they help to create and maintain. Both disciplines need to embed a deep and nuanced practice of thinking beyond execution and towards social responsibility and outcomes.

According to Rob Reich, professor of political science at Stanford University, the imperative for educational institutions is to focus on cross-disciplinary competence.[28] He suggests that one approach could be having students focus on philosophy, politics and engineering, a new PPE curriculum,[29] in order to begin training a new generation of professionals that will encounter this overlap in real world organizations.

In the last 10 to 15 years, engineering and business schools have begun introducing mandatory ethics courses in their curricula. Front-running universities are pushing lessons from the social sciences into business and engineering disciplines through textbooks, such as *Engineering Ethics; Ethics, Technology,* and *Engineering*; and *Philosophy of Technology: An Introduction for Technology and Business Students*. Programmes in the Netherlands and Germany have been particularly successful in creating cross-disciplinary theoretical and case-based research.

Nonetheless, ethics courses for engineering and business students often focus narrowly on issues of compliance and procedure rather than on a broader duty to think through the potential societal impact of one's work.[30] Clear and consistent educational requirements have yet to emerge. Ultimately, lessons need to reach beyond the university to build individuals' skills, so they can influence technologies through their roles as users, consumers, citizens and investors.[31]

Achieving transformative innovation

These are not theoretical issues. Engaging with values and ethics in technology is practical, accessible and essential at the beginning of the Fourth Industrial Revolution. Transformative innovation will enhance well-being for society as well as bring economic value to businesses, manifesting both tangible and intangible benefits.

Leaders looking for transformative innovation can find it by shifting their perspective towards the human-centred approach outlined in the first section. Adopting this new perspective does more than clarify the role that technologies play in shaping society; it brings a more comprehensive way of increasing well-being. Three main sources of economic value are at stake, but they require a broader outlook that cultivates medium- and long-term benefits.

The first major source of value will come from building trust through more attentive and inclusive processes of technological development that prioritize multistakeholder input. According to the Edelman Trust Barometer, industry leaders need to rebuild trust and facilitate transparency by safeguarding privacy, investing in jobs and focusing on consumer safety.[32] Demonstrating commitment to the public by involving those affected by technologies and attempting to understand how business can further societal priorities are steps in this direction.

The second source of value comes from widening the market by authentically raising well-being. Developing technologies aligned with societal values and the common good, and promoting greater inclusivity and accessibility, has the ability to affect and provide more people with a higher quality of life, creating a more robust and resilient marketplace.

And third, a larger market with increased trust between actors spells the creation of surplus value through higher quality of market participation and exchange. The lowering of transaction costs, the willingness to take risks, and the potential for the output of economies to be greater than the sum of their parts are all dependent on the fostering of an environment where values and ethics are incorporated in such a way that they blend into the background of technological development.

To do this effectively, however, business leaders and policy-makers must create and implement new ways of working collaboratively among employees and citizens, individuals and institutions. Transformative innovation requires new tools, new skills, new partnerships and new institutions that can mould technologies to serve a collective vision of the future.

A. New tools

Soft governance tools may not be encoded in legislation, but they do have the ability to shape technological development. Standards, codes of conduct, oaths and company policies are all good starts, but consideration must go beyond simply adding a layer of aspiration. The following six imperatives identify what needs to be done as technologies are developed, and where businesses, governments and the public need the tools to do more.

1. **Involve others** – Participatory tools are needed to understand how a technology fits into stakeholders' lives, engages citizens in policy-making and incorporates external voices in critiques of the technological development process. From "guerrilla testing" to "journey mapping", the UK government has collated many such promising tools in its Open Policy Making toolkit.[33]

2. **Surface assumptions** – Individuals and social groups may not realize they work on different assumptions about societal values and ethical concerns, especially in environments lacking diversity in gender, background, regional experience or other factors. For example, decision-makers may wrongly assume that every city resident would welcome a network of sensors providing data about air quality, not considering that homeowners in poor areas might justifiably worry about a potential negative impact on their property values.

3. **Determine consequences** – Foresight tools, such as horizon scanning and scenario planning, can be extremely helpful in anticipating how a technology may influence individual behaviour, how it fits into a population's "social and material arrangements", and what its "moral outcomes and consequences" may be.[34] The UK Government Office for Science, for example, provides *The Futures Toolkit* for such foresight thinking.[35]

4. **Align incentives** – Stakeholders can explicitly align incentives at critical junctures by using more nuanced methodologies that accompany technologies as they are developed.[36] While many process tools already exist, such as in responsible research and designing for values,[37] they are often regarded as options and not as requirements.

5. **Facilitate decisions** – Tools are needed to evaluate risks and benefits to give leaders practical guidance, helping them to make decisions at inflection points of the technological development process.

6. **Maintain flexibility** – Technologies can meet resistance as they grow and evolve in unexpected ways. For example, how can companie s and citizens constructively respond to the concern about addictive "slot-machine" principles in mobile applications?[38] Leaders need tools that help in conversations with those affected and the ability to effectively address undesirable outcomes.

Design thinking, a growing trend, has an excellent set of tools that create flexibility in thought processes for developing new technologies, as well as for organizational needs. Tim Brown, Chief Executive Officer, IDEO, USA, characterizes design thinking as "a human-centered approach to innovation that draws from the designer's toolkit to integrate the needs of people, the possibilities of technology, and the requirements for business success".[39] Nesta, the United Kingdom's National Endowment for Science Technology and the Arts, has used design thinking to help policy-makers contextualize policy development around citizens and users. The same approach is applicable to technological development.

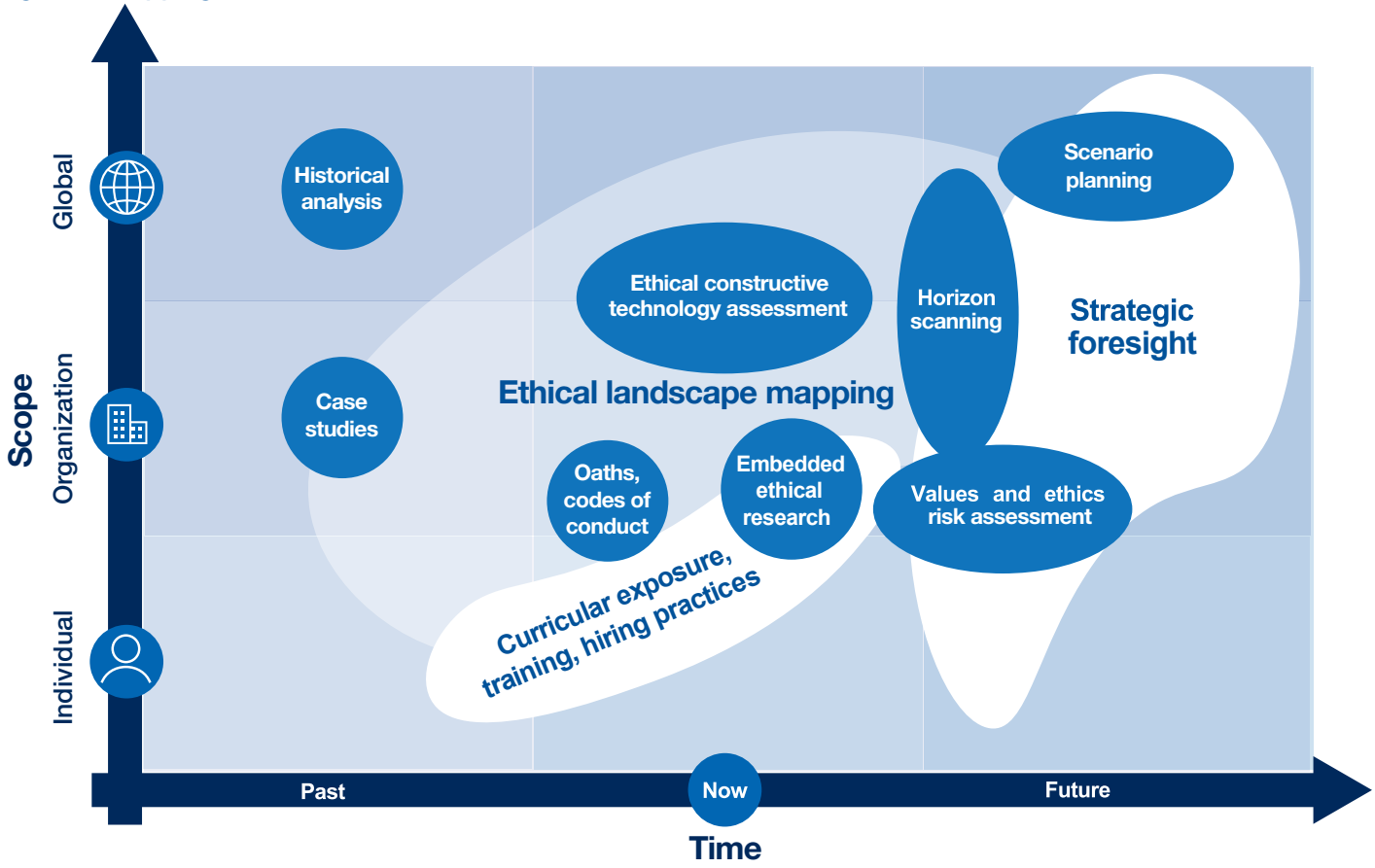
Another example is the implementation of "The Signal Code", developed by the Harvard Humanitarian Initiative.[40] The rights-based framework provides a clear way for governments, the private sector and civil society to think about what rights people have in humanitarian crises in relation to the ethical challenges created by information technologies and their capabilities.[41]

To realize the potential economic value as well as the quality of life value – to push for truly transformational change – institutions and companies need to know which questions regarding values and ethics are worth asking, as well as how technologies are impacting citizens, consumers and communities. Developers and adopters of technology must answer questions such as:

- Who are the stakeholders involved and what is at stake?
- Whose values are driving this technology?
- What values are involved with the technology at this point in its development?
- How do those values align with societal priorities?
- Which value sets are in conflict?
- Which ethical issues need to be addressed that relate to the technology?
- What is the best format for deliberation, exchange and action?
- How is technological decision-making related to investment, social or regulatory pressures?
- Which social groups might lose out from the effects of the technology?
- What recourse is available to those affected adversely?

These questions have not always been given the proper priority, but rethinking technological development and engaging in a human-centred approach will require rethinking current siloed practices.

Figure 3: Mapping Values and Ethics Tools and Frameworks



Source: Authors (for more on various ethical technology assessment strategies, see Kiran et al., 2015)

Indeed, many existing tools can meet some of these challenges, at least in part (Figure 3). Transformative innovation, however, demands a systemic approach to make sense of the ethical landscape and to apply principles across the incentives, cultures, designs and constraints that result in a finished product. New, more inclusive methodologies – some in pilot schemes, others still as theoretical options – look at technological development from a broader view and address values and ethics issues throughout the process. To make full use of these tools, however, requires new skills.

B. New skills

Much discussion already focuses on how the Fourth Industrial Revolution is creating the need for new workplace skills; automation replaces some jobs, significantly changes the nature of others and opens up new opportunities for people to create value. Investing in lifelong learning opportunities is a commonly promoted strategy to help labour markets adjust to this change.[42] However, new skills that assess the values- and ethics-related issues of technologies are needed just as urgently.

Critical-thinking and problem-solving skills are necessary but not sufficient. Collaborative thinking will be increasingly important, relying on broad technological competence which, in turn, implies more opportunities to experiment with new technologies. The complexity of converging technologies means that most are developed in multidisciplinary teams and working environments, requiring skill sets in science, humanities, business and the arts. Thus, collaboration skills and cognitive flexibility will be required on top of standard technical expertise. As mentioned in the previous section, skills that apply new tools and can facilitate their use within organizations will also be highly desirable.

New skills are particularly required in crafting common understanding, resolving conflicts, mapping systems and overlaying them with ethical frameworks. For example, understanding when aggregate outcomes contradict the intentions behind individual actions is critical, as is being able to parse complex issues, such as the desirable and undesirable aspects of anonymity and encryption.

When anticipating the future, policy-makers and educators must ask the right questions, beginning with: what values- and ethics-related skills are needed now for dealing with technologies?; will these skills be needed in the future?; what value do they bring? The World Economic Forum's report, *The Future of Jobs*, identified the trends in skills changes most desired by 2020, and ranked the top 10 (Figure 4).

> **"The complexity of converging technologies requires skill sets in science, humanities, business and the arts"**

Figure 4: Top 10 Skills are changing as the Fourth Industrial Revolution progresses

in 2020	in 2015
1. Complex Problem Solving	1. Complex Problem Solving
2. Critical Thinking	2. Coordinating with Others
3. Creativity	3. People Management
4. People Management	4. Critical Thinking
5. Coordinating with Others	5. Negotiation
6. Emotional Intelligence	6. Quality Control
7. Judgment and Decision Making	7. Service Orientation
8. Service Orientation	8. Judgment and Decision Making
9. Negotiation	9. Active Listening
10. Cognitive Flexibility	10. Creativity

Source: World Economic Forum, Agenda, "The 10 skills you need to thrive in the Fourth Industrial Revolution", 19 January 2016

In addition to technical and collaborative skills, stakeholders need new models for framing technologies; with these, they can challenge current structures so engrained that they go unnoticed – for example, the assumptions about artificial intelligence and robotics that initially considered automating human tasks rather than augmenting employees' skills and capabilities.

Firms, governments and individuals stand to benefit from understanding how to act on and respond to issues involving values and ethics as they encounter ever more technological crises. In relation to employment, for example, it is not just the skills people have that are important – it is thinking about how these skills provide meaning, about the intrinsic value of individuals, and about how reskilling protects and helps create a just transition for those affected by technological change.[43]

These skills can help everyone see where choices about technologies can lead to unwanted outcomes and thus help them to respond collectively. Moreover, cultivating new skills around values and ethics is essential for building a collective vision of the future, one that remains open to opportunity and retains space for self-realization. And, critically for an economic transformation, these skills can help to expand economic models beyond financial and growth metrics by

paying closer attention to the vital role of intangible value for society.

Furthermore, developing values and ethics skill sets can help society anticipate threats, reveal conflicts between moral stances, build a collective vision, cultivate responsibility and accountability, and align business models with societal priorities. Making best use of these new skills, however, will depend on the quality of stakeholder partnerships.

C. New partnerships

Emerging technologies present business and government leaders with a challenge: creating, shaping and commercializing these technologies require groups of people with specialized education, vision and business acumen. Assessing their role in society demands the involvement of stakeholders who lack these specialized skills. Moreover, not all people whose inputs are needed are likely to be found in the same place at the same time.

New models of collaboration that go beyond organizational boundaries create value in four main ways:

1. *Understanding what other stakeholders think and how they act is necessary to develop technologies that support their values.* The needs of customers, communities or members of product value chains cannot be understood sufficiently through secondary research. Traditional arm's-length approaches to consultation, based on surveys or requests for input, often fail to surface deep beliefs and cultural values critical to how a technology is perceived, used, experienced and reinvented. Partnering with a group of stakeholders around shared goals, risks and rewards is often the only way to truly appreciate what drives and challenges them.

2. *Assessing and embedding positive values in the development of technology will require human resources that almost inevitably lie outside an organization.* According to economist Friedrich Hayek, "the knowledge of the circumstances of which we make use never exists in concentrated or integrated form".[44] Or, as Sun Microsystems founder, Bill Joy, stated, "No matter who you are, most of the smartest people work for someone else."[45] Companies cannot always solve problems by hiring smart people from elsewhere. They need to develop knowledge systems and partnerships that incentivize ongoing, strategic conversations with external experts who bring challenging perspectives and constructive feedback that can help improve products and services.

3. *Partnering with external organizations can signal seriousness.* Partnerships are not easy. They consume valuable management time and financial resources, making them a credible indicator of legitimacy for organizations investing in ethical approaches.

4. *Working across organizational boundaries is the only way to achieve systemic change.* This is particularly so in solving problems related to public goods or the commons. For visionary leaders, partnerships can transform entire industries. Successfully catalysing new standards, spreading norms and contributing to public policy all require commitment to external engagement – often through institutional mechanisms.

D. New institutions

Institutions can spread new tools, skills and models of collaboration among stakeholders. This helps to turn zero-sum games into cooperation that creates both tangible and intangible value for all through the alignment with societal values. Traditional institutions, however, are struggling to keep up with the complex, transformative and distributed nature of emerging technologies. Governing responsibly in response to the speed, scale, scope and impact of change will require disrupting institutions by changing their own incentives – or, in some instances, creating entirely new institutions.

As institutions evolve in the Fourth Industrial Revolution, they will have to assume four key responsibilities:

1. Protect and promote responsible innovation for a sustainable and inclusive future
2. Build clear and fair rules for competition and create incentives for players to perform in accordance with societal values
3. Safeguard and serve vulnerable and marginalized communities
4. Assess and manage systemic risks proactively that derive from the impact of technologies

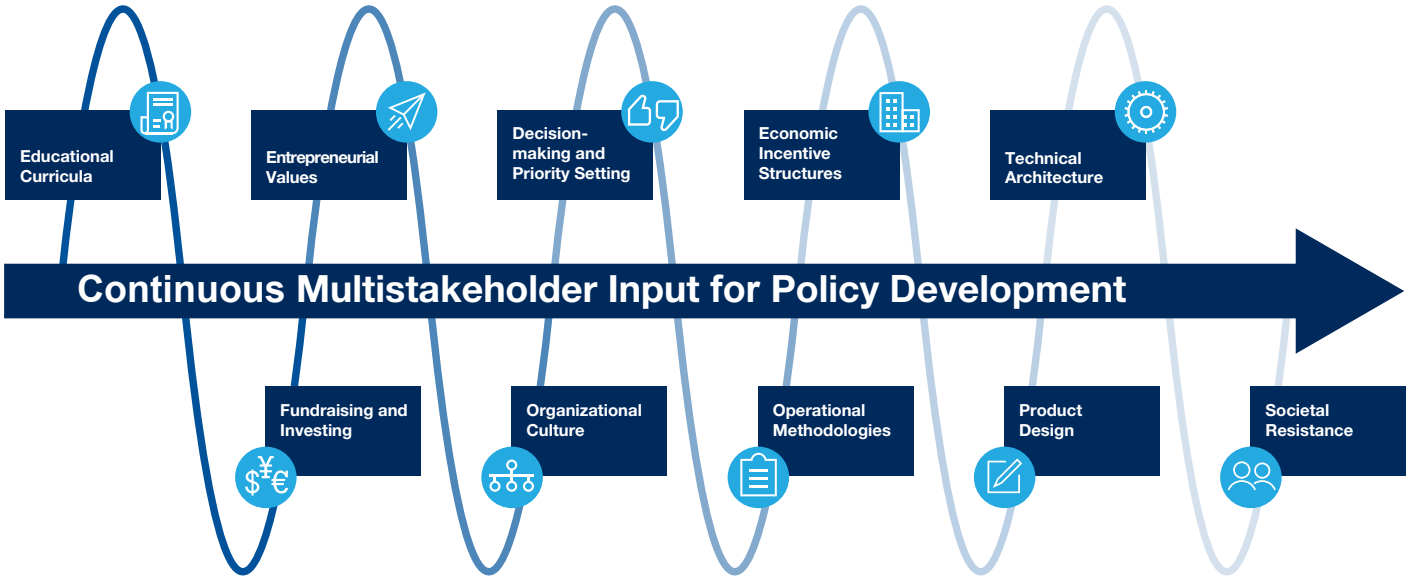
Building these institutions, either *de novo* or from existing ones, will challenge governments and societies to work more closely together. This especially concerns technologies that could deploy government services or create perceived risks for portions of society. Participatory models that include citizens and social groups will be needed to ensure fair outcomes that optimize benefits across stakeholder domains.

Constructive public deliberation will be no less important. Polarized discussion around technologies with no opportunity to resolve conflicting viewpoints could fester into political turmoil. Inclusive governance, participatory processes and alternatives to cumbersome regulatory schemes can turn the corner towards more effective policy and public engagement.

Traditional institutions, however, will have to change. Currently, they tend to act periodically, apply general principles to specific cases, focus on objectives and rules, monitor activities from a top-down perspective, and incentivize by enforcing penalties. Newly configured or engineered institutions must become more agile, inclusive and iterative – acting when needed, judging when to

apply existing principles to new cases or adapt principles in light of new cases. They must focus on outcomes and impact, and incentivize through influence to create intrinsic motivation and empower organizations and individuals with responsibility and authority.

Figure 5: Inflection Points - Target Areas for New Institutional Engagement



Source: Authors (for more on the inflection points, see Schwab and Davis, 2018)

Institutions need to implement agile governance principles and engage stakeholders at each of the inflections points of the technological development cycle (Figure 5). Building the capacity of institutions to develop new regulation and governance, including creating new business models and incentives – from scoping and goal-setting to implementing, iterating, assessing and evaluating – is paramount. The willingness to experiment and try out diverse governance mechanisms is the key to success in a dynamic technological environment.

The World Economic Forum is taking this approach as well. Applying agile governance principles and deliberation over values and ethics issues is being integrated into its System Initiatives and projects within the Centre for the Fourth Industrial Revolution Network. The Network's pilots offer the potential to further explore the development and application of values- and ethics-related skills, methods and tools. Work within the Network involves nascent and growing technologies, where many values and ethics components are often undefined and/or under-regulated, or not regulated at all. The Forum is committed to addressing values and ethics in a cross-cutting way at these early stages because it provides the greatest opportunity to profoundly influence the future.

Conclusion

The opportunities and threats created by emerging technologies require leaders across business, government and civil society to understand the importance of values and ethics in technological development. This means taking a conscious perspective of technological development that prioritizes the values of society and acting accordingly. Contrary to the common perceptions of the challenges of working with values and ethics, taking them on in the process of developing technologies is beneficial and, more importantly, practical, accessible and essential.

The increasing attention given to how technologies can support, undermine, influence and contravene societal values is evidence of a shifting global consciousness towards a more constructive view of technology, its complexity and its impact on daily life. The saturation of urban, rural and orbital environments with technical infrastructure; the personal and professional needs for connectivity; the advancement of computational capabilities; the breakthroughs of biotechnological manipulation; and the rapid scaling and dissemination of emerging technologies have all contributed to this shift.

Continuing to treat technologies as merely objects, industrial products or external forces prevents us from understanding how technologies impact the world around us – their cohesiveness, capabilities, models for employment, perspectives on what is meaningful, and ultimately what they value. We need to invest in a more grounded approach to technological development that doesn't lose sight of the true ends of technological progress – social progress and the well-being of humanity in terms of opportunities and self-realization – and comprehends the difference between material wealth and quality of life. This means investing in the tools and approaches that have just begun to be described in this paper.

In practice, rethinking technological development will require taking a human-centred approach – that recognizes how technologies and societies are co-produced – and prioritizing a future that involves all stakeholders, fostering the goal of greater social cohesion, trust and well-being. It will also mean developing and investing in new tools and skills, bringing together new curricula to shape future generations, and building new institutions and partnerships.

This challenge is a systemic challenge, where progress made in values leadership can positively affect both technology leadership and governance leadership. In *Shaping the Fourth Industrial Revolution* (Schwab and Davis, 2018), leaders are tasked with developing systems leadership through three components: technology leadership, governance leadership and values leadership. Taking on the imperative of working through values and ethics issues is one pillar in the move towards transformative innovation and responsible leadership in the Fourth Industrial Revolution.

We need to invest in technological development that doesn't lose sight of the true ends of technological progress – social progress and the well-being of humanity

Endnotes

1. D. McCloskey, *Bourgeois Equality*, 2016.
2. Chui et al., "Notes from the AI frontier: Applications and value of deep learning", 2018. Available at https://www.mckinsey.com/global-themes/artificial-intelligence/notes-from-the-ai-frontier-applications-and-value-of-deep-learning.
3. S. Ardittis, "How Blockchain can benefit migration programmes and migrants", 2018. Available at https://migrationdataportal.org/blog/how-blockchain-can-benefit-migration-programmes-and-migrants.
4. N. Davis, "Better technology governance can help Australian society benefit from the Fourth Industrial Revolution", forthcoming at https://theconversation.com/global.
5. Paragraph 70 of the 2030 Agenda for Sustainable Development. Available at https://sustainabledevelopment.un.org/post2015/transformingourworld.
6. B. Keeley, *Income Inequality: The Gap between Rich and Poor*, 2015. Available at http://espas.eu/orbis/sites/default/files/generated/document/en/0115391e.pdf.
7. OECD, *How's Life? 2017: Measuring well-being*, 2017, p. 31. Available at http://dx.doi.org/10.1787/how_life-2017-en.
8. D. Collingridge, *The Social Control of Technology*, 1980.
9. J. Lau, "Same Science, Different Policies: Regulating Genetically Modified Foods in the U.S. and Europe", 2015. Available at http://sitn.hms.harvard.edu/flash/2015/same-science-different-policies/.
10. Intersoft consulting, General Data Protection Regulation, "Art. 25 GDPR, Data protection by design and by default". Available at https://gdpr-info.eu/art-25-gdpr/.
11. Davis, forthcoming.
12. P.-P. Verbeek, "Resistance Is Futile: Toward a Non-Modern Democratization of Technology", 2013.
13. See some examples of this shift in mindset through the impact of sociological and political studies dedicated to science and technology production in Bijker, Hughes and Pinch, *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*, 1987; S. Jasanoff, *States of Knowledge*, 2004; H. Harbers, *Inside the Politics of Technology: Agency and Normativity in the Co-Production of Technology and Society*, 2005.
14. See previous, as well as Bowman, Stokes and Rip, *Embedding New Technologies into Society: A Regulatory, Ethical and Societal Perspective*, 2017.
15. R. Volti, *Society and Technological Change* (8th Edition), 2017.
16. Latour and Woolgar, *Laboratory Life: The Construction of Scientific Facts*, 1979.
17. See Latour and Woolgar, 1979; Pickering, 1995; Hughes, 2004; Adas, 2006; and Jasanoff, 2015; among others. Examples abound, from technologies' role in cultural identity, dominance and hegemony to the collective creation of knowledge and collective imagination of the future. Although contemporary textbooks on ethics and engineering often point out this situated development of technologies, the critical issues for the field remain (how engineers are obligated to act, their responsibilities and the distribution of accountability).
18. Influential philosopher of technology, Peter-Paul Verbeek, raises the following answer to the question, Do artefacts have morality?: "If ethics is about the question of 'how to act?' or 'how to live?', and technologies help shape how we act and live, there is good reason to claim that technologies have explicit moral significance." He argues in *The Moral Status of Technical Artefacts* that technologies are "intrinsically involved in moral decision-making".
19. Kiran, Oudshoorn and Verbeek, "Beyond checklists: toward an ethical-constructive technology assessment", 2015. Available at http://dx.doi.org/10.1080/23299460.2014.992769.
20. White Junod and Marks, "Women's trials: the approval of the first oral contraceptive pill in the United States and Great Britain", 2002.
21. IETF, Network Working Group, "Request for Comments: 3935", 2004. Available at https://www.ietf.org/rfc/rfc3935.txt.
22. Cath and Floridi, "The Design of the Internet's Architecture by the Internet Engineering Task Force (IETF) and Human Rights", 2016.
23. For more on algorithms and ethics, see Mittelstadt et al., "The ethics of algorithms: Mapping the debate", 2016. Available at http://journals.sagepub.com/doi/pdf/10.1177/2053951716679679.
24. Cath and Floridi, 2016.
25. P. Brey, "The strategic role of technology in a good society", 2018. Available at https://doi.org/10.1016/j.techsoc.2017.02.002.
26. Karwat, Eagle, Wooldridge and Princen, "Activist Engineering: Changing Engineering Practice By Deploying Praxis", 2015. Available at http://doi.org/10.1007/s11948-014-9525-0.
27. B. George, *True North: Discover Your Authentic Leadership*, 2007.
28. Conversation and personal correspondence.
29. As opposed to philosophy, politics and economics, the current PPE subjects.
30. C. Mitcham, "Engineering Design Research and Social Responsibility", 1994.
31. Many issues with institutional design can be referenced in Crow and Dabars' *Designing the New American University*.
32. Edelman, "2018 Edelman Trust Barometer: The State of Trust in Business". Available at http://cms.edelman.com/sites/default/files/2018-02/2018_Edelman_Trust_Barometer_State_of_Business.pdf.
33. See the UK Government Open Policy Making toolkit. Available at https://www.gov.uk/guidance/open-policy-making-toolkit.
34. P. Brey, "From Moral Agents to Moral Factors: The Structural Ethics Approach", in Kroes and Verbeek, *The Moral Status of Technical Artefacts*, 125-142, 2014.
35. UK Government, Office for Science, *The Futures Toolkit*, 2017. Available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/674209/futures-toolkit-edition-1.pdf.
36. Verbeek, "Resistance Is Futile", 2013.
37. For example, the Design for Values course offered by Delft University. See https://online-learning.tudelft.nl/courses/design-for-values/.
38. T. Harris, "How Technology is Hijacking Your Mind—from a Magician and Google Design Ethicist", 2016. Available at https://medium.com/thrive-global/how-technology-hijacks-peoples-minds-from-a-magician-and-google-s-design-ethicist-56d62ef5edf3.
39. IDEO, IDEO U Design Thinking courses. Available at https://www.ideou.com/pages/design-thinking.
40. Greenwood et al., "The Signal Code: A Human Rights Approach to Information During Crisis", 2017. Available at https://hhi.harvard.edu/sites/default/files/publications/signalcode_final.pdf.
41. PLOS, "A Rights-based Approach to Information in Humanitarian Assistance", 2017. Available at http://currents.plos.org/disasters/article/a-rights-based-approach-to-information-in-humanitarian-assistance/.
42. OECD, *How's Life? 2017*, 2017, p. 83.
43. For more on reskilling opportunities, see *Towards a Reskilling Revolution: A Future of Jobs for All*, 2018. Available at http://www3.weforum.org/docs/WEF_FOW_Reskilling_Revolution.pdf.
44. F. A. Hayek, "The Use of Knowledge in Society", 1945.
45. B. Schlender, "Whose Internet Is It, Anyway?", 1995. Available at http://archive.fortune.com/magazines/fortune/fortune_archive/1995/12/11/208457/index.htm.