



Understanding wellbeing in the context of rapid digital and associated transformations

Implications for research, policy and measurement

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Abstract

Digital transformation is affecting every aspect of human endeavour to some degree, including generally accepted concepts within liberal democracies of privacy, autonomy, agency, and the implied contract between citizens and their governments. While other factors have also played a role in changing people's lives in recent years, it is apparent that digitalisation and its associated technologies are affecting established patterns of human activity and the human networks within which activities take place. There is evidence to suggest that rapid and pervasive change may affect the human brain's ability to cope, having evolved to operate within smaller human networks. This is mirrored at a macro scale with our social institutions struggling to adapt to rapid technological change. Policy agendas and tools as well as measures for monitoring and sustaining human wellbeing must therefore adapt to take into account the impact of digitalisation and associated technologies. As a first step, we present a framework that can help structure the research agenda and policy considerations. It focuses on the dimensions of wellbeing that are potentially most affected by digital transformation: the evolving institutions of self, of social life and of civic life. Our analysis suggests a number of priorities for policy development, research and monitoring that could support human wellbeing and better individual and societal adaptation to the impacts of digital transformation.

Introduction

Digital transformation, with its many associated technologies, is arguably the most pervasive and rapid transformation that human society has seen, at least since the invention of the printing press. Nearly every aspect of human society, industry, organisation, economy and politics has been or is being transformed by it. Further, the transformation is only now at its early stages with technologies such as artificial intelligence, the internet of things, quantum computing, machine-human interfaces, among others, only now emerging and further compounding this continuing transformation. The pace of introduction and adoption of these pervasive technologies is rapid and unprecedented. The effects of digitalisation are felt at all levels, from individuals, communities, societies to nation states. One can be optimistic, pessimistic or pragmatic about many of these changes, but they cannot be ignored.

Governments, industry and civil society are all seeking to understand the impacts of this transformation. While much analytical and policy attention has been paid to the future of work in response to automation, machine learning and artificial intelligence, many other aspects of this transformation, particularly those that affect the individual or non-economic dimensions of society, have had little systematic analysis.

This paper summarises a project which aimed to develop a systematic way of considering digital transformation through the lens of 'human wellbeing', broadly defined. Wellbeing is a diffuse concept but it is often looked at in a relatively narrow framing. Typically it comprises objective indicators of material conditions and subjective measures of self-perception. By contrast, we have chosen a very broad and multi-level approach, which deliberately reflects a range of dimensions for which the policy and political communities will need to engage the broader research community, particularly in areas such as human development and the social sciences but also in the humanities.

This paper was prepared by INGSA at the request of the OECD's STI division in the context of their 'Going Digital' programme of work [1, 2], which is designed to explore the multi-dimensional impact of pervasive digitalisation. The International Network for Government Science Advice (INGSA) [3] is the global network of academics and policy practitioners, which has the mission of building skills, knowledge and capacity at the interface of science and public policy.

Process and methods

The starting point was to take the OECD's current wellbeing measurement framework [4] and to consider its sensitivity to the impacts (and expected impacts) of pervasive digital transformation. The OECD wellbeing framework has generated considerable comparative data through the '*How's Life?*' series of country profiles (2013, 2015, 2017) [5]. However, it is insufficiently sensitive or multi-dimensional to account for the rapidly changing context of digital transformation and may therefore miss important consequences to human wellbeing.

This project was developed in several phases. First, the report's lead authors developed a concept paper outlining the issue and presenting an analytical instrument ([6] (see also appendix 2)). This instrument was a multi-dimensional, multi-level table intended to structure thinking about the changes in individual, social and civic spheres as a result of digitalisation. The concept paper was then circulated for comment among experienced and emerging policy makers and researchers within INGSA's network. Notably, helpful feedback was provided by the New Zealand Department of Treasury, which is internationally known for the establishment of the Higher Living Standards framework [7] of wellbeing-based measurement and policy making.

The concept paper and analytical instrument were then refined and used as the basis for an expert workshop held in London in April 2018 (appendix 1). Workshop participants used the analytical instrument to interrogate, debate, generate and refine ideas about the likely impacts of digital technologies.

The project identified five constituent areas of human wellbeing that merited further examination as candidates for being highly affected by digitalisation, yet are also relatively neglected in traditional indices.

Any consideration of the impact of technologies on wellbeing must acknowledge that there are distinct types of digital technologies which may have very different impacts in order to fully appreciate and develop a utilitarian wellbeing framework for the digital age.

Defining the scope and breadth of terms

Fundamental to this project is to focus on the interaction of two complex concepts: digitalisation and human wellbeing. Each of these concepts is the subject of its own expertise and body of literature, but in bringing them together, a new and uncharted terrain emerges. Here we deal with each concept in turn to understand its scope and its relationship to the other. In the next section, we describe an analytical instrument that brings the concepts together to help generate a list of impacts

It is by now self-evident that human lives are being transformed by digitalisation in every aspect of our activities, from how we earn a livelihood and access the resources necessary to support and enhance our lives to how we form social relationships and raise the next generation. This evolution is largely a global phenomenon, though its relative penetration and impacts will vary according to material and cultural circumstances. In analysing impacts and thus possible responses, however, it is insufficient to paint 'digitalisation' with a broad and monochrome brush. Instead, we need to consider the distinct and combined impacts of specific types of digital technologies.

Therefore, a typology of four foundational technologies was identified and applied to this analysis to structure thinking about the possible impacts of the digital transformation on human wellbeing:

1. Monitoring and information technologies (e.g. data collection, internet of things, cybersecurity, sensors)
2. Automation technologies (e.g. robotics)
3. Artificial Intelligence and related technologies
4. Communication technologies (including new media and social media)

Virtual and augmented reality may need to be considered as a potential further category as it may well be that its ability to further confuse reality creates a distinctive impact on wellbeing.

Similarly, the concept of human wellbeing needs to be broken down and categorised. Existing frameworks and indices to analyse and measure wellbeing tend to focus on material conditions and objective measures such as access to health care, education, educational attainment, employment and housing status and civic participation such as voting. But taking inspiration from a broader ‘social determinants’ of health perspective one can see a much broader range of dimensions of wellbeing.¹ In addition, as mental health and illness become increasingly important and gain public profile, wellbeing measures that take into account self-perceptions of loneliness and connectedness, for instance, are desirable. Indicators such as voter turn-out at the population level or time-use surveys or individuals in aggregate have been used to offer clues about civic engagements and social connectedness respectively. However, there is relatively little systematic and reliable data on a population-wide basis of such measures. There is also a lack of robust data about the impact of transformative digital technologies on these aspects of wellbeing. We may be able to gauge civic engagement through political participation and voting, but qualitative changes in the institutions of democratic governance that affect citizens are not easily assessed. Similarly, time-use indicators can say something about humans evolving social habits, but not the qualitative impact of these.

So while the broadening scope of wellbeing measurement undertaken by the OECD and a number of governments is encouraging, it is still insufficient to fairly assess the drivers of self-perception or account for the cumulative impact of humans’ moral, psychological, emotional and non-cognitive states on their wellbeing. Such features of human wellbeing are largely based on values, which cannot be assumed to be universal, making them extremely difficult to define, measure and compare. Yet these appear to be among the dimensions of wellbeing that are most affected by transformative digital technologies (although this remains to be tested across cultures).

¹ See for instance the NZ Higher Living Standards framework which includes natural and social capital [7] or the Canadian Wellbeing index which includes social and civic engagement [8].

Another reason it is difficult to monitor or measure the full breadth of implications of transformative digital technologies on human wellbeing may be the fact that the context of digital transformation itself will change our views of what constitutes wellbeing. For instance, in OECD countries, will traditional employment statistics adequately account for the changed nature and perception of work – itself still somewhat uncertain? Will education statistics show the uptake and impact of self-instruction and the changed needs in education (beyond largely cognitive needs), and life-long learning needs? Can conventional home ownership/rental statistics explain changes to community social capital in neighbourhoods? Are we monitoring sufficiently population-based mental health to track and investigate emerging trends? Are traditional psychological and psychometric measures adequate to describe the changing mental states in response to digital technologies across the lifespan? It is clear that our conventional measures of wellbeing poorly account for the impact of digital transformation on individuals, families, society and the nature of the nation state itself.

Today digital transformation is sufficiently multidimensional and pervasive that it may affect some of our most basic values and the institutions through which they are enacted. Many of the values and institutions of modern liberal democracies, which are often regarded as constants, emerged during and after the Enlightenment in Europe (e.g. concepts of privacy, autonomy, individual agency, democracy and the social contract between State and citizen). These are social constructs, which could change rapidly as society changes in response to pervasive influences.

In other words, wellbeing in the context of digital transformation is a necessarily broad concept, comprising elements of self-perception together with socially-constructed expectations and objective material conditions. A singular focus on any one of these components risks missing the pervasive, interacting and possibly cumulative effects on wellbeing of transformative digital technologies.

Furthermore, change that occurred during and following the Enlightenment period was in no small part a movement of civil society aimed at countering the social, governance and knowledge paradigm largely set by the Church and Monarchy. By contrast, in the case of digital transformation, much of the most dramatic change is driven by the private sector with a willing public engaging because of its conveniences and little proactive consideration of any potential consequences – governments in general have been relatively passive in considering the issues. In this context, the evolving role of government may be affecting the wellbeing of citizens due to the changing ways in which it can or cannot protect and represent citizen interests.

Thus, to understand wellbeing in the 21st century requires an understanding of transformative digital technologies as drivers of change not just in human material circumstances, but also in human values and organisational systems that support wellbeing.

The analytical instrument ²

The underpinning analytical instrument developed for this project to identify and explore the impacts of transformative digital technologies does not start with the types of technologies themselves. Rather it starts with an examination of changes in long-established human institutions.

Taking a cue from the work of Elinor Ostrom, the instrument we developed adopts a broad definition of ‘institutions’ that includes the formal laws and governance mechanisms of societies but also the informal and less codified rules and norms of behaviour that exist and are replicated within a society’s shared vernacular of language and action.

This broadened definition of institutions, which is well-established in the social science literature, offers a useful lens through which to view the implications of the digital revolution on individual and social wellbeing because it can accommodate the most human-focused of our institutions: the institutions of the self; institutions social life; and institutions of civic life.

The analytical instrument breaks these institutional dimensions down into a partial list of their constituent parts. In other words, the instrument considers the predictable individual and societal practices that endure over time and are more or less universal (albeit with distinct cultural and geographic expression). Of course some of these practices and patterns of behaviour are so established that they are by now considered fundamental material conditions of wellbeing which are objectively monitored (access to healthcare and education for instance) as, for example, in the indicators to the Sustainable Development Goals. Others are socially constructed practices that need to be considered at a more granular level (e.g. changing types of employment relationships; parenting practices; etc.)

² See appendix 2 for the full analytical tool that was developed for this exercise.

The instrument is designed to aid in the analysis of what has changed or is changing as a result of the adoption of transformative digital technologies, working systematically through the typology of technologies against each of the institutional dimensions and their constituent parts.

In applying the instrument, it is recognised that a 'trajectory of change' approach is necessarily the perspective of digital adopters as opposed to digital natives. As such, it is acknowledged that some of the perceived unintended consequences of transformative digital technologies may not be a concern shared in the same way or in the same focus by generations of digital natives. However, the instrument's diachronic perspective is deliberate. As a practical tool, it highlights demonstrable change at multiple levels of human endeavour and thus opens up the space to discuss and debate desirable uses of transformative technology.

By way of illustration, the instrument helps to identify change in human development patterns that are increasingly mediated by digital technologies. Whereas early childhood learning is understood to be based on modelled behaviour and social cues that form over time and with repetition, the variety of stimuli and incentive structures offered to children (and parents) through digital technologies now could be either a useful tool or a dangerous distraction. But the technologies themselves are evolving so rapidly with little well-designed research that educationalists are largely relying on intuition and bias rather than robust evidence as they confront these technologies in such a critical dimension (e.g. [9]).

Similar ambivalence is revealed when thinking through possible impacts on institutions of self-actualisation and autonomy. Whereas once life skills and autonomous authority were gained through training and experience, increasingly there is a reliance on automatic and algorithmic assistance. Such decision-aids may or may not reduce critical analysis but also may make use of considerable data that were previously inaccessible (though the reliability and filtering of the input data then becomes a further consideration). Again, this innovation may be of significant benefit to individuals, or it may be perceived as limiting autonomy.

Examples at the level of societal institutions demonstrate similar complexity and ambivalence. For instance, the changes enabled by digital communication technologies in how friendships, romantic relationships and groups form can be both liberating and alienating. Humans will always seek connection, but it may be some time before we truly understand whether the quality of that connection is compromised or enhanced depending on degree, type and means of interaction and on whether we are connecting with a 'real' human or a cyborg/AI facsimile.



Examples at the level of civic institutions are becoming more obvious, but to date are not typically taken into account in indices of wellbeing per se. For instance, journalistic freedom (and integrity), representative government, rule of law and reliable public services have all been shown lately to be straining under the impact of transformative communication technologies, combined with monitoring technologies and AI/machine learning. Yet these technologies can also be incredibly enabling for democracy, citizen engagement and civic expression and learning.

By applying the analytical instrument at three levels of (more or less universal) human institutions, the complex implications of digitally-driven change in the patterns of behaviour that underpin wellbeing can be revealed.

Results: Specific dimensions of wellbeing that merit attention

The range of institutional constituent parts within each domain that were considered is listed in appendix 2. No doubt additional constituent parts could be identified. Where feasible indicators and monitoring possibilities exist for the identified drivers of wellbeing, these are highlighted in the tables below. More often, monitoring is complicated by lack of national data or, even more obviously, by the need to better understand the issue in the first instance. Therefore, policy and research responses are also suggested.

Through the workshop, the project identified a limited number of constituent elements of wellbeing that merit particular attention and which are not well accounted for in existing frameworks or indices of wellbeing.

1. Human development including early childhood learning

Digital technologies likely affect aspects of human activity and behaviour that have been shown to be fundamental to human development, such as the way children are parented or the way they learn, the physiological responses that are triggered and neural patterns that are set with a variety of device uses [10]. There is much that remains unknown in these regards.

Discussions on the future of work have raised the issue of lifelong learning and new skills that are needed. But there has been surprisingly little focus about what that means for early education and the compulsory school years. Promoting critical thinking and non-cognitive executive function (e.g. empathy, attention, etc.) are most often mentioned. Indeed the available research in developmental neuroscience points to the importance of years 0 to 5 as the core period for the development of these skills and for promoting psychological resilience, which will be critical in a rapidly changing environment. Yet the period of early childhood education is not often systematically monitored in terms of promoting the outcomes desired. Indeed, in many countries of OECD interest, early childhood is not given sufficient policy focus to make a sustainable difference. The OECD has recently launched a study on early-years education which would benefit from formalising a link to work on digitalisation in order to consider changing developmental and learning practices.

Table 1: Addressing the impact of the digital transformation of human development through monitoring, policy and research: examples

National monitoring	Addressing policy gaps	Areas for further research
Early childhood assessments included in national data	Greater focus on the core dimensions of early childhood education and impacts of digital technologies	The development of non-cognitive skills (empathy, resilience) in the digital age
Outcomes of early childhood education in terms of self-control, resilience, empathy non-cognitive executive function	Ethical standards and guidelines for technology use and children	The basic minimum age-appropriate developmental skills for the digital age
Continued monitoring of non-cognitive functions through compulsory school years		Calibrating new monitoring techniques and indicators of human development for the digital age
		Defining skills for lifelong learning and methods for retraining
		Further systematic research on educational needs across early childhood and compulsory school years in the face of digital technologies
		Research on most effective forms of adult learning and retraining

2. Mental health across the lifespan

Many advanced economies are facing a growing mental health burden reaching crisis proportions and emerging disproportionately in young people (e.g. [11, 12]). It may be due in part to significant demographic changes and the changing social context in which we live, where expectations may not meet reality; the pace of life has increased significantly. Many of these issues seem to be directly or indirectly related to the impacts of digitalisation on individuals, the economy and society.

Table 2: Addressing the impact of digital transformation on mental health through monitoring, policy and research: examples

National monitoring	Addressing policy gaps	Areas for further research
Self-reported loneliness frequency of real-life interactions (number and type)	Strategies that promote emotional resilience and self-control	Research on acceptable ethical standards for monitoring mental health
Self-reported usage of media platforms and time-use surveys	Youth mental health strategies that include a particular focus on online life	The impacts of various applications of virtual and augmented reality
Rates of suicide by age	Gender and age-based policy interventions	Use of big data techniques to link mental health to other dimensions of social life
Mental health service usage		Pilot surveys regarding drivers of mental illness at various life stages, and contexts (e.g. cyberbullying, precarious gig employment, unmet life expectations and personal comparisons, isolation, radicalisation etc.
Surveys that focus on attributes of mental wellness rather than classical mental illness diagnoses.		

3. Social inclusion (e.g. group formation and dynamics, social capital and trust)

Whereas the digital drivers of mental illness tend to operate at an individual level, there is equal concern about the impacts of the transformation on various collective groupings that can form within societies and affect social inclusion. Social media has helped new groups and communities of interest to form and grow, but it has also enabled more polarised and entrenched views to take root, and among the groups that form are anti-social ones that take advantage of the dark web to build new collectives based on violent, anti-social, morally objectionable or illegal behaviours. Workshop participants agreed that social inclusion, new forms of large scale social group identity-formation, norm-building and dynamics, generation and use of social capital and trust, as well as radicalisation should all be part of a monitoring, research and policy agenda for wellbeing in the digital age. However, because this is a new and quickly evolving area of policy, it is likely that not enough is known or understood to set policy directions or even know what to monitor. But it is clear that better use of data to bridge multiple dimensions of the issue could have major value in better understanding it.

Table 3: Addressing the impact of digital transformation on social inclusion through monitoring, policy and research: examples

National monitoring	Addressing policy gaps	Areas for further research
Better linkage of multiple dimensions of relevant social and demographic data	<p>Social inclusion analyses and impact assessments of government policies as a matter of course</p> <p>Protections against AI and algorithmic decision-aids impacting unfairly on immigration, justice, credit decisions etc.</p>	<p>Research on formation of internet-based and real life social groupings</p> <p>Culturally and social group disaggregated data on wellbeing indicators</p> <p>Linking SES and other social data and type of internet use. Are the benefits of the internet shared equally?</p> <p>Understanding drivers of individual and collective wellbeing and whether these are operating at cross-purposes and if this is exacerbated by digitalisation.</p>

4. Personal and public security

Whether for individuals or groups, one emergent issue of personal and public security relates to the increasing potential for real and immediate impacts from various forms of virtual, online and remote surveillance technologies. For instance, on one hand the concept of surveillance of public spaces may make people feel safer, but in practice is it also limiting personal freedom? Cyberbullying, and misuse of social media increasingly can polarise and fragment societies and threaten our sense of wellbeing, especially if they spill over into real-world actions. In the area of interpersonal relationships, the transition of online relationships to ‘in real life’ situations can have security consequences. It could be a minor who is enlisted into risk-taking behaviour in real life, or someone who has been radicalised online and goes on to violently enact their beliefs. In these and other types of cases, the persuasive and self-reinforcing nature of online activity carries an increased potential for real world consequences as the lines between our real and online lives increasingly blur.

Table 4: Addressing considerations of the impact of digital transformation on personal and public security through monitoring, policy and research; examples

National monitoring	Addressing policy gaps	Areas for further research
Existence of laws, policies and public education regarding individual protection and protection of minors	Law enforcement with specialised training for online environments	Qualitative and cultural understanding of various online forums, particularly those that incite violence or hatred against various groups.
Self-reported security incidents that can be linked to online activity	Review of laws for applicability in online (multi-jurisdictional) situations including various forms of cyberbullying	
National risk registers to monitor digital threats to national and economic security	Ensuring a balance of freedom from surveillance within public safety framework	
	The challenge of digital slander and libel	

5. Governance

In this discussion, the concept of governance includes democratic processes (e.g. public representation, electoral integrity, trusted public institutions, independent and reliable 4th estate) as well as fair and just delivery of government core services. While these two meanings of governance must be distinguished, they nonetheless both affect wellbeing and are themselves affected by the impact of digital technologies. Workshop participants recognised the significance of both concepts for a wellbeing framework, but engaged with them separately.

Table 5: Addressing the impact of digital transformation on governance through monitoring, policy and research; examples

National monitoring	Addressing policy gaps	Areas for further research
Existence of broad and proactive data regulatory/governance frameworks and ethical guidelines	More inclusive and broadly based ethical guidelines extending beyond individual focus	Applied ethics research to identify principles and guidelines for different digital technologies (concept of 'contextual integrity')
Accessibility of personal data held by organisations	Data strategies including data navigators for public access to open government data	Impact on decision-making of information overload, fake news and persuasive technologies
Registry of organisations holding private data (type, use etc.)	Citizen digital literacy (regarding data, media, persuasive technologies etc.)	Comparative research on regulatory regimes related to digital governance and public trust
Existence and training for long-form analytical journalism (J-schools)	Open government processes and related public engagement to build trust	Operational research on new uses of blockchain-based technologies (pro-social and anti-social)
	Exploring greater uptake of blockchain-based technology for open registries	
	Ability to guide behaviour of platform companies	

Discussion

One of the most significant themes to emerge in applying the analytical instrument was the need to attend not just to individualised concerns but also to collective dynamics. Too often wellbeing is considered only through the lens of individuals. Even the social and civic dimensions of the analytical instrument are really a reflection of the impact of these elements on individuals. There is a need to expand current analysis and monitoring to better account for collective action issues rather than strictly impacts on individual rights and privacy.

At the same time, privacy itself is a quickly changing concept in the context of digital transformation. Current definitions of privacy and privacy protection measures are being updated, but will they be sufficiently supple to address the multiple ways in which privacy is being affected and the ways in which the very notions of privacy appear to be changing? Technologies of monitoring and communication in particular have prompted more nuanced consideration of the specific aspects of privacy that really matter to most people rather than a coarse and all-encompassing notion. These specific aspects include *context* (where and how my data are used) *control* (my approval for various types of data use) and *security* (can my data be used for harm?).

But whereas these nuanced privacy considerations are most relevant to discussions of big data-driven technologies, other types of digital technology will have different impacts on wellbeing. For instance, how will the predictive functionality of AI and machine learning be balanced with the increasing inputs of private data it will require to 'optimise' user experiences and decision-making? How will rights to private thoughts (including changes of direction) be protected?

At the level of civic institutions, the project has identified the need to distinguish between governance and government in thinking about the impact of transformative digital technologies. For instance, the delivery of government core services through the use of monitoring and communications technologies is distinct from how a government comes to power and makes policy decisions. Both aspects affect wellbeing, but are themselves affected by different digital technologies in different ways. However, the overarching consideration that links the two concepts is a focus on the *quality and nature of human decision making* more generally. For instance, we might assume that a democracy reflects the aggregate of human decisions, but the quality of those decisions is now modulated by a combination of user-driven functionality, third party manipulation and algorithmic responses with cumulative effects on outcomes [13]. With regards to both mechanism and outcome, this is something worth monitoring, assuming that sustaining the current model of democracy is desired.

The generally accepted model of (western) governance and economics is predicated on the belief that the preferences and decisions of the voter or consumer are the ultimate authority [14]. But in manipulating these preferences, and thus decisions, can the owners of technologies short-circuit our economy and our system of government? Evaluating the impacts on consumer choice and democratic decision making will require further research to enable the development of reliable metrics. The complexity of the problem, however, is not a reason to ignore it.

Finally, the project also identified a number of assumptions that need to be confronted if a robust definition and framing of wellbeing in the digital age is to develop. To understand transformative digital technologies as drivers of change acting on the human values that underpin wellbeing requires an understanding of those values. This in turn requires an awareness of any bias (cultural, gender-based or generational) that may be influencing the perception of change due to digitalisation. For instance, the very perception of self, privacy and autonomy is not shared in the same way across all cultures. To be robust, a monitoring, policy or research agenda must take this into account.

Thus a complementary analysis on the impact of digitalisation on human values in the first instance would enhance the analysis. The Joint Research Institutes of the European Commission is developing a project on the 'science of values'

Digital transformation will have different impacts on wellbeing across different age bands. The impact on children born this year will be very different to that on people now in their seventh or later decade. Given some of the issues highlighted in this paper it seems logical and important to develop wellbeing indicators specific indicators to different age groups.

Conclusions

This project, prompted by the OECD's recognition of the broad impact of digital transformation, has revealed that the conventional understanding of that impact of wellbeing is limited and narrowly framed. To date, the majority of academic and policy attention has been directed toward the future of work in the face of automation and the impacts on privacy of individuals. Emerging scholarly commentary has begun to dissect impacts of digital transformation on democracy and the implementation of the rule of law [15-17]. However, a robust and holistic approach that draws all of these considerations under the broader perspective of human wellbeing is yet to fully develop. This report provides a step in that direction.

A broadly defined view of human wellbeing at individual, social and civic levels, that is analysed in the context of four core digital technology types yields at least five dimensions of wellbeing that merit particular scholarly and policy attention: human development and early childhood learning; mental health across the lifespan; personal and public security; social inclusion and trust; and governance and quality decision-making.

These five areas present the ideal opportunity for governments to engage proactively on the impact of the digital revolution. For some, monitoring and evaluation may already be feasible and easily done. For others, more knowledge or a policy response will be required first.

What is clear is that technological and social change is upon us and the speed will only increase. The five identified areas require deliberative and proactive attention by governments because the stakes are too high to ignore or to leave to the market to resolve.

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Appendix 1: Expert workshop

The workshop assembled a multi-disciplinary group of researchers with expertise in psychology, evolutionary biology and human development, sociology, social anthropology, ethics, policy studies, media studies, political philosophy, data science, AI, statistics, and monitoring and evaluation.

It opened with presentations on OECD's *Going Digital* project [4] to examine the impact of digitalisation. These interventions presented the context of the present work on wellbeing, which is one of the dimensions to be monitored within the OECD project. Background on wellbeing monitoring was presented along with a discussion of how indicators are derived and operationalised. The OECD presentations are included in attachment to this report.

Participants at the workshop used, as an analytical instrument for reflection, a set of three tables listing general and longheld 'human institutions' (see appendix 2). These tables, which had been prepared and circulated in advance of the workshop by the authors, served to prompt conversation on current and potential digital disruptions and their relative impact on human wellbeing.

As a tool for reflection, the tables took as a starting point the OECD's framework for measuring wellbeing [4], and identified the gaps related to the impact of digitalisation. As such, the tables framed wellbeing from a sociological perspective which considers the institutions of self, of social life and of civic life. This 'onion' model is similar to social determinants of health models, which are already commonly used as the basis for many frameworks, while emphasising the specific impacts of digitalisation.

In small groups, participants were invited to critically consider the framing and content of the each of the institutional elements of the tables, bringing to bear their own domains of expertise. It was noted that the possible disruptions listed on the tables exist at multiple levels of analysis (e.g. objective material conditions, contextual features, and individual self-perception).

It was also noted that to draw the causal link between a given digital disruption and a feature of human wellbeing is challenging for some of the identified elements. Nevertheless, it was felt that the impact of digitalisation is sufficiently pervasive at multiple levels of human endeavour that we should not be limited by existing measures and methods of analysis in order to better understand it. For this reason, participants were asked to identify not just indicators (where these were possible), but also policy and knowledge gaps and areas where more research was needed.

Where knowledge gaps were identified, participants also discussed the type of research that might be needed in order to fill these. It was noted that in some cases, the response could be as straightforward as adding some pertinent questions to existing national measurement exercises (e.g. socialisation questions added to early childhood education and development surveys). In other cases new research and data gathering exercises would be required (e.g. national mental health/wellbeing surveys). It was further noted that some small scale qualitative research should be undertaken to help identify and probe key areas of digital disruption and new definitions of wellbeing (e.g. changing concepts of privacy and the 'multiple self') in the digital age before larger scale metrics could be identified.

Workshop participants

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Annoni, Alessandro	Joint Research Centre of the European Commission, Digital economy
Barber, Michael	Fellow, Australian Academy of Science
Binder, Jens	Nottingham Trent University, Cyberpsychology
Deschenes, Mylene	Office of Quebec Chief Scientist, ethics and legal counsel

Gluckman, Sir Peter	University of Auckland Liggins Institute, NZ Chief Science Advisor, Chair, INGSa. Evolutionary medicine, developmental biology and medicine, public policy
Gropas, Roubini	European Political Strategy Centre (EPSC) European Commission
Gupta, Abhishek	McGill University, AI Ethics and computer science
Harayama, Yuko	CSTI Japan, and Cabinet Office
Heaton, Chris	Department of digital culture, media and sport, UK
Heikensten, Lars	Nobel Foundation
Kennedy, Helen	University of Sheffield, Digital society
Langedijk, Sven	Joint Research Centres of the European Commission, Finance and economy team
Mair, David	Joint Research Centre of the European Commission, Science advice to policy
Manclossi, Silvia	Office of National Statistician, UK
Murtin, Fabrice	OECD, Statistics directorate
O'Sullivan, Barry	Insight, Centre for Data Analytics, Ireland
Pilat, Dirk	OECD, Science, technology and innovation directorate
Shah, Hetan	Royal Statistical Society, UK
Snape, Dawn	Office of National Statistician, UK
Ubaldi, Barbara	OECD, Digital government and open data
Verhoef, Petra	Rathenau Institute, Health and society

Whitehouse, Harvey Oxford University, Anthropology

Wilsdon, James University of Sheffield, Political science, Deputy Chair, INGSA

Wilson, Sir Alan Turing Institute

Appendix 2: Analytical tool

Institutions of the self

	From...	Towards...	Potential opportunities	Potential unintended consequences and inequities
Human development	Early learning by experience and imitation from family and care givers aided by formal instruction; The importance of physical play to build social skills and non-cognitive functions	Increasing use of digital device-based learning in place of interpersonal learning. Less interactive and potentially less inter-human play Less 'reality testing' in defining exposures	Broader range of learning possibilities and skills development (e.g. allowing disadvantaged or isolated communities access to quality education) ...	Potential negative impact on acquisition of key skills in human development; Exposure to unreal and hyper stylised experiences influencing interpersonal skills development (added effect of violent, abusive or anti-social exposure); Changes in attention time affecting learning; Change in risk taking behaviour, change in personality development (e.g. narcissism, conduct disorder), changed view of nurturing and authority roles Greater likelihood of exhibiting lack of self-control under stress; Conduct disorder and mental health concerns

	From...	Towards...	Potential opportunities	Potential unintended consequences and inequities
Measures of self-worth	Job, salary, and other socially scripted milestones at socially scripted times across the life trajectory	Celebrity: 'friends', 'likes', 'views', 'shares' (move toward extrinsic measures from intrinsic?); pervasive measurement of performance and algorithmic mitigation for productivity (job, social, physical fitness and diet, other); The 'quantified self movement'; Changed expectations of time (instant gratification, instant expertise, instant fame)	Better monitoring of performance standards create more scope for self-improvement and can offer personally tailored opportunities for interventions or growth; more access to diverse images of self especially for isolated or marginalised individuals (e.g. LGBTQ)	Increased pressure to portray idealised self (mental health) ; automation could replace sense of personal fulfilment leading to the need to find other expressions of human worth; pressure to compete with machines in the workplace; need to adapt education systems; fewer opportunities for natural growth and development without monitoring and intervention; achievement-oriented child development at the cost of intrinsic character development; Individual reputation harder to protect against slander, rumour.
Opportunities for self-expression and self-actualisation	conventional education, training, career advancement or artistic expression	More expansive self-taught, artisanal, entrepreneurial opportunities	Greater freedom of self-expression; Lower barriers to entry into desired sector; more diversified communities of practice	Greater potential for artifice and self-doubt. Mental health issues ensue, especially in developmental stages of adolescents and adulthood; false or unverifiable claims of expertise
Personal health care	Emphasis on doctor-patient relationship; skills required to obtain information (augment the amount available)	patient-managed care; skills required to distinguish information (reduce the amount available); increased use of pervasive monitoring (quantified self) and algorithmic decision-aids	Fewer human errors in diagnosis and treatment decisions; portability of care through e-health record-keeping; patient empowerment through: Fitbit and other personal data collection management; ability to connect to patient groups (for support and information)	Patient-managed care assumes a basic level of health literacy, which can contribute to inequalities; Errors in self-diagnosis and treatment; Undue influence of new tech on medical best practice; Decision-aids may neglect important aspects of personal contexts including cultural paradigms for healthcare interactions; focus on quantified personal data monitoring rather than meaningful lifestyle habits/changes; digitally-aided testing or diagnosis outstrips ability to treat

	From...	Towards...	Potential opportunities	Potential unintended consequences and inequities
Privacy	Identifiable organisations responsible for stewardship of personal data. Accountabilities and terms are mutually understood	Broadened diversity of organisations (public and private) holding personal data. Uncritical sharing of personal data within supposed social networks or as the price to gain access to perceived benefits; the private becomes public through pervasive social networking and changed assumptions of sharing personal information	Changed public attitude to privacy standards enables innovation	Diffuse responsibilities for safeguarding privacy mean no one is responsible; No obvious recourse; increasingly difficult to exercise "right to be forgotten"
Autonomy	Life and decision-making skills acquired through training and experience	Reliance on life skills and decision aids and automation;	Reach level of supposed 'maturity' and 'mastery' more quickly and with less effort; time saved can be devoted to other pursuits; cumulative effect of faster upskilling	Effects (possibly cumulative) of deskilling at individual and population levels
Self-sufficiency	Sustained work and obvious career paths	Constant or frequent retraining or directional changes	More diversity and flexibility in professional life; global workers; peer-to-peer lending and trading reducing barriers to entry into the market	Generational disadvantage, uncertain income, middle class squeeze; effects of deskilling (practical and social skills)

Institutions of social life

	From...	Towards...	Potential opportunities	Potential unintended consequences and inequities
Social interaction	Often proximal and potentially more in-depth	Increasingly remote and potentially more superficial.	Increased ability to crowd source material and presumed emotional support when needed; ability to establish and enhance social interactions is without limit. New forms of meaningful contact delivered by AI	There is specific documented impact on adolescent development and potential for poor mental health outcomes; Loss of meaningful human contact with increased everyday automation; heightened self-awareness and constant comparison can lead to anxiety; Fear of Missing Out (FOMO)
Public education	Teacher as authoritative and respected figure in classroom (albeit 'inverted' classroom); Balanced 'liberal arts' formative education in primary to early secondary years Primary and intermediate education as much about developing pro-social skills as literacy and numeracy	Increased reliance on devices to access authoritative knowledge. Increase in 'BYOD' learning Gamification of learning Significant emphasis on ICT curriculum with consequent trade-offs for pedagogical space.	Teachers can focus on most needy learners while others self-guide using devices Access to knowledge and expertise regardless of location Better engagement of hard-to-reach students	Potential erosion of teacher role (impact on number of teachers?) BYOD classrooms serve to emphasise inequity among students and the digital divide Reinforced incentive and reward system rather than intrinsic value of knowledge or critical understanding
Population health	Promulgated and operationalised through primary healthcare providers and other community-based sources	New channels of population health information and intervention (big data trend tracking, precision messaging...)	Social media interest groups able to amplify support for population health intentions via social media; etc.	Social media interest groups able to undermine population health intentions via social media; etc.

	From...	Towards...	Potential opportunities	Potential unintended consequences and inequities
Friendship and fellowship	Social and support networks mostly grounded in direct personal and shared experiences	Social and support networks can grow from shared beliefs, ideas, motivations, but without direct personal experience	Increased ability to crowd source material and presumed emotional support when needed; ability to establish and enhance social interactions is without limit	Potentially less stable social support when not backed by frequent real interaction; distinction between 'real friends and Facebook friends'; uncharted territory of robot-human friendships
Romantic partnership	Often identified via personal and shared experience (place of work, study, worship, network of friends etc.). Often legitimised and supported by extant social network	Broader scope of potential partners, not limited by geography or social circumstances, yet potentially reduced diversity of selection pool due to use of algorithmic selection criteria	Potentially removed from extant support networks, which could allow greater personal freedom	Distance from extant support networks could also lead to more volatility in the absence of sanctions from trusted peers for behaviour that may hurtful to a partner. Human-machine emotional relationships
Family	Legitimacy and authority of parenting roles is inherently recognised	Parent-child dyad mediated through technology (device games, movies, interactive apps that mimic socialisation or parental guidance...	Diversifies sources of parenting advice and influences; Technologically assisted parenting; allows for involvement of extended family not in proximity; Greater exposure to healthy parenting practices	Parents (and children) in a constant state of semi-distraction in a 24/7 communication and work environment (potential of flexi-time backfiring); relaxing of family standards and parameters for child mental/social development
Societal values (western)	Societal values date to post-enlightenment Europe: social responsibility is balanced with concepts of autonomy and personal rights and social responsibilities that are underpinned by a shared understanding of socially defined values.	Underpinning institutions that protected post-enlightenment western values change and values themselves turn out to be more malleable than generally assumed.	Greater opportunity for community-building that is not bound by geography. Sharing economy and social innovation can thrive. Speed of communication allows better flow of ideas; opportunities for pluralism and diversity through greater exposure not limited to physical proximity	Nature of 'communities' fundamentally changes through expansion of platform tools (e.g. Airbnb effects on neighbourhoods); speed of communication enables normalisation of ideas previously considered anti-social; impact of breaches of societal values quickly lose significance (e.g. compare the enduring societal impact of Port Arthur Australia to similar events throughout the 2000s)

	From...	Towards...	Potential opportunities	Potential unintended consequences and inequities
Cultural expression	Geographically and traditionally defined modes of expression	Active structuring and mediating of culturally relevant digital content.	Greater reach of culturally relevant learning and expressive opportunities. Diaspora and heritage language communities can be better linked. Culturally relevant/driven commercial or political resources/opportunities expanded	Cultural appropriation or discrimination might increase through online platforms or be more difficult to address; reliance on algorithmic results or decision making could exclude culturally relevant aspects...

Institutions of civic life

	From...	Towards...	Potential opportunities	Potential unintended consequences and inequities
News media	diversity of news consumption help to form personal opinion or stance on topics of personal and public interest	Less diverse consumption of news as media is algorithm-driven to be personalised and cater to already entrenched views and tastes; Yet, also opportunities for consumers of news media to be producers (prosumers)	'Democratisation' of media allowing marginalised voices to be heard. Otherwise under-reported stories can attract greater attention, particularly where corporate mainstream media is interested. No need to rely solely on journalists (of which there are fewer in a corporate media market) to play 'critic and conscience' role	Opinions on issues may become more polarised and entrenched at a population level; Views are supported by like-minded peers; Phenomenon of 'fake news' and lack of trust as in the 4th estate, yet the alternative (bloggers, prosumers) does not meet conventional journalist ethics and integrity standards. Decline in civic reason
Politics	In democratic societies, participation in civic life through political campaign and voting at municipal, regional, national levels. Public participation in politics requires personal hands-on) effort (meetings, leafleting, physical voting etc...); Formal institutions of government have broad public legitimacy but are largely opaque to the public	Less diverse input into political discourse as media is algorithm-driven and persuasive technology delivers bespoke messages to entrenched views; Public opinion data and opportunities for micro-messaging given more scope to drive political agendas; Institutions are made more accessible through pro-active information posting,	Public participation in politics requires less personal effort (virtual voting, online enquiry submissions, livestream political events etc.), which can increase engagement and voter turn-out; Better opportunities for marginalised views to be heard by elected officials (no need to rely on formal channels or elections to express opinion and have it heard)	More entrenched political views and less opportunity for consensus building, particularly on controversial topics; Groups negatively economically or socially affected by digital revolution may feel let-down by democratic process and become further marginalised by not participating; More adversarial styles of politics; Ironically, more public scepticism and loss of authority of formal institutions as they become more open; Greater access to information can serve to obfuscate the process (including intentionally); potential for political and social issues from one jurisdiction internationally to influence another, regardless of distance or connection to the actual issue.

	From...	Towards...	Potential opportunities	Potential unintended consequences and inequities
Governance and public service	Sovereign nations exert policy and regulatory control over matters in their jurisdiction: taxation; environmental protection; public safety; public health; matters of public interest such as housing, etc.;	Regulatory influence of platform companies in hospitality, transportation, retail, freelance services and a growing number of sectors yet to be imagined; private sector become custodians of public data assets through cloud applications	More innovation opportunities that can benefit individuals and communities; digital public services create efficiencies in the public sector whether through data-informed decisions or government e-services (health, education, justice, transportation, citizenship etc.); opportunities for direct democracy through efficient polling technologies and other tools	Market forces and the rise of 'prosumers' in an increasingly platform based economy are able to circumvent or advocate against policy and regulatory controls such as income tax or public safety (e.g. example regulating number of hours driving commercially or on other job sites; measures to curb short term rental accommodation and promote affordable housing, etc.)
Income redistribution and national fiscal levers	Sovereign nations controlled their tax base, could predict income tax flows and could control their (reserve) currencies	MNCs and platform companies exert greater fiscal regulatory control; crypto-currencies are an increasing reality; Change in domestic income flow changes tax base	Greater consumer choice and power; more and greater availability of tools that drive the circular economy (e.g. time banks and local currencies)	Core roles of the sovereign state compromised (e.g. reserve banks); hidden transactions; Unpredictable tax base; State's ability to meet citizen's expectations and manage the economies declines with socio-political and environmental implications; emerging security risks (personal and national)
Rule of law	Individual(s) found responsible for breach in rule law can be held to account; States power to set and enforce laws is recognised (civil, criminal, corporate, constitutional, environmental)	Decisions or actions are increasingly undertaken by autonomous non-human entities such as self-improving algorithms or robots; Platform companies overriding sovereign nations' law-making through market forces	Fairer application of laws? Fewer human errors in adjudication of a case? Faster access to legal counsel	Less ability to identify individuals or organisations to hold accountable (e.g. what kind of accountability to assign to a robot or an algorithm for wrongdoing or adverse outcomes?); Loss of sovereignty in regulation (e.g. environmental, fiscal, social policy, ethics...) Libel law no longer effective; loss of legal paradigm (innocent until proven guilty) in the face of public outing.