The digital economy and society (DES): A preliminary commentary[1]

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Preamble

This commentary emerged from discussion at the OECD Science Technology and Innovation Advisory Group meeting in April 2016. The topic of that meeting was the "digital economy and society (DES)". In the course of the discussion, it became clear that much greater consideration should be given to the current and expected societal impacts of digitalisation and internet-based technologies.

Impacts include not only the manifest benefits of such technologies, but also the implications of what may be the largest and certainly fastest shift in individual, societal and economic relationships and power dynamics that humankind has ever faced. In this context the phrase 'hope and fear' was used by several members of the STI Advisory Board to describe the rapidly evolving scenarios. The outcome of the OECD conversation was an agreement that I would produce an overview of the issues as a discussion paper in consultation with the Small Advanced Economies group[2]. This paper is a slightly expanded version of that paper taking the New Zealand context into account.

In this paper, I use the term 'digital world' to refer to internet-based and related technologies. These include, but are not limited to, machine learning, artificial intelligence, remote applications, social media and crowd-sourcing, accessible big data, and now increasingly, the 'internet of things' to name the most current.

This paper can only be considered as an extended abstract; that is a superficial survey of some of the main issues. It is intended to assist discussion and does not attempt to undertake a deep dive into each issue raised, nor does it support each statement with extensive background material. By its very nature the paper encompasses some sweeping generalisations: exceptions will be identified and different value judgements made about the opportunities, risks and concerns that are raised. The paper is intended foremost to prompt reflection and discussion.

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[1] *I thank colleagues from the OECD, the SAEI, NZ experts and my staff for comments on drafts.*

[2] *The Small Advanced Economies Initiative (SAEI) is a policy think tank of senior officials from New Zealand, Singapore, Israel, Ireland, Denmark, Finland and Switzerland. Its focus is science, innovation, economic and trade policies, as well as on national 'branding' and projection on the international stage. Its secretariat is based in the Office of the Prime Minister's Chief Science Advisor in New Zealand. A draft was circulated prior to and then discussed at the SAEI principal's meeting in Dublin in Sept 2016 with further feedback provided by some participants.*

1. Introduction

It is not the purpose of this paper to ignore or downplay the positive effects and innovative potential of digital technology, nor conversely, to take an alarmist position. Rather, in particular it seeks to highlight potential issues that are emerging from the inevitable and rapid digital revolution and which merit reflection. The digital revolution certainly creates some challenges that appear beyond obvious means of societal regulation or control (beyond 'the market'), yet have far-reaching implications at all levels of social organisation, from the individual right through to the nation-state itself. In itself this merits the development of a far deeper discourse between policy makers (both nationally and in globally), scientists and innovators, public and private sectors, and civil society.

Virtually all technologies that humans have invented or will invent present both benefits and risks. The history of humankind is that of invention, development and exploitation of technologies while managing the downsides. However, it is the speed and global pervasiveness of digital technological change and the scope of such changes across virtually every aspect of human endeavour that generate an enormous array of possible implications. Such characteristics undoubtedly set the digital/network revolution apart from past technological revolutions in the way they challenge aspects of human behaviour and social institutions.

Much of this, as in the case of many previous innovations, is created by individual entrepreneurs or companies. The inherent nature of digital technologies, while profoundly affecting individuals and society, means that they have not been generally subject to significant pre-release discussion, societal debate or anticipatory regulatory processes. Such 'trial by market forces' has been the history of many - but not all – technologies in the last two centuries. However, in situations where there *has* been anticipatory regulation to limit the use of particular technologies, this has generally been driven by perceived financial risks to existing firms rather than any other type of risk assessment (even though the arguments may often be dressed as the latter). In other words, it is rare for there to be deliberative societal reflection and debate that goes beyond managerial risk assessment and which would address the normative ("ought we?") questions surrounding the introduction of new technologies.

In general governments are either very precautionary or conversely, they are rather hands-off with regard to new technologies. In the latter case they may then have to react to any consequences that follow. To some extent this is the classic conundrum of risk assessment in that the arguments for or against any technology are always filtered by an assessment of likely gains and losses (and by whom).[3]

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[3] *See my recent essays on decision making in the face of uncertainty;* http://www.pmcsa.org.nz/wp-content/uploads/PMCSA-Risk-Series-Paper-1_final_11May2016.pdf

In the case of the digital technologies the perceived immediate and generalised benefits, especially of the internet, have meant that there has been rapid adoption of the technologies, while the broader implications have been given little robust critical consideration.

Consequently, societal and regulatory precaution has largely been non-existent. However with more generalised access and the explosion of internet-based technologies, products, services and apps some concerns are now emerging. Further, the inherent nature of both current and future digital technologies means that many elements may well be beyond either a precautionary or even a *post-hoc* regulatory approach. In contemplating the rapid development of the internet-of-things, artificial intelligence and machine-learning, the indications suggest that we are only at the start of a very rapid change in societal, consumer and citizen behaviours. With such change, there are implications for the way people live their lives, how societies operate, how democracy works and how State authority can operate. These issues demand deep consideration. Indeed, some newer technologies will challenge us in many ways – for example to what extent will artificial intelligence ultimately affect our sense of autonomy and self- determination? As with any fundamentally disruptive technology, there will be both foreseen and unforeseen consequences and with them, winners and losers.

But beyond the obvious issues such as the changes in manufacturing processes and in service delivery that affect traditional industries and employment patterns (with both personal and political implications), there is now also a rapidly emerging set of broader of issues that society must consider. In general, nation-states are only now starting to discuss the numerous implications that the digital revolution brings. There is a growing recognition of the profound and irreversible changes that the digital revolution is bringing to the role of the State, the social fabric of nations and for individual citizens and their relationship to each other. The key consideration is obviously the extent to which these changes are serious and are a cause for concern. With that, the question is which concerns can be dismissed as alarmist, or if not, can we adapt to the inherent challenges that arise and optimise the opportunities? Clearly the perception of risks and benefit will differ amongst stakeholders. It is beyond the scope of this abstract to take a position on these issues.

It is important to recognise that both direct and indirect effects arise from the adoption of digital- and internet-based technologies. For example in some cases it is not easy to distinguish the impact of digitalisation from other trends such as economic globalisation that, while a separate phenomenon, is greatly facilitated by the digital world.

2. The benefits of digital technologies and DES: a growing list

There are undeniable and numerous manifest and potential benefits within DES, which have generally been well-described elsewhere and which are self-evident. The many benefits have been heavily promoted both by governments and industry and can only be summarised here.

The OECD has published a number of reports[4] pointing to the positive effects of digital innovation and technologies on productivity.

Clearly the digital revolution is spurring innovation, enhancing service delivery in every sector and leading to increased productivity. However, a mismatch has emerged between the extent of the expected productivity benefits of digital technology investment and the consequent impact on economic growth as measured by GDP. This mismatch may reflect the limitations of the latter measure or temporal phenomena, but the digital economy may also exert some unrecognised drag through other effects such as the effects on labour – some of this is discussed later.

Obviously the digital revolution has played a major part in the globalisation of economies through talent and value-chain distribution. Rapid information transfer and access, data-sorting and trans-national capital and financial interactions have all become essential to the globalised economy. It has enabled a new wave of fiscal instruments (e.g. derivative markets etc.) that have played a major part in the development and sustenance of some economies. Internet- based technologies have allowed a global trade in services to develop alongside that in goods. This has benefited a broad range of economies.

Big data has enormous potential for the development of new kinds of services and opportunities such as for forecasting in financial services, policy-making, and in advancing science. The data revolution has already generated new forms of business and business models where information is gathered, often for no cost, then mined, manipulated and sold at great profit (e.g. Facebook).

Some governments are investing heavily in data management and services specifically to support public policy making and this investment has led to novel framing for the policy discourse (e.g. adopting a social investment model in national budgets as in the case of New Zealand). For society and for the individual, better data management by governments has brought practical conveniences such as e-citizen services (e.g. passports, tax services etc.), e-health and mobile-phone mediated health services.

Internet based technologies have brought markedly enhanced communication capabilities and improved information access to both individuals and organisations including companies. The consequent empowerment of individuals in both economically developing and developed countries through access to networked technologies such as smart phones and their plethora of 'apps' has conferred major benefits. In general the internet has given great benefit to individuals, organisations, companies and science.
The almost immediate accessibility of information and knowledge can create social mobility. For many people it has also created new social connections, reduced isolation and a sense of personal empowerment.

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[4] *http://www.oecd-ilibrary.org/science-and-technology/oecd-digital-economy-papers_20716826*

The use of leisure time has also been drastically changed by the digital revolution through access to a broad range of entertainment media as well as on-going engagement with social media. These are now the dominant forms of leisure for many (particularly for the younger 'digital native' generations).

3. Emerging issues related to digital technologies and DES

Despite these clear benefits, the challenges of the digital revolution are also becoming apparent. Many will require due consideration by societies and their governments. These challenges will be considered below at three overlapping levels: the nation-state; communities, and the individual. The impact on education systems is discussed separately.

3.1 The reach and authority of the State

The digital economy and digital and internet-based technology more generally have led to the rapid rise of major transnational companies with unique knowledge and extraordinary access to data, and with consequent ability to influence individuals, governments and global affairs. Transnational corporations have existed for centuries (for example the Dutch East India Corporation, which was founded in 1602, or the Hudson's Bay Company founded in 1670). But digitalisation has led to a qualitative change in the reach of today's transnational corporations; this is particularly so for the digital platform companies (eg Google, Facebook etc).

For instance, the ease of access to taxation minimization strategies is now greatly enabled, if not empowered, in a digitally connected world. Such practices are clearly challenging the traditional income base of sovereign States. Indeed, the sovereign authority of the State to regulate many socio-economic activities may be eroding. Regulation of marketing and some aspects of consumer protection (e.g. pharmaceuticals, alcohol, tobacco, or products aimed at children, etc.) are made more difficult with a globalised cultural economy of sales and marketing via the social media and the internet more generally. And any ability to prevent harmful messaging or communication (e.g. terrorist related, cyber-bullying, sexual predation) is similarly impeded.

Within social media there is also clear ability to engage publics and to create social movements for both good and bad. The need to protect and promote freedom of expression while sanctioning predatory practices and protecting vulnerable groups is obvious, but how best to do this is not. Are we experiencing a neo-imperialism with de facto 'global' internet standards set by the companies with the most dominant online presence irrespective of national values? Where national values do exert themselves, they can be difficult to maintain in the face of internet giants. This is seen in the very different approaches to internet privacy taken by Europe and the USA and in the subsequent legal battles emerging over issues such as internet neutrality and rights of individuals to privacy.

The issue of ownership of and access to data creates many issues. For example the recent debate in the USA over access to data on a cell phone to reach into a terrorist investigation illustrates the inherently conflicted issues that are emerging.

The development of widely-encompassing horizontal platforms such as Google has greatly accelerated globalisation and in many ways has 'flattened' traditional societal structures and hierarchies. While this can be seen as empowering of citizens, the pervasiveness and misuse of such platforms can have impacts on policy-making that are not necessarily positive (e.g. the effects of the platform technologies themselves diminish the power of competition policy and the regulation of commerce). Further they have crimped the power of the nation- state itself to manage nefarious social practices such as gambling, pornography etc.).

Even sovereign States' traditional control of financial and treasury infrastructures is not immune to the effects of rapidly advancing digital technology. The 'block-chain' technology that underpins Bitcoin represents the kind of technological development that could greatly enhance the ability of the State to reliably manage internal payments while reducing the potential for (say) welfare fraud. However, the disruptive aspects of this technology mean that the fundamental role of financial institutions (and by extension, the State's financial regulatory reach through these institutions) could diminish. In addition, it is not clear that we have fully considered the darker possibilities of the block-chain system particularly if associated with advanced encryption capabilities. Could these undermine traditional banking systems and undo the progress made to date on greater financial transparency?

Highlighting the dark side of the internet can be dismissed as fear-mongering, but there is good reason for governments to be concerned. The rise of ISIS and other terrorist activity has clearly been greatly aided by the digital and communication revolution that allows for secure messaging alongside broader recruitment possibilities. Further, the 'darknet' is extensively used by criminal organisations for financial crimes and trading in illegal materials. Bitcoin, while it has legal uses, has been linked to activities seeking to avoid oversight by the State (e.g. in the illegal arms and drug trade).

The rise of cybercrime in the past two decades (from deception to phishing to industrial and political espionage) has created a cyber-arms race in which any internet-connected system is potentially vulnerable.

The rise in cyber-attacks, cyber-espionage and unauthorised information leakage is a major threat to the security of states as well as to legitimate enterprises within them. Cyber-security relies both on technology and on human factors – while human factors have always been a risk for companies and states, the volume of information that can be accessed and thus the potential impact of security breaches have magnified enormously. Further, not only are risks created by commercial and security espionage, but also by the insertion of malware and misleading information into critical systems. We have seen increasing evidence of

cyber-espionage being used to affect democratic processes and being used to harm individuals (for example in various hacks of private data being released into the media). Traditional libel laws become less meaningful.

The nature of warfare is changing as a result of the digital revolution, including the potential for new forms of asymmetrical warfare. With an increasing amount of personal, professional and government transactions conducted online, we have created new targets for attack and the risks of cyber-sabotage create new challenges for national security. The dependency of society on an effective integrated digital system may create points of extreme vulnerability; a Carrington–level solar radiation event would be a natural equivalent.

At the same time there has been a massive rise in the ability of sovereign states to monitor activities of individuals and enterprises. Part of this is in response to the issues discussed above, but part happens because 'it can be done' and can enhance the efficiency of multiple agencies including those associated with public safety. With this however is the risk of a shift in the perceived and actual relationships between the State, private citizens and the public safety apparatus. While big data offers enormous opportunities for states (and businesses) to provide better and more targeted services to citizens and to inform public policy, the risks to individual privacy or other forms of misuse by governments mean that transparent and well-understood social consensus is needed between the State and citizens regarding data use. The recent concerns over an integrated health data system in the UK highlighted the fears of the public and the challenges created if nation states move ahead of social consensus. The Data- Futures Forum[5] is an important part of New Zealand's attempt to reach such a consensus.

Similar issues over the misuse of data that are held by private sector companies will almost inevitably boil over at some stage even if companies claim to be responsible stewards. At the moment most of us are probably relatively unaware of the amount of data held by companies. The ubiquitous use of Facebook and fads like *Pokémon Go* are reminders that corporations are able to extract large amounts of data from individuals under a regime of presumed consent, presumably for financial gain but without the public being really aware. As data from the private sector get on-sold its potential for misuse by unknown groups grows. Such on-selling without consent is likely impossible to regulate across national borders. The recent Facebook experiment[6] that intentionally manipulated the mood status of unwitting users without their consent and with totally inadequate ethical oversight highlights the potential power over individuals and society that lies in the hands of internet companies.

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[5] *https://www.nzdatafutures.org.nz*

[6] *Kramer et al 2014: http://www.pnas.org/content/111/24/8788.full.pdf*

The greater access and immediacy of information (of variable quality and reliability) to private citizens is also affecting the nature of democracy and public discourse. The nature of journalism (and the fourth estate more broadly) has changed dramatically and this has been accelerated by the digital revolution. It can be argued that this is having an impact on democracy, at least as it has been practiced for the last few decades.

The rise of the transnational social media and citizen journalism, while empowering citizens, has also challenged the traditional institutions on which democracy relies. The extent to which this is a direct effect of digitalisation may be debated but there can be no doubt that this shift is empowered by the digital revolution. Internet-based and social media have accelerated the demise of traditional journalism – an institution of democracy that is marked by its rigour, its ethics and its professional codes of practices. By contrast, citizen journalism may open the landscape to a diversity of voices, but how many of these meet standards of professional journalism? Unfortunately, the marketplace dictates that extreme opinion and sensation is more lucrative online than journalistic rigour.

Budgets are cut and serious media outlets are losing their capacity as an instrument of true democracy. In the competition for an ever-distracted readership, complex issues are trivialized either through sound bites, click- baiting or sensationalism and where effectively there is no editorial responsibility for accuracy. This perception of a decline in the quality of national discourse is amplified by the 'echo chamber' effect of social media in which individuals have their biases and egos reinforced by only hearing from people with similar views. Has democracy been harmed by an increasing disregard for both accuracy of information and quality in-depth analysis?

Representative democracy has long been the mechanism by which elected individuals are charged with understanding, assessing and making decisions about complex issues on behalf of citizens. However, now the immediacy of digital interaction is such that a more direct engagement is emerging. Unfortunately, this engagement is not always underpinned with quality information. People can form views based more on reinforcing their biases again through their own 'echo chambers' of social media than on evidence. At the very least this is misleading. In turn, it limits the scope of serious and informed public discussion and debate. The ability for quite misleading information to be widely distributed can and has already affected democratic processes in some countries as well as how societal consensus is formed.

The recent outcry about false news being created and promulgated by social media is accelerating progress towards what has been called the 'post-truth society.' In a sense this is nothing new in that false claims have been put forward for centuries for political and other purposes. However, what is new is the pervasiveness and speed with which misinformation can be spread either intentionally or unintentionally, with virtually no accountability and aimed at communities already primed for such misinformation. Here the social networks seem to legitimise the lies, by cross-referencing each other as sources.

3.2 Impacts on society

We now have at our disposal rapid ways of transmitting greater quantities of information. But how to separate the reliable, the unreliable and the outright lies? How to filter highly variable information and sources? Doing this well is made more difficult because of the conscious and unconscious biases in the way we select and curate what information to receive (not to mention the information that is selected for us via scripted software algorithms – for example there can be biases in what search engines deliver to us based on our known pattern of interests) and in the way we check and evaluate the veracity of information.

On one hand new digital technologies have broadly empowered many citizens, giving us rapid access to services and information that we would not otherwise have. But the trade-off is the obligation to provide information, consciously or not, to third parties that people may not normally wish to share. The vast amounts of information now held by the private sector has the potential for manipulation beyond the already ubiquitous selective commercial messaging now integral to the products of the major search and information–based companies (examples have already been identified). Many people are unaware of the large amount of information that the private sector now has about them and the lack of control over how that might be used. Indeed, what companies might consider consent or presumed consent for collection and use of private data could be interpreted as coercion given the reality that it is almost impossible to refuse to accept the major internet platform companies' terms.

The emergent issues of privacy and data ownership are growing rapidly. There are fundamental questions related to the balance of rights between an individual's privacy, freedom of expression and the importance of free enterprise. In general, all countries have yet to resolve how the 'right to privacy' should be maintained in a digital world on one hand, and how this is to be balanced with a right to free enterprise and the promotion of innovation on the other, especially now that 'big data' is the new 'gold-rush' for business. Even though many databases, both public and private, imply or assure anonymity, the reality is that anonymity cannot be assured – it has been repeatedly shown that identification of anonymised data is possible, particularly where databases are linked and data points are cross-referenced.

A further issue has been highlighted in a recent White House report[7] that considered the potential risks posed by biased algorithms that affect various uses of data such as decisions over individual credit ratings and indeed, even influence decisions made by government (e.g. in sentencing guidelines). Algorithms need to be both transparent and tested for potential or latent bias.

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[7] *This appears to have been a factor in the recent USA presidential election*

While organisations (public or private) may well have acceptable guidelines for managing data, the potential for misuse (whether malevolent or inadvertent) exists and may be beyond the reach of governments or citizens themselves to control. The recent debate in the USA over governmental access to the concealed contents of a terrorist's cell-phone shows the complexities ahead.

There is a related set of concerns that are developing around the future of employment; this is a major topic and will not be given extensive discussion here. But there is a widespread acknowledgment that digitally-driven innovation is reducing traditional job opportunities. This is certainly the case for incremental innovation that is essentially about driving greater efficiency in firms. But disruptive innovation does not necessarily provide jobs in volume and at appropriate locations - in many cases the evidence is otherwise[8]. Even with vocational retraining, success in regaining jobs lost to automation may be lower than is frequently stated. The rise of machine learning and artificial intelligence will almost certainly lead to further losses in vocational areas that, to date, have been relatively immune to job loss. The policy issues that emerge from this are already challenging to governments and societies and can only grow.

The social consequences cannot be ignored. In turn, disruption of the traditional labour market may have major implications for the social structure of societies, signalling the need for a social safety net to support those affected, at least for the transitional generation. This is in fact one of the arguments that underpins a growing discussion about universal basic income policies. The pace of digitally-driven innovation may well lead to major generational divides. Effort will be required to maintain inclusivity for those who could be excluded by age, locale or disadvantage.

Paradoxically the digital world can also compromise the work-life balance in the opposite direction by virtue of the fact that many workers are never truly 'switched off'. This situation is exacerbating the work inequality -- increasing the workload of some while compromising the work potential of others.

Taken together, these issues surrounding the digital revolution are probably contributing factors to a growing sense of societal discomfort and the rise in antagonism to globalisation in various sectors of society. The issue becomes: how to address this unease given the irreversibility of the digital revolution. Similar discomfort and concerns surrounded the industrial revolution – although the Luddite movement which was a symptom of this concern was not, as is sometimes portrayed, anti-technology *per se.*

Impact on education systems[8]

Much is made of the new digital and networked technologies being used in schools to promote what are called 21st Century skills. Here there are numerous implications for education systems. These various trends increase the need for an educational system that can give children and adolescents the skills needed to, on the one hand, cope with the growing information load productively, and on the other to be able to critically and constructively use that information.

There are data to suggest that new technologies may have the effect of shortening attention spans of learners. This must affect the fundamental construct of education and pedagogy. New digital technologies also influence the skillsets that should be provided to young people – not just in matters digital but also in areas such as critical thinking such that they are better able to identify reliable from less reliable information. Executive non-cognitive skill development, which starts in early childhood, will become even more critical if automation replaces many jobs with low requirements for such skills.

The ubiquitous use of digital tools and environments afforded by cell phones, portable devices, the social media and the internet, creates both risks and opportunities for the development of young persons' social, emotional and critical thinking skills. For example, multitasking is common in schools that have wide spread digital adoption. This includes presentation of multiple sources of formation on a single monitor screen, working on several open windows, using interactive white board technology and engaging in activities in on line or video game formats. Multitasking, has both costs and benefits for cognitive and brain development. There can be costs in terms of efficiency and accuracy of performance, especially for younger children whose attention systems and executive functions are immature.

But positive impacts on academic performance and cognitive development have been found for multi-tasking and for wider digital environments, including games. The benefits accrue when tasks are sufficiently complex and developmentally appropriate, where there is greater self-regulation and engagement, and where there is substantial teacher guidance. There is evidence to suggest that there can be positive effects on self-control, collaboration, and cooperation from games and computer mediated activities, especially when the design of the activities, the game platform and teacher guidance and feedback enable these. Adding games to business as usual in the classroom is associated with significant positive outcomes on intrapersonal measures (conscientiousness, intellectual openness, work ethic and self-evaluation).

But there may also be other adverse effects. The duration of use of digital devices is emerging as a risk for cognitive and social development; with increased distractibility being associated with higher amounts of use for younger children and also addiction-like behaviours or pathological engagement for older children. Cyber bullying in children and adolescence is a growing concern particularly in schools.

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[8] *This section was assisted by Prof S McNaughton; chief education science advisor in New Zealand.*

It has effects on proximal measures of health and school performance (e.g. drop out rates and academic performance), as well as longer term costs. It seems plausible that the access to digital devices is increasing both the nature and the prevalence of bullying.

4   Impacts on individuals

Given the plasticity of the human brain at younger ages, it is not clear what impact digital technologies may have on long-term brain function – emotionally, socially and physiologically. It may be that it affects emotional and personality development, while the altered leisure patterns clearly affect physical health (e.g. obesity).

The ubiquity of the internet and social media has led to fundamental changes in the way we communicate with others. Networks of people (often misleadingly called 'friends') are expanded with multiple and uncertain consequences. These may variously reduce or paradoxically increase social isolation and even play a part in the selection of romantic and sexual partners. There may be deeper consequences – evolutionary biology suggests our brains are designed for much smaller networks than many that people often now have.

The upside of this changed nature of interpersonal communication may be obvious, but it has led to a number of concerns. Certainly anonymity allows for changes in communication that break previous social norms. What is the impact of virtually continuously preening and photographing oneself and sharing previously private communications with a potentially global audience, for instance? For some, the dependence on the internet can lead to a loss of direct interpersonal communication. Furthermore, there may be effects arising from the sexualisation, particularly of youth, brought about by the almost immediate access to pornography and the apparently growing practice of 'sexting', which are not yet fully understood.

An issue we are yet to consider is the potential impacts of artificial intelligence and machine learning on our sense of autonomy and self-control. It is generally accepted that emotional health is heavily dependent on these two concepts but these emergent technologies may impact on both in uncertain ways.

5   Final comments

The digital revolution is unstoppable and irreversible. The magnitude, rates of uptake and the pervasiveness of digital and communications technology is profound. But like every other technology-driven change, it has benefits and challenges. Further, the direction and speed of change is largely autonomous and driven not by the deliberative decisions of sovereign states or by reflective societal consideration, but by the private sector and effectively instant social movements that are given emphasis through the echo chamber of social media. In this context, major issues can emerge overnight[9].

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[9]
  An example is Pokémon Go which led to otherwise sacred and private places being turned into places of entertainment within days.

This essay has attempted to outline some of the issues that will continue to challenge government, society and individuals. Much of the digital network- driven change will be highly beneficial but it will not be without cost. The challenge, as with all technologies, is how to maximise advantage while minimising negative impacts.

However, in contrast to the growing level of public debate and discourse about new biotechnologies for instance, digital and networked technologies have not been subject of significant consideration.

Yet for any given technology there are both positives and negatives. It took over a century for the downsides of a fossil fuel based society to be understood against the background of manifest benefits to individuals, some countries and corporations. Societies and governments need to grapple with the challenge of the DES in ways that exploit its manifest benefits and mitigate challenges that are emerging.