

# **The Social, Cultural and Environmental Costs of Hyper-Connectivity**

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# **The Social, Cultural and Environmental Costs of Hyper-Connectivity: Sleeping Through the Revolution**

BY

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INVESTOR IN PEOPLE

# Dedication

*For Nora and Larry.*

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# Contents

Acronyms	<i>xi</i>
About the Author	<i>xiii</i>
Foreword	<i>xv</i>
Acknowledgements	<i>xvii</i>
<b>Chapter 1 Introduction</b>	<b>1</b>
Our New Digital Age	1
Big Brother Knows Exactly Who You Are!	2
Understanding Technology: Who Designs the Future?	7
Understanding the Digital Age	10
Coming in the Following Chapters?	13
<b>Chapter 2 The Digital Behemoths</b>	<b>19</b>
The Big Four	19
Google	20
Amazon	22
Facebook	25
Apple	27
So, What's the Problem?	29
Digital Age Sloganism	36
<b>Chapter 3 Towards Cultural Homogenisation</b>	<b>39</b>
Is There Digital Diversity?	39
The Rise of European Culture	41
The United States and Big Tech Takes the Reigns	43
What Digital Wants Digital Gets	47
Towards Musical Homogenisation	52

<b>Chapter 4 The Challenges to Our Innate Cognitive Abilities and Mental Well-being</b>	55
The Human Costs of Digital Technologies?	55
Changing Minds?	56
Humans: The Weakest Link?	61
Surrendering to the Machine	63
Precarious Work	66
A Just Transition	68
<b>Chapter 5 The Smartphone: A Weapon of Mass Distraction</b>	71
Our New Digital Appendage	71
A Brief History of the Mobile Phones	72
Attraction and Distraction	75
Addiction as a Design Feature	77
The Human Cost of Our Smartphones	82
<b>Chapter 6 Online Privacy and Surveillance</b>	85
The House Is Watching, and Listening	85
Privacy in the Digital Age	86
Privacy Matters	88
Ground Zero for the Digital Surveillance	91
Digital Surveillance States	93
The Cambridge Analytica Scandal	96
Who Protects Our Privacy?	100
<b>Chapter 7 Digital Divides</b>	103
Mind the Gap	103
The Digital Haves and Have-Nots	104
The Digital Gender and Race Divides	109
Big Tech's Role in Economic Inequality	114
The Need for Inclusivity	118
<b>Chapter 8 An Increasing Ecological Threat</b>	121
The Ecological Fallacy of Digitalisation	121
The Ecological Reality: (Over)Consumption and Mounting Waste	123
The Insatiable Energy Demands of the Digital Age	127
Big Tech's Clandestine Role in Intensifying Climate Breakdown	130
Digital Technology Alone Cannot Save Us?	134

<b>Chapter 9 Digital Democracy: The Winners and Losers</b>	<i>137</i>
The Digital Promise of Democracy	<i>137</i>
Watching Freedom Fail	<i>139</i>
Weaponising the Internet against Liberty	<i>141</i>
A Free and Open Press	<i>143</i>
Distrust, Disinformation and Discontent	<i>145</i>
The Retreat from Reality	<i>147</i>
Back to Reality: Enter the Showman	<i>150</i>
The Wizards Behind the Curtain	<i>152</i>
<b>Chapter 10 Retaking the Reins</b>	<i>155</i>
Make Digital Get Again	<i>155</i>
Doing Nothing Is Not an Option	<i>156</i>
Epilogue	<i>164</i>
Index	<i>167</i>

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# Acronyms

AI	Artificial Intelligence
AIGS	Artificial Intelligence Global Surveillance
ARPANET	Advanced Research Projects Agency Network
AWS	Amazon Web Services
BRI	China's Belt and Road Initiative
CDMA	Code-Division Multiple Access
CEO	Chief Executive Officer
CERN	European Organisation for Nuclear Research
DARPA	Defense Advanced Research Projects Agency
DRC	Democratic Republic of the Congo
EEA	European Economic Area
EEE	Electrical and Electronic Equipment
EU	European Union
FCC	Federal Communications Commission
FTC	Federal Trade Commission
GDPR	General Data Protection Regulation
GPRS	General Packet Radio Service
GPU	Graphics Processing Unit
GSM	Global System for Mobile Communications
http	hypertext transfer protocol
ICT	Information Communication Technology
IoT	Internet of Things
IPCC	Intergovernmental Panel on Climate Change
IPO	Initial Public Offering
IRS	Internal Revenue Service
MIT	Massachusetts Institute of Technology
MOSFET	Metal-Oxide-Semiconductor Field-Effect Transistor
NMT	Nordic Mobile Telephony

*xii* *Acronyms*

NTT	The Nippon Telegraph and Telephone Corporation
PDA	Personal Device Assistant
PDF	Portable Document Format
R&D	Research and Development
REM	Rapid Eye Movement
SST	Social Studies of Technology
TCP	Transmission Control Protocol
WHO	World Health Organization
WWW	World Wide Web

## **About the Author**

Mike Hynes is a Sociologist and Lecturer in the School of Political Science & Sociology at the National University of Ireland (NUI), Galway, Ireland. He holds a first-class honours' Bachelor of Science degree in Information Technology (IT) and an honours' Master's degree in IT from NUI Galway. His teaching and research interests focus on efforts to improve urban and rural liveability, in addition to digital information and communication technology and the societal changes stimulated by online social media platforms and policy design in relation to work and environmental decision-making. He lives in Galway City, Ireland, with his wife Annette and has three adult sons.

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# Foreword

When the devastating impacts of the Covid-19 coronavirus forced the social and economic shutdown of nations and regions across the world, many turned to digital information and communication technology (ICT) to remain in touch with family, friends and work colleagues. Digital technologies became our vital lifeline to those we love and cherish in a time of great stress and anxiety and allowed many to continue to work, albeit from home. It is exactly because our digital devices and global networked technologies have become some integral and embedded into our daily practices that we need a much deeper insight and understanding into the ways such technology has enhanced our everyday lives but also how some of the more darker elements of the digital age are being left unchecked in an environment of often blind techno-utopianism. We must strive to strengthen the elements of digital ICT that support and promote human flourishing and well-being and equally endeavour to limit or eliminate the structures and features of digital technologies – including the ways the digital tech industry itself is organised – that are proving to be socially, culturally, economically and environmentally harmful. This text is an attempt to add to more enlightened discussions and debates on the utility, or otherwise, of digital information and communication innovation and technology and seeks a better understanding of a number of key areas of concern that will grow more conspicuous in the coming months and years ahead. The vast number of ways digital tech has enhanced our lives – in the fields of medicine, education, work, leisure and in staying connected to others – is regularly acclaimed by public commenters, tech writers, journalists, celebrities, politicians and key decision-makers, and these are unchallenged in this book. What is discussed is the often-hidden societal, cultural, economic and environmental dangers that lurk in the darker corners of digitalisation, and the discussions in this text will shine a light into these more shadowy locations. The digital tech visionary Jaron Lanier suggests that it is the tech critics that drive improvements, and it is exactly that spirit in which this book was written.

On a personal level, I regularly use digital tech and appreciate the many ways it has enhanced my own life. It is again the very reason that I seek to advance overall knowledge of the ways we design, develop and adopt our digital devices and see grave dangers in how just a small cohort of organisations and individuals have come to dominate and control all our digital tech futures and the digitalisation narrative. This digital oligopoly exploit our personal data at every opportunity and in ways that have made them the most powerful corporate entities in the world, while at the same time undermine states and societies by avoiding paying

their fair share of tax while heavily influencing legislation and state actions solely in pursuant of their own individual commercial agendas. They are actively shaping societal norms by selectively justifying a hands-off approach on policing certain content on their platforms, on the one hand, while also making other content deliberately available, thereby actively shaping views and public opinion. Furthermore, are the guiding principles underpinning some of these digital innovations and technologies themselves deeply flawed in that they work to diminish, limit or destroy some of our uniquely human competences and adversely affect our overall well-being, while continuing to support and promote a destructive consumerism lifestyle that escalates the damage to our environment and hastens climate breakdown?

This text is aimed at a broad readership, and chapters can be taken as stand-alone pieces of work rather than a singular linear monography. The genesis for this book was born from class discussions and reactions to several topics in 'Digital Citizenship', a module undertaken by applied social sciences undergraduate students at NUI Galway. While not intended to cover all existing debates and aspects of digital ICT's impacts and consequences, or digitalisation futures, it is an attempt to explain some of the potential problematic issues and concerns now emerging in this new digital era and to add to much-needed deliberations that have, heretofore, remained marginalised or silent. I, therefore, would appeal to the reader for some forbearance with respect to the subjective licence taken in some sections of the text, in particular in the later parts of the chapter on Digital Democracy in which I search for my own grasp of modern political realities. The overall intent of this book is not always to fully explain or indeed to be definite about all possible digital futures. Rather, the text also seeks to prompt deeper thought and contemplation about potential and possible impacts and consequences of digitalisation, so some opinion and commentary will be noted at times. Indeed, the reader should feel provoked on occasions and may agree or disagree with some of the lines of argument presented. This, it is hoped, will trigger new reflection, understandings and debates on subjects of some significant societal importance and offer a better awareness of the forces and challenges we are now facing in shaping all our collective digital futures. As a global digital community, we have hitherto collectively failed to fully engage in the critical public debates that would allow us to consider and plot the trajectory of digital ICT innovation and development so that it happens in a way that primarily serves humanity and the planet. Such digital technologies should help limit or eliminate human suffering and ecological destruction. This text, thus, is an effort to add to all our collective knowledge in seeking a more humane and responsive digital technology future.

## Acknowledgements

The process of writing this book has been a challenging but extremely rewarding experience over the past number of months, but the ideas for the text have been in gestation for about two years. When the Covid-19 coronavirus pandemic paused life as we know it, we were all forced to pivot into new and strange realities, and much of the writing for this book also ceased temporarily. To Ramya, Carys, Jen, Kim and all the publishing team at Emerald Publishing, I thank you for your patience and consideration during this time and for all your efforts and work on getting this text from concept to completion. I have had the good fortune of ongoing conversations about relevant topics with colleagues in the School of Political Science & Sociology at NUI Galway, which began with an opportunity to pitch my ideas in a weekly seminar to school members. I have also been fortunate to have had continuous discussions with undergraduate students of the Applied Social Sciences programme about their lived experiences and understanding of the digital world. To my colleague and students, I am extremely grateful for your time and contribution to my journey of discovery and own personal understanding of the issues. I further wish to acknowledge the ongoing support of the Social Sciences Research Centre (SSRC) at NUI Galway and, in particular, Tony Varley for the encouragement and support to continue developing my thoughts and writing. To Ken Bruen for reading a very crude early draft but giving me hope that my efforts had legs, I thank you. And to Barbara Heisserer who meticulously went through an initial draft and provided constructive and beneficial feedback, I deeply appreciate all your practical and helpful comments but, more importantly, your support and friendship which has been an invaluable motivation. To my parents, for all your love and care: words will never be enough, but I've made a start here! And to my wife Annette, everything that I have been able to achieve and have been able to experience over the past number of years has all been down to your help, support and love, and I will be forever grateful.

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# Chapter 1

## Introduction

One of the great liabilities of history is that all too many people fail to remain awake through great periods of social change. Every society has its protectors of status quo and its fraternities of the indifferent who are notorious for sleeping through revolutions. Today, our very survival depends on our ability to stay awake, to adjust to new ideas, to remain vigilant and to face the challenge of change.

Martin Luther King (1968)

Electrical information devices for universal, tyrannical womb-to-tomb surveillance are causing a very serious dilemma between our claim to privacy and the community's need to know.

Marshall McLuhan (1967)

### Our New Digital Age

In the twenty-first century, digital technologies have, and continue to have, profound effects on our individual and collective lives. They have been the catalyst for some incredible progress in the fields of medicine, work, education and communications broadly, and this has allowed us stay better connected to family and friends over distance than any time in human history. Cheap, lightweight, portable, mobile, digital information and communication devices are not only connecting the world, but they are providing individuals with extraordinary access to vast stores of news and information through always-on internet connectivity and allowing people to organise and manage their daily routines effortlessly. But our new digital age has also brought a unique set of societal, cultural, economic and environmental challenges that have yet to be fully appreciated and confronted. By and large, the internet is dominated and controlled by some of the largest and most influential corporations we have known since the beginning of the

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**The Social, Cultural and Environmental Costs of Hyper-Connectivity:  
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industrial age. Such megacorporations operate across international borders and are immune to the conventional regulation and controls considered necessary for such large organisations to operate in liberal democracy societies in an ethical and socially responsible manner. In the absence of effective oversight and control, harmful and sometimes sinister forces are organising with almost impunity: harvesting, monetarising and weaponising vast quantities of our personal data in the Wild West environment of this new digital age. The noble aspirations of Tim Berners-Lee, the often-cited creator of the internet, to develop an information superhighway that would empower the individual and be an instrument for human flourishing have largely given way to vast stores of worthless trivia and deceit that is hijacking our attention at every opportunity, a plethora of extremism and hateful speech, cyberbullying, trolling and a bountiful supply of dancing cats and skateboarders falling over.

This book aims to build upon a previous call for a stronger sociological engagement with the design, development and adoption processes of digital information and communication technology (ICT).<sup>1</sup> In the absence of robust sociological investigation and imagination at the conceptual stages of digital technology development, the probability of such technologies delivering changes that are deeply personally, socially, culturally and environmentally damaging will continue to grow apace. An enhanced and more critical exploration and understanding of the personal, organisational, social, political and environmental context of the emergence of digital ICT is, therefore, urgently required. Without such critical investigation and reflection, digital technologies will continue to be left to their own devices to determine and influence the social, economic and cultural values of our societies, for better or worse. But it's not just features such as the internet and social media; there is a headlong rush towards digitalisation driven by an almost unstoppable technological determinism and utopianism that does not match the realities of what is now emerging from the first decades of this new digital age. Many individuals across society have now awoken to real and genuine concerns and fears about the influence and overreach of such digital technologies in the transformation and shaping of individual lives and community behaviours. Immense changes in how we coordinate our lives, in our homes, in the organisation of work and leisure, are all been driven at breakneck speed by technologies controlled by a handful of individuals and organisations, leaving many helpless as to their oversight, course and influence on our overall well-being. We thus begin this chapter with a brief exploration of the impacts and consequences of a digital-based surveillance technology that has emerged with little debate and almost undetected over the recent past: facial recognition.

### **Big Brother Knows Exactly Who You Are!**

When you post a photo on a social networking website and the platform automatically tags an individual in the image, you might not give a second

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<sup>1</sup>Hynes (2018).

thought about the technology that underlies such a convenient and useful feature. In addition to this automated process, individuals themselves can tag photos and identify persons on social media or in cloud storage facilities on Microsoft, Apple or Google. We will soon be able to check out at supermarkets and department stores without having to pull out our money or credit cards; our faces simply scanned and matched to the store's customer database and financial management systems. Retail outlets have already begun to use technology to generate vast detailed purchase data on their customers, tracking our every move and shopping habits and micro-targeting in-store marketing and advertising. At an artificial intelligence (AI) bar or restaurant, facial recognition technology will soon be used to identify customers who approach the counter to provide a speedy, more efficient and personalised service, matching your drink and food preferences to that previously stored on their point-of-sale systems. Churches are now beginning to use facial recognition technology to monitor attendance at religious services, and schools are seeking to use it to keep tabs on students who may be trying to skip class and teachers who take longer than normal coffee breaks. Biometric authentication is being used by Chinese authorities in Beijing now combating a toilet paper stealing epidemic by locking the supplies away behind a dispenser powered by such facial recognition software.<sup>2</sup>

As facial recognition becomes mainstream, your face will soon become your password, unlocking everything from your smartphone to your bank account. Phones like the iPhone X, Galaxy Note 9 and LG G7 all use biometric information which allow you unlock your device, and we can only expect other smartphone manufacturers to improve upon this facial unlocking feature into the future. Want to know who is at your door? A video doorbell with facial recognition software will not only let you know someone is there but who that someone is, regardless of whether you know the person or not. Marketing departments and advertisers are quickly getting in on the act, and thanks to such technology, billboards can now micro-target advertisements based on exactly who individuals are: their sex, age, how they are feeling at a given time of the day or evening and other personal information that can be gleaned from their social media profiles to create a holistic picture of who the person is and how they are feeling.

One of the key advantages of facial recognition technology may well be safety and the potential to enhance our overall security. Police forces are now using the technology to track down criminals, to find missing children, the elderly or other vulnerable people in the community. In cities and towns where police do not have adequate manpower to tackle petty crime, business owners are beginning to install facial recognition systems to watch people and identify individuals of interest when they enter their premises. Airports are increasingly turning to such technology to allow passengers pass through their facilities without the need to

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<sup>2</sup>Hernández, J. C. (2017). China's high-tech tool to fight toilet paper bandits. *The New York Times*, March 20. Retrieved from <https://www.nytimes.com/2017/03/20/world/asia/china-toilet-paper-theft.html>

#### 4 *The Social, Cultural and Environmental Costs of Hyper-Connectivity*

check their passports; the US Department of Homeland Security predicts that it will be used on about 97 per cent of travellers to America by 2023.<sup>3</sup> Facial recognition is also being used at live music events. A system was in place during Taylor Swift's Rose Bowl concert in May 2018, according to *Rolling Stone*, in which a kiosk set up to allow fans watch a recording of Swift's rehearsal had a camera hidden inside.<sup>4</sup> Each image of a face was sent to a command post in Nashville where a facial recognition search was conducted against a database of known Taylor Swift stalkers. Being upfront about this use of the technology may have decreased its usefulness, but it does call into question the ethics of doing so without informing most law-abiding music fans whose faces were scanned and image then analysed. And what subsequently happened to this store of collected personal data after the event?

Facial recognition is the process of recognising and verifying the identity of an individual using a captured image of the person's face, and the technology has developed rapidly over the recent past as the tech industry continues to build upon progress made in the underlying technology known as machine learning. It captures, analyses and compares features and patterns based on the person's facial details, information gleaned from our insatiable desire to continually share our images and personal information with friends and family online. Thanks to Flickr, Pinterest, Instagram, Facebook, Google and a host of other sharing platforms, the internet now stores billions of photos of people's faces, which have been scraped from our social media profiles and gathered into massive image datasets. These are then used to train deep neural networks, a mainstay of modern AI, to detect and recognise facial features using powerful graphics processing units (GPUs). When an image is captured on a security camera trained on a crowd or in a shopping centre, a 'faceprint' of elements – such as a person's eye colour, shape and size, eyebrow thickness and contours of their nose – will organise and classify these features together. And much like a fingerprint record, by distinguishing a unique set or pattern of characteristics taken together distinctively identifies a person. This faceprint is then compared with images of known individuals in an image database to confirm identification, or a faceprint can be compared to a large database of facial images in the hope of identifying an unknown person. But this ability to record, store, analyse and easily access enormous amounts of images of individual faces on such an enormous scale leads to some fundamental challenges to our notion of privacy, equality and trust.

China, for instance, has enthusiastically embraced biometric authentication and automated facial recognition on a vast scale. Cameras now screen hundreds of thousands of citizens on a daily basis and have been used effectively, for example, to identify and control the Uighur population, a largely Muslim minority in

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<sup>3</sup>DHS (2019).

<sup>4</sup>Knopper, S. (2018). Why Taylor Swift is using facial recognition at concerts. *Rolling Stone*, December 13. Retrieved from <https://www.rollingstone.com/music/music-news/taylor-swift-facial-recognition-concerts-768741/>

the Xinjiang autonomous region persecuted on religious grounds, many of whom are now held in vast detention centres that dot the north-west of China.<sup>5</sup> Over the recent past, authorities have considerably ramped up their ability to spy on the country's nearly 1.4 billion people to new and disturbing levels, giving the world a blueprint for how to build the basis of a digital totalitarian state.<sup>6</sup> The Chinese state is hurriedly refining technologies like facial recognition and combining this with phone and other identifying data allowing matches to be made much easier. Authorities in Russia ordered 260 million roubles (\$4 million) of facial recognition technology for surveillance cameras to monitor protests and other mass gatherings in cities right across the country.<sup>7</sup> Moscow claims to have one of the world's largest networks of some 160,000 surveillance cameras, some equipped with facial recognition technology, and had plans to boost the number to 200,000 by the end of 2019. Proponents of these facial recognition-equipped cameras in Russia point to the role they have played in maintaining public order and safety, while critics warn of false matches and surveillance overreach.

DARPA – the US Defence Advanced Research Projects Agency – have several facial recognition projects in the works. Using drones and unmanned aircrafts with mounted cameras and flying at up to 20,000 feet, one such project can identify objects as small as six inches and can monitor everyone's movements in a 10-square mile radius. With the addition of facial recognition technology, it will soon be possible to target an individual from this distance, but worryingly, all this is being exclusively developed for covert operations into the future. This is leading to growing concerns from some quarters. Civil rights advocates in the United States are adamant that software that seeks to identify people using image databases should be banned in many instances because it too often misidentifies people with darker skin and contributes to police bias against black communities.<sup>8</sup> Facial recognition systems consistently perform differently for darker skin tones and reportedly misidentify black people at rates 5–10 times higher than they do white people.<sup>9</sup> On a micro level, such technology can now be used by individuals to identify people from simple snapshots taken at random. By matching the

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<sup>5</sup>Byler, D. (2019). China's hi-tech war on its Muslim minority. *The Guardian*, April 11. Retrieved from <https://www.theguardian.com/news/2019/apr/11/china-hi-tech-war-on-muslim-minority-xinjiang-ughurs-surveillance-face-recognition>

<sup>6</sup>Mozur, P., & Krolik, A. (2019). A surveillance net blankets China's cities, giving police vast powers. *The New York Times*, December 17. Retrieved from <https://www.nytimes.com/2019/12/17/technology/china-surveillance.html>

<sup>7</sup>Nikerichev, A. (2019). Moscow to deploy facial-recognition tech at rallies. *The Moscow Times*, October 2. Retrieved from <https://www.themoscowtimes.com/2019/09/06/moscow-to-deploy-facial-recognition-tech-at-rallies-a67174>

<sup>8</sup>Petty, T. (2020). Defending black lives means banning facial recognition. *Wired*, July 10. Retrieved from <https://www.wired.com/story/defending-black-lives-means-banning-facial-recognition>

<sup>9</sup>Simonite, T. (2019). The best algorithms struggle to recognize black faces equally. *Wired*, July 22. Retrieved from <https://www.wired.com/story/best-algorithms-struggle-recognize-black-faces-equally/>

captured image with an individual's social media profile, it is possible to uncover personal information, family and friends and even the area where they live. And to what ultimate end authoritarian and democratic governments will eventually end up using facial recognition technology should be deeply concerning for us all, and heightened vigilance and action against its abuses and any assault on our privacy must be a civic duty in the digital age.

So, while there are potential positive outcomes from the use of facial recognition technology, there are also numerous hidden dangers that have now begun to emerge into the light. This theme is the principal argument repeatedly emphasised throughout this book; we are failing to fully appreciate – or at times even attempting to debate and beginning to understand – the true negative consequences and impacts of new digital ICT before their universal circulation and normalisation across society. While many do make important and significant contributions to individual lives and society in general, not all digital technologies are desirable, nor is its rapid rate of development and deployment in our best interests. Whether digital technologies develop in a positive or negative manner is very much at the discretion and behest of those who promote its design, development and growth from within the tech sector. Some digital technologies, such as facial recognition, may be emerging as the greatest threat to individual freedoms we now face partially because of the intimacy and sensitivity of the information it takes and gives to the state or large megacorporations with or without an individual's consent but also because we really do not know what is actually being done with such sensitive and personal information. The fundamental question needs to be asked. Whom does new digital technology serve, and for whose benefit?

Digital technological design, innovation and development are very much a social activity with, primarily, economic objectives at its core. But it needs much more appropriate social controls and oversight and should not be technical advances for its own sake, lacking the necessary oversight. Someone or organisation seeks to develop and implement such technologies for financial gain ordinarily, but much of this may be at the expense of individual privacy and freedoms which we may, or may not, choose to give away. Indeed, it may not only be just our privacy we stand to lose. Some new digital ICTs may be even impacting our uniquely human cognitive abilities in ways we have yet to fully comprehend and appreciate. For example, automating processes that have previously keep our minds active and muscles exercised may work to diminish these human capacities over time. If we don't use it, we may well lose it. Meanwhile, the data now being collected by online platform megacorporations are being analysed, packaged, monetised and in some cases weaponised against some of our traditional and once stable institutions of state, and democracy itself may be under threat. We should always know what is being done with our personal information and for what purpose and gain. Facial recognition, for instance, is expected to become a \$9.6 billion burgeoning market,<sup>10</sup> but regulation of the industry has failed to keep pace with the development of

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<sup>10</sup>Facial recognition market overview. *Allied Market Research*. Retrieved from <https://www.alliedmarketresearch.com/facial-recognition-market>

the underlying technology. Instead, companies and states are expected to police themselves and are not held to account for how they collect, store and use our personal data and information. The barn door is open and the horse ready to bolt.

## Understanding Technology: Who Designs the Future?

It is important to begin with an historical perspective on how, over many centuries, new technology was understood and valued in the societies of its day. Some key influential social thinkers of the past were never afraid to meet technology development head-on and to ask difficult and searching questions to help shape its design, development and deployment. Reflecting on these debates may offer important insights into how contemporary digital technologies now lack the scrutiny and attention of the technology of the past. Philosophical discussions and questions relating to technology design and development in Europe date back to the very dawn of Western philosophy. The word ‘*techne*’ in ancient Greece signified the knowledge or the discipline associated with a form of *poiésis*. For instance, medicine was a *techne* that sought to heal the sick. A number of prominent themes emerged from that early period of European history, one of which was a view of technology as an imitation of nature, a position endorsed by Greek philosophers such as Heraclitus and Democritus.<sup>11</sup> For example, based on what we see in nature, we learn and adapt to copy creatures like bird and spiders to construct out dwellings and other such buildings.

A more developed viewpoint, principally put forward by Aristotle, was that technology did not merely imitate nature and that there was a fundamental ontological distinction between natural things and artefacts in that nature, inherently, had the principles of generation and motion. Animals and plants have the capacity to move, grow, change and reproduce over time, driven by the overall purpose of nature itself. Artefacts, on the other hand, have only outward cause based on human aims and forms; they cannot reproduce themselves and need a guided human purpose and hand. This thesis, that there is an essential difference between man-made products and nature, has had a long-lasting influence which continues to the present day. Aristotle’s doctrine of the four causes – material, formal, efficient and final – is regarded as a third early contribution to the philosophy of technology and is also still present in contemporary discussions and debates of technologies and artefacts. An additional theme from this era was the extensive employment of technological images by both Plato and Aristotle. Both found technological imagery indispensable for expressing their belief in the rational design of the universe.<sup>12</sup> Yet, while the ancient Greeks made important contributions to many sciences – most notably mathematics, astronomy, optics and acoustics – actual Greek technological achievements were far less impressive than their enlightened discussions and broad scientific achievements.<sup>13</sup>

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<sup>11</sup>Franssen, Lokhorst, and van de Poel (2018).

<sup>12</sup>Lloyd (1973).

<sup>13</sup>Volti (2015, p. 54).

The epoch of the Roman Empire and throughout the Middle Ages were times of considerable technological progress, yet, peculiarly, philosophical and social reflection on such technology did not grow at a corresponding rate. Roman contribution to the sciences was limited, yet their engineering achievements reached a very high level of sophistication and accomplishment. Following the fall of the Roman Empire and the decline in Greek civilisation and knowledge, most parts of Europe were cut off from an important source of ancient learning, although a small number of Christian clerics and scholars maintained the spirit of rational inquiry with regard to science and technology throughout the Dark Ages. Indeed, there appeared a disconnect between scientific and technological development throughout the sixteenth and seventeenth centuries leading Thomas Khun to speculate that for the bulk of human history technology flourished in societies where science had remained underdeveloped and vice versa.<sup>14</sup>

The Renaissance led to much greater appreciation of human endeavour and creative efforts, including technology, and as a result, philosophical reflection on technology and its impact on society once again began to flourish. Francis Bacon was one of the first modern authors to put forward such considerations; his works credited with developing the scientific method and remained influential through the scientific revolution. Many of the views expressed in his fantasy novel *New Atlantis* in 1627 were overwhelmingly positive, and this positive mindset lasted well into the nineteenth century and incorporating the first half-century of the Industrial Revolution.<sup>15</sup> Other profound thinkers at that time, such as René Descarte, Jean-Jacques Rousseau and Immanuel Kant, were among key figures of the Enlightenment who argued that the human mind and human society were akin to nature inasmuch that they were ‘rational’ – they were ordered and governed by laws which could be understood through the application of a rigorous scientific approach or, in short, the application of reason.<sup>16</sup>

The Industrial Revolution was largely characterised, stimulated and shaped by the design and development of major new transformative technologies such as the steam engine, the spinning jenny and other mechanical machines that replaced human effort and brawn. The great technological innovations and changes that began in the mid-fifteenth century with improvements in ship building and ocean navigation were closely associated with the rise in capitalism and the emergence of a market system in the late eighteenth and early nineteenth centuries.<sup>17</sup> Karl Marx and Friedrich Engels attributed fundamental importance to technical improvement and change in their analysis of forms of capitalist production. Marx focussed much of his early writings on the social effects of machinery, namely on the replacement of workers and a wide-ranging deterioration of working conditions brought about the widespread adoption of new technology in the workplace. But he also examined the relationship between

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<sup>14</sup>Kuhn (1977).

<sup>15</sup>Franssen et al. (2018).

<sup>16</sup>McIntosh (1997, pp. 1-2).

<sup>17</sup>Volti (2015, p. 46).