



Brett King is a four-time Amazon bestselling author, a renowned commentator and globally respected speaker on the future of business. He has spoken in over 40 countries, to half a million people, on how technology is disrupting business, changing behaviour and influencing society. He has spoken at TED conferences, given opening keynotes for *Wired*, Singularity University's Exponential Finance, the *Economist* and many more. He has visited the White House to advise the National Economic Council on the Future of Banking and been invited to meet with regulators from the United States, China, the European Union and the World Bank.

King hosts "Breaking Banks", the world's leading dedicated radio show on technology impact in banking and financial services (72 countries, 1 million listeners). He is also the founder of Moven, the world's first mobile, downloadable bank account. This successful mobile start-up, which has raised over US\$24 million to date, is available in the United States, Canada and New Zealand.

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LIFE IN THE SMART LANE

"Science is on the edge of radically changing the way we live and the experiences we have day-to-day. So often the views of that future are bleak but the Augmented Age is an optimistic view of that future and the challenges we'll face. The possibilities are limitless..."

Tory Belleci, host of *Mythbusters*, *Punkin Chunkin* and *Thrill Factor*

"Having watched many innovations occur over the last few decades, it has always confused me as to why so many resist change. The world Brett and Alex describe in *Augmented* is one where the most significant changes in our lifetime are just around the corner. The Augmented Age is tremendously exciting."

Nolan Bushnell, founder of Atari and author of *Finding the Next Steve Jobs*

"We are in the midst of a huge wave of technological change. Augmented reality. Self-driving cars. Human-like robots. Additive manufacturing and much more are bringing deep cultural change and exposing long-fed fears of a dystopian future. Brett King not just properly catalogues all of these, but also tells us what it all means: that we soon will be augmented. His look at what's happening will be my bible for a long time."

Robert Scoble, author of *Age of Context: Mobile, Sensors, Data and the Future of Privacy*

"Welcome to the Augmented Age. Super powers. Super cities. Super vehicles. Super robots. Technology is about to change everything in your life. Whether you're scared, excited, or both, you need to read this awesome roadmap of the future that Brett King has created. Those who can anticipate the future can thrive in it."

Ramez Naam, author of *Nexus*

"With *Augmented*, Brett King and Alex Lightman have penned a must-have read for any technology enthusiast, with contagious chronicling of the Augmented Age and what the future holds for all of us. We're in for quite a ride—and it's only getting faster!"

Walter O'Brien, founder and CEO of ScorpionComputerServices.com and real-life inspiration for the CBS prime-time television series *Scorpion*

TECHNOLOGY/BUSINESS

ISBN 978-981-4634-03-8



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For Review Only

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AMAZON BESTSELLING AUTHOR

BRETT KING

With contributions from
Alex Lightman, JP Rangaswami & Andy Lark



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LIFE IN THE SMART LANE

augmentedbook.com

The Internet and smartphone are just the latest in a 250-year-long cycle of disruption that has continuously changed the way we live, the way we work and the way we interact. The coming Augmented Age, however, promises a level of disruption, behavioural shifts and changes that are unparalleled. While consumers today are camping outside of an Apple store waiting to be one of the first to score a new Apple Watch or iPhone, the next generation of wearables will be able to predict if we're likely to have a heart attack and recommend a course of action. We watch news of Google's self-driving cars, but don't likely realise that this means progressive cities will have to ban human drivers in the next decade because us humans are too risky.

Following on from the industrial or machine age, the space age and the digital age, the Augmented Age will be based on four key disruptive themes—Artificial Intelligence, Experience Design, Smart Infrastructure and HealthTech. Historically, the previous "ages" brought significant disruption and changes, but on a net basis jobs were created, wealth was enhanced and the health and security of society improved. What will the Augmented Age bring? Will robots take our jobs and AIs subsume us as inferior intelligences, or will this usher in a new age of abundance?

Augmented is a book on future history, but more than that, it is a story about how you will live your life in a world that will change more in the next 20 years than it has in the last 250 years. Are you ready to adapt? Because if history proves anything, you don't have much of a choice.

“As a long-time R&D project manager in military technology innovations and national security policy, I am deeply impressed by the potential value of *Augmented*. It has great potential to inform evolving security policy and creative new options, and to prepare government and industry leaders for the emerging future. King, Lightman and their contributors are to be congratulated for their thought-provoking work. The book should be required reading for professionals in the US and international defense and security organisations.”

Dr. Christopher Harz, RAND, DARPA, DHS and NATO

research analyst and project manager, author of *Electric Blue*,
and co-author of *Food Security via Clean Energy*.

“If you wonder about what your life will look like in 20 years, read this book. Things are about to get real, and Brett and Alex lay it out beautifully in a way that is accurate, easy to understand and only a little bit scary.”

Dave Asprey, New York Times Bestselling Author of *The Bulletproof Diet*

“You may think you’ve heard all there is to know about the dramatic changes to come in our digital future. Well, prepare to have your mind blown... again. In a crowded field of prognosticators, Brett King stands out for his clearly articulated vision of how technology is changing who we are.”

Michael J. Casey, author of *The Age of Cryptocurrency*:

How Bitcoin and Digital Money are Challenging the Global Economic Order

“As one of the world’s most followed and provocative voices in digital finance, Brett King has once again thrown down the gauntlet. Brett’s vision of the future should be required reading for governments, think-tanks, investors, or basically anyone wondering how transformational technologies like artificial intelligence, robotics, Bitcoin and gene-editing may impact our society.”

Seth Wheeler, former White House advisor on financial services
and Brookings Institution guest scholar

“Whole industries have been vaporised by technological progress but as Brett King show us, this trend is just getting started. *Augmented* is your guide to a world in chaos, where each wave of technological innovation collides with several others. Get ready, get smart; read this book.”

Robert Tercek, author of *Vaporized*

“We live in a world where software is getting smart enough to automate tasks that only people could do just a few years ago. This is going to radically change the way we educate our children and the way people work in the future. *Augmented* is a wake-up call for a whole swathe of industries including the accounting profession. If your job can be automated, it probably will be.

Artificial intelligence, embedded experience design and real-time advice will undermine many of the professional services industries that grew rapidly last century. The future is one that is very different and King, Lark, Lightman and Rangaswami are the best guys on the planet to explain how we might get there.

In the next 20 years we'll see professions like accountants, financial advisors, bank tellers and others dramatically effected by automation, experience design and artificial intelligence. *Augmented* shows us that these changes are typical of historical disruptions, but this time the changes are happening much faster. This book really blew my mind. All I can say is: I'm glad I run a technology company.”

Rod Drury, CEO of XERO

“When someone as obsessed and thoughtful about the future as Brett King gets ahold of a keyboard and sufficient time to think and write—watch out, world. Here comes a book that will broaden your mind and make you re-examine what you think you know about tomorrow.”

David Wolman, author of *The End of Money*
and contributing editor at *Wired*

“What happens when you take accelerating exponential change for granted? The augmented world of the future described by Brett King and Alex Lightman is shaped by the profound consequences of this understanding. The social transformation, the radical impact on the very definition of being human and the huge economic upside of the global opportunities are all deeply analysed and richly illustrated in this inspiring book.”

David Orban, Managing Partner of Network Society Ventures

“If you want real financial security and the ability to fund your dreams in the future, then you need to see what is coming next. Brett King's *Augmented* is a roadmap of the biggest changes and the most disruptive technologies we'll need to navigate to get there.”

David Bach, New York Times Bestselling Author of
The Automatic Millionaire

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AMAZON BESTSELLING AUTHOR

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With contributions from

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Cover design by Kylie Maxwell

Book design by Benson Tan

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Published in 2016, reprinted 2019, by Marshall Cavendish Editions

An imprint of Marshall Cavendish International



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Marshall Cavendish Corporation. 99 White Plains Road, Tarrytown NY 10591-9001, USA • Marshall Cavendish International (Thailand) Co Ltd. 253 Asoke, 12th Flr, Sukhumvit 21 Road, Klongtoey Nua, Wattana, Bangkok 10110, Thailand • Marshall Cavendish (Malaysia) Sdn Bhd, Times Subang, Lot 46, Subang Hi-Tech Industrial Park, Batu Tiga, 40000 Shah Alam, Selangor Darul Ehsan, Malaysia.

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National Library Board, Singapore Cataloguing-in-Publication Data

Name(s): King, Brett, 1968- | Lightman, Alex, 1961- contributor. | Rangaswami, J. P., contributor. | Lark, Andy, contributor.

Title: Augmented : life in the smart lane / Brett King, with contributions from Alex Lightman, JP Rangaswami & Andy Lark.

Description: Singapore : Marshall Cavendish Editions, [2016]

Identifier(s): OCN 906658326 | ISBN 978-981-4634-03-8 (hardcover)

Subject(s): LCSH: Technology--Social aspects. | Technological innovations--Social aspects. | Technological forecasting.

Classification: LCC T173.8 | DDC 303.483--dc23

Printed in Singapore

Change is the law of life. And those who look only to the past or present are certain to miss the future.

John F. Kennedy

To my daughter Hannah who has learned strength is best measured from the inside. And to Michael Armstrong and Peter Brooks whom I can never thank enough for starting me on this journey.

Contents

Acknowledgements	8
Introduction	10
 Part 1: 250 Years of Disruption	
1 The History of Technology Disruption	16
2. The Augmented Age	52
3. When Computers Disappear	81
4. The Robot Advantage	117
 Part 2: How the Smart World Learns	
5. Human 2.0	158
6. The Augmented Man	197
7. Life Stream, Agents, Avatars and Advisers	243

Part 3: The Augmented Age

8. Trains, Planes, Automobiles and Houses	268
9. Smart Banking, Payments and Money	294
10. Trust and Privacy in an Augmented World	325
11. Augmented Cities with Smart Citizens	341
12. The New Era of Engagement	372

Conclusions: Life in the Smart Lane	404
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About the Author	437
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About the Contributors	439
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Acknowledgements

My thanks to the team at Moven for giving me the flexibility to pursue this endeavour, especially Alex Sion and Mircea Mihaescu. My thanks to the coffee shops that allowed me to write while consuming their java, namely Las Vegas in Fairfield, Koffee in New Haven, the lobby lounge of The Algonquin Hotel in NYC, Coupa Café in Palo Alto, Les Deux Magots in Paris, Drip Café and Artista Perfetto in Taiwan, Truth Coffee in Cape Town, Scopa Caffè in Wellington and numerous Starbucks around the world. My thanks to the FinTechMafia for allowing me to bounce ideas off them constantly. The team at Voice America for keeping me on the air. Thanks to Rudi at Performance Flight for teaching an old dog new tricks. To Jay Kemp, Tanja Markovic, Leanne, Parker Blue and, most of all, Rachel Morrissey for keeping me sane and looking after me on the road and at home day after day. Thanks to Rose Marie Terenzio for helping get the word out and to Katharine Carpenter, Rachel Heng, Janine Gamilla and

the team at Marshall Cavendish for making this happen. And, of course, to my co-authors in this endeavour, especially Alex Lightman who went above and beyond.

But most of all, thanks to Rebekah, Hannah, Matt and Thomas who put up with me when I went off to write for hours at a time, and then came back home bursting with crazy ideas on nanotech, robotics, AI, health tech and other such things.

From Andy Lark: For Sophia and Zach, I can barely imagine the worlds you will create and interact with.

From Alex Lightman: My sincere thanks to Brett King for inviting me to join him in writing *Augmented*, to my mother Elizabeth for instilling my love of reading and writing, to Eric Schuss for assistance with robots, to Eddy Waty for helping me to reach many of my goals in recent years, to Dr Mohammed Abdel-Haq for showing me how money and power move the world and to Paul Shepherd and Dr Chris Harz for three decades of best friendships.

Introduction

My six-year-old son Thomas won't need a driver's licence to own a car and it's highly likely he won't even own a car; he'll simply rent car "time" instead. Throughout his entire life, he will never be without a smart device which will soon tell him when to go to the doctor for advice (and his insurer will require him to wear it), he'll live in a smart house where robots clean and fridges or a household AI order groceries (delivered by a robot), he'll never use a plastic card or chequebook to pay for anything (and likely no cash either) and he'll interact with hundreds of computers every day that won't have a mouse or keyboard. Thomas is part of the so-called Generation Z which is growing up in a world so dramatically different from the world that their grandparents were born into that if you had predicted these changes 100 years ago, it would have simply been called science fiction.

You might be tempted to pass these changes off as the simple forward march of technology, but there is something more

fundamental taking place at a personal level and even in the way society itself functions. How many times a day do you check your smartphone for messages or check your Facebook newsfeed? How often do you log in to a website or use an app? Do you listen to music, read a book or play games on a device? How often do you walk into a new restaurant, hotel or office and immediately ask for the WiFi password? Have you ever taken a selfie?

While it is true that humans have been adapting to technology continuously, in the next two to three decades more changes will be thrust upon humanity than in the last 1,000 years. We'll have the technology to cure diseases and perhaps even extend life itself, we'll have machines that mimic or surpass humans in intelligence, we'll have self-driving cars, we'll land the first humans on Mars and we'll finally have the technology to live sustainably on the planet with abundant energy and creativity.

Shifts of these magnitudes often bring incredible opportunities, jarring sociological adjustment and, on many occasions, even violence.

The Internet, social media and smartphones brought us email, selfies, hashtags and YouTube, but they also brought us the Arab Spring, ISIS propaganda, Wikileaks, NSA's PRISM programme and the global Occupy movement. Social media gave us Facebook and Twitter and arguably propelled Barak Obama to the presidency in 2008, but it has also allowed some of the most hateful and racist vilification in recent history to find a home. It has created cyberbullying that has left numerous victims in its wake and has exposed intimate details of both famous personalities and secret government agencies.

Is all this technological advancement inherently good or bad for us? Are the emerging changes going to result in a new golden age, or an age of even greater disruption?



This book is about the world that is coming, the changes society will need to make to adapt to that world but, more importantly, *it is about the journey that each of us individually will take to arrive in that future.* We will explore where we've come from and how we've found ourselves in potentially the most disruptive and innovative age of mankind's history. What will your life look like in 2025, 2030 and beyond? How will we get there? That's the essence of what we're trying to answer in the pages that follow.

This glimpse into that future is ultimately optimistic but, along the way, I wanted to see if there are any specific lessons we could learn as to how we might react to the seismic shifts coming. I interviewed and sought the contributions of some of the world's most pre-eminent experts in the areas of network effect, health care, artificial intelligence, robotics, consumer behaviour and sociological impact to ensure that you don't just get a single commentator's view.

In the last decade, I've spent my life talking to business leaders, entrepreneurs and media about the future. How banking, money and commerce are being fundamentally changed by smartphones, how identity and privacy are evolving, how consumer buying habits have shifted around buying books, music and TV and will never return to what they were in the past. What continues to astound me, the optimist that I am, is how many so often push back against technology changes and trends as they emerge.

I think it is fair to say that most people have a nostalgic view of the past; it is why we call them the "good ole days"! The world, however, never stays stuck in the past. So why is it the instinct of some to resist change, often passionately? What I do know is that despite any fears that we might have and challenges we

might face, the future is incredibly bright, incredibly interesting and coming at us fast.

Augmented is about how your life will change on a day-to-day basis as data, sensors, machine intelligence and automation enhance our world, and our place in it. It's about *how you will adapt to live in a smart world*.

I hope it will inspire you and supercharge your imagination.

Before we get started in earnest on this journey, I'll leave you with a quote from one of the greatest science fiction authors of our time, William Gibson.

The future is already here—it's just not evenly distributed.

William Gibson, *Economist*, 4th December 2003

Thanks for taking this journey, but then again... do you really have a choice?

BK

Part 1

250 Years of Disruption

Chapter 1

The History of Technology Disruption

"Every generation likes to think it is improving on the last, that progress is inevitable... But the truth is,... History has a way of repeating itself. It's just most people don't live long enough to see it happen."

Forever, Season 1, Episode 5, 2014

I wasn't there to see it but I imagine that the invention of the wheel was a pretty big deal at the time. As with every major invention since though, I'm also fairly sure that there was a priest, shaman, village elder, local trader or town official who cautioned why the wheel was bad for the town, how it was going to destroy jobs and lead to disasters of possibly apocalyptic proportions. History teaches us that technology is incredibly disruptive. Despite repeated attempts throughout history to resist changes to the

way we live and work, we can't stop that forward march. Today, technology appears to be disrupting our lives faster than ever.

In the last 200 years, there has not only been a continuous cycle of disruption¹ through the introduction of newer and better technologies, there has also been a dramatic speeding up of those cycles of innovation. Researchers refer to this concept as technology adoption or innovation “diffusion”. As technology becomes increasingly diffuse (or common) in society, new technologies face less resistance to adoption. As the world has become more interconnected, new technologies are distributed across a wide range of markets, at a much faster rate than was possible in the past. Take the iPhone as an example. Soon, technology like 3D printing will result in instant delivery of new products into your home, even faster than an Amazon Prime drone.

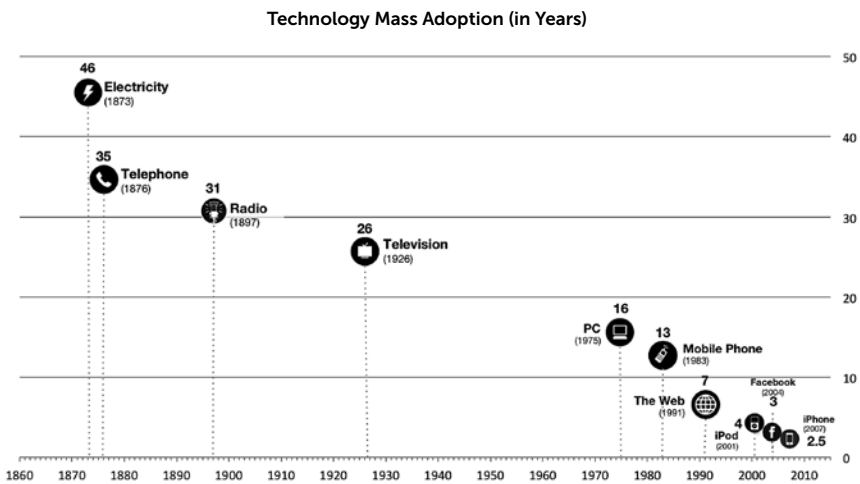


Figure 1.1: Years till mass adoption of specific technologies² (Source: Various)

We often talk about adoption of new technology in terms of “early” versus “late” adopters, but it is getting harder to tell the difference between these two groups as adoption

¹ The term “disruption” is often overused today. When we refer to “disruption”, we generally refer to disruptive innovations that fill unmet or future needs or created entirely new markets, and in doing so displace incumbents who fail to adapt (see Clayton Christensen’s *The Innovator’s Dilemma*).

² In this case, until 25 per cent adoption in the US economy



cycles compress. In recent years as new technologies like the smartphone, Facebook, Angry Birds, Snapchat and WeChat emerged, they became mass-market propositions 30 to 50 times faster than technologies such as the aeroplane or telephone. We live in extraordinary, accelerated times.

Technology adoption and innovation has a compounding effect on the way we live when viewed over the long term. As we invent new technologies, they accelerate our ability to invent or create yet newer technologies. The invention of the printing press allowed more people to become educated and allowed knowledge to be distributed as never before. The invention of the integrated circuit (IC) not only allowed us to mass-produce consumer electronics and microchips, but also allowed us to rapidly improve design and fabrication methods for subsequent generations of computers and devices. Consequently, the time between major new technological advancements has been reducing over time. It's why, as consumers, we have come to expect major new features to be incorporated into every new iPhone.³

The graph on the following page shows what accelerated technology growth has looked like over the last 600 years. Statisticians call this sort of graph a “hockey stick curve” as it indicates evidence of an exponential growth scenario. In the 20th century, graphs like this appeared with increasing regularity, especially where technology was involved. This led to the hypothesis of what mathematician John von Neumann and futurist Ray Kurzweil dubbed the **singularity** (sometimes called the technological singularity)—a time when technological advancement reaches escape velocity. In theory, the singularity means that we could solve any problem mankind faces through the application of increasingly powerful computing.

3 “This is the best iPhone yet!” All Apple® and iPhone® trademarks are the property of Apple Inc.

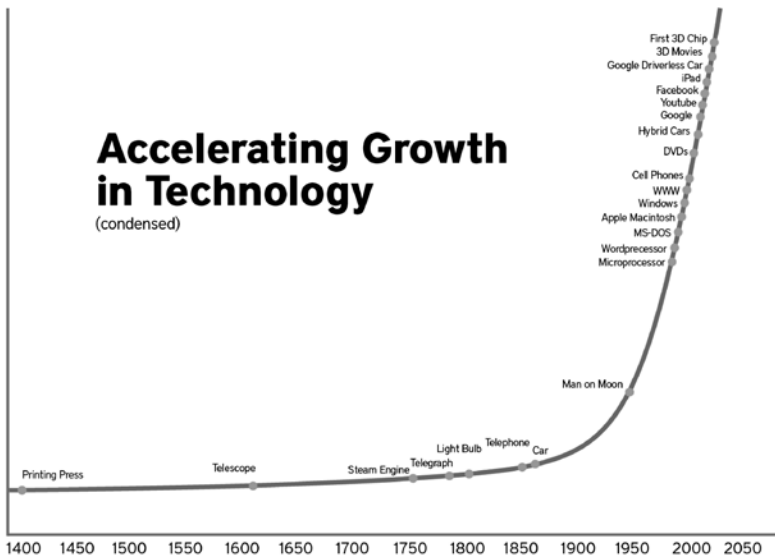


Figure 1.2: Major technology improvements are accelerating.
(Image credit: Asgard Venture Capital)

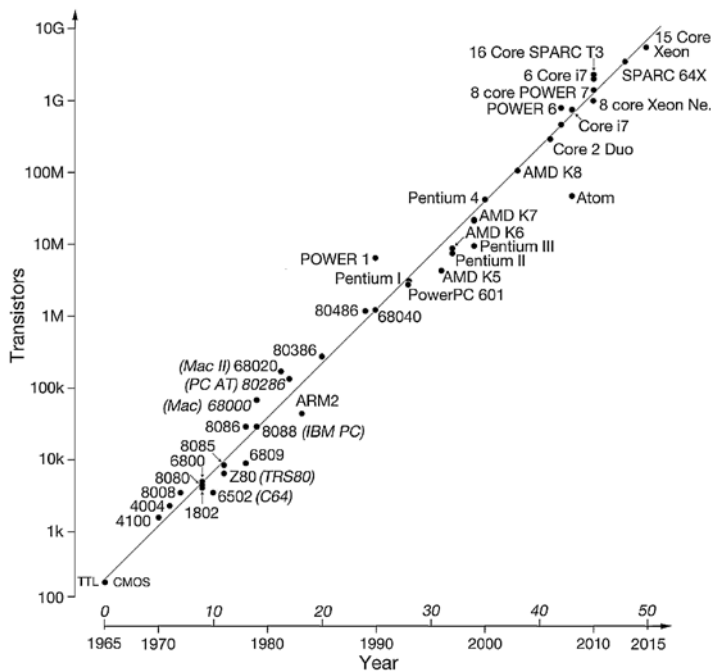


Figure 1.3: Moore's Law over the last 50 years (Image credit: Elektor Magazine)



The single most fundamental metric of these accelerated advancements in technology is embodied in a law known as “Moore’s Law”. Moore’s Law is the observation that, over the history of computing hardware, the number of transistors in a dense integrated circuit doubles approximately every two years. While Moore’s Law is now slowing down due to the limitations of physics, it has proven uncannily accurate the last 50 years. The law is named after Gordon E. Moore, co-founder of Intel Corporation, who described the trend in his 1965 technical paper.⁴

Today, technology is changing us faster than any other time in human history. The rate of change that society has to cope with is increasing from one generation to the next. The so-called Millennials (the generation reaching young adulthood around 2000) are a generation that appears mostly comfortable with these rapid innovations. Historically, however, the disruption wrought by new technologies has come with frequent social impact. Should we be wary of the disruptions new technologies bring or is it just history taking its course?

One of my favourite disruption stories is that of the Pony Express in the days of the so-called “Wild West”. The Pony Express closed on 26th October 1861, just *two days* after the first transcontinental telegraph line connecting the eastern and western parts of the United States went into operation—now that wasn’t a coincidence.

The telegraph was, in turn, rapidly disrupted by the invention of the telephone. Today, we know Western Union as a money transmitter but, back in 1856, Western Union was the largest provider of telegraph services across the United States, and by 1890 its reach extended even across the Atlantic. Inflation adjusted, Western Union was capitalised at around US\$850 million dollars (US\$41 million actual) in 1876. Western

⁴ “Cramming more components onto integrated circuits” by Gordon E. Moore was published in *Electronics* on 19 April 1965.

Union was operating more than a million miles of telegraph lines and two international undersea cables at the time.

When Alexander Graham Bell and his partners⁵ patented the telephone in 1876, initially referring to it as a “talking telegraph”, they offered Western Union the patent for the sum of US\$100,000.⁶ The established communications monopoly declined their offer, deciding that higher dividends were more important than investment in new technology.

Between 1881 and 1909, the Bell Telephone Company (known as AT&T from 1899 to date) subsequently battled Western Union until they had acquired a controlling stake in their business.⁷ AT&T, now operating as a national telecoms monopoly, was forced to nationalise under the so-called “Kingsbury Commitment”, one of the first major antitrust lawsuits brought by the US government against a monopoly. Despite the phenomenal success of the telephone, in 1913 there were still senior public figures trying to protect the incumbent telegraph industry, or they simply didn’t appreciate that the telephone was a fundamental technological leap.

“Lee DeForest has said in many newspapers and over his signature that it would be possible to transmit the human voice across the Atlantic before many years. Based on these absurd and deliberately misleading statements, the misguided public ... has been persuaded to purchase stock in his company...”

The US District Attorney, prosecuting
DeForest for selling stock “fraudulently”
for his Radio Telephone Company in 1913

In 1913, the US District Attorney prosecuted Lee DeForest, one of the major telephone industry players of the time, for

5 Gardiner Hubbard and Thomas Sanders

6 The equivalent of US\$2.5 million in 2010

7 Gerald Sussman. *Communication, Technology, and Politics in the Information Age* (Thousand Oaks: Sage Publications, 1997), 76.



fraudulently suggesting that voice could be transmitted across the Atlantic. Something millions of people do every day today. Was the District Attorney's objection to this technology scientific, based on a perceived risk to the stock market, or in an attempt to protect the existing telegraph industry? It hardly seems to matter now—it certainly didn't stop the telephone from changing the world.

As consumers, we seem to be constantly rushing to buy the latest shiny gadget, but perhaps we sometimes forget that all this technological progress comes at a price. It is doubtful that many of us mourned the fading of Motorola, Blackberry and Nokia from the commercial landscape as Apple and Samsung came to dominate smartphone sales, but I'm also sure that most of us were appalled at learning that Foxconn workers in China making iPhones were committing suicide⁸ as a result of poor working conditions there.

At each stage of history, technology disruptions have been significant enough to create ripples that we still talk about today. When we call someone a "Luddite" nowadays, we are suggesting that person has an adverse reaction to new technologies. Other verbs in the common vernacular such as "Kodak Moments", "xeroxing" and "he sounds like a broken record" have been replaced by the more modern equivalents of "googling", "uberling", "tweeting" or "taking a selfie". Our language changes, our behaviours change, but society adapts.

Before we can predict what will happen over the next three to four decades as a result of emerging technology, it would be helpful to look back at technology disruption over the last 200 years to see if there are any long-term patterns or trends. If these patterns repeat, it is logical that we should be able to predict what disruptions the **Augmented Age** will bring.

⁸ Joel Johnson, "1 Million Workers. 90 Million iPhones. 17 Suicides. Who's to Blame?" *Wired*, 28 February 2011.

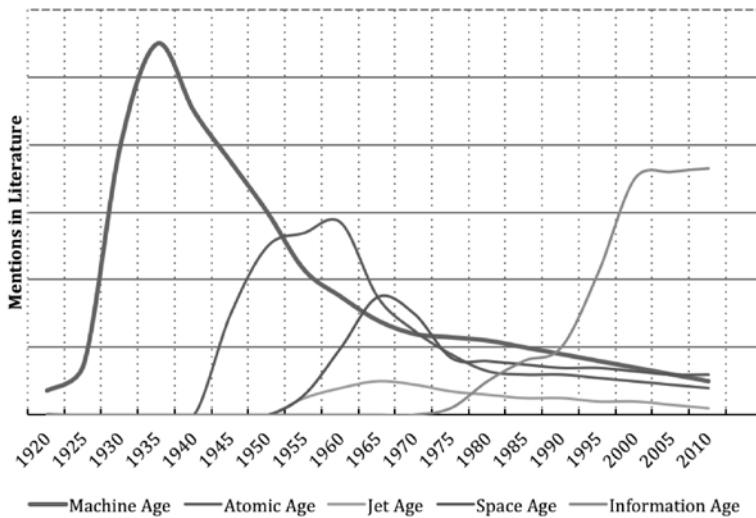


Figure 1.4: Mentions of "ages" in popular literature (Source: Google)

For the purpose of definitions, we'll use the accepted language and timeline for these "ages" as have been defined in modern literature and academia over the last 100 years.

The Industrial or Machine Age (1800–1945)

The industrial age or revolution was largely a transition to large-scale manufacturing processes focused around production methods, chemical and metals production (particularly iron), transitioning through the improved use of water (sewerage, plumbing, irrigation, etc.), to steam power and ultimately automated machine tools. The impact of the so-called Industrial Revolution was such that it touched the lives of people in many ways. In fact, it could be argued that almost every aspect of daily life was altered in some way over the space of 50 years by the machine age.

History shows us that once a new technology starts to take hold in an industry or in consumer markets, there is no successful defence for a traditional business model against that new technology beyond a few years, ever...



The Industrial Revolution was centred in Great Britain (the dominant world power of the day) and started about 1760, focusing initially on advances in the two largest industries of the time—the textile and agricultural industries. The changes in the textile industry really started to take hold in the early 1800s with the use of labour-saving machinery such as the stocking frame, spinning frames and power looms. Power looms were initially powered by water (mills) but, by 1803, Thomas Johnson and others were building looms based on steam engine technology. The steam engine typically drove a leather belt which, in turn, powered a “warp” and a “shuttle” that mimicked the way a textile operator worked a manual loom.

These labour-saving devices resulted in employers hiring unskilled, low-wage workers to replace the skilled “artisans” who dominated the textile industry at the time. Between 1811 and 1817, mass protests erupted across Britain, but centred mainly around textile mills in Nottinghamshire, Yorkshire and Lancashire. The textile workers who initiated these protests, which included smashing these steam machines,⁹ were called “Luddites” by the press.

This is the first trend that we often see repeated historically. As a new technology emerges, which threatens to either revolutionise or disrupt an industry, protests arise and incumbent players may enlist the government’s support to clamp down on the disruption. Within a decade, the new technology has become ubiquitous and employment patterns have altered irrevocably. History shows us that once a new technology starts to take hold in an industry or in the consumer marketplace, there is no successful defence for a traditional business model against that technology beyond a few years, ever.

The Internet turned 25 in 2014, and for most of the world it

9 See “Heathcoat of Tiverton, Lace Manufacturers,” UK National Archives, Devon Heritage Centre (1791–1957)—1816 attack by Luddites on the Heathcoat lace-making machine. <http://apps.nationalarchives.gov.uk/a2a/records.aspx?cat=027-4302b&cid=0#0>.

is now an element of daily life. However, Pew Internet Research shows that as of 2014, 13 per cent (more than one in ten for those of you who prefer fractions) of Americans still didn't use the Internet,¹⁰ and around 19 per cent didn't even use a computer. Maybe that doesn't sound like a lot, but it represents more than 30 million people in the United States alone. Having said that, the United States is the biggest incarcerator of prisoners in the world (around 22 million people, or 25 per cent of the world's prisoners), and most of these prisoners don't get access to the web, so this definitely skews the data.

The growth of the Internet has dramatically slowed in the United States since 2010, with just 2 per cent annual growth. However, the intriguing elements of Pew's research are the reasons *why* people don't use the web.

More than one third of those who don't use the Internet in the United States reject it as irrelevant, another third say it's too difficult or they worry about viruses and getting "hacked" while the final third say they can't afford web access. While the final third of users may be won over by cheaper smartphones or tablets, it is unlikely that the remaining technology laggards will have a change of heart. We can predict that Internet penetration in the United States will max out at around 90 to 91 per cent and smartphone penetration will reach saturation at around 80 per cent.¹¹

Those figures are not representative of the world. At the time of printing, there are already more than ten countries in the world where smartphone adoption *exceeds* 100 per cent, meaning that in these countries most adults own a smartphone, but many own multiple phones. Countries like Singapore, Hong Kong, the United Arab Emirates, Sweden, South Korea and even Saudi Arabia all put the United States to shame when it comes to technology adoption.

10 "The Web at 25," Pew Research Center, February 2014, http://www.pewinternet.org/files/2014/02/PIP_25th-anniversary-of-the-Web_0227141.pdf.

11 Kamelia Angelova, "Here's When Smartphones Will Saturate the US Market," *Business Insider*, 5 January 2013, <http://www.businessinsider.com.au/chart-of-the-day-smartphones-us-saturation-2013-1>.



Today, we might classify people like those in the United States who obstinately refuse to adopt the Internet or smartphones as Luddites or even “Neo-Luddites”¹². We can almost always find people in society who aren’t simply sceptics in respect to technology but actively promote an anti-technology philosophy. The 2014 movie *Transcendence*, starring Johnny Depp, dramatises the supposed coming clash between the movement for machine or artificial intelligence (AI), broadly classified as the singularity, and an extremist group called R.I.F.T. (short for Revolutionary Independence From Technology) whose goal is to stop the development of AI. When a new technology like the ATM, mobile phone, the Internet or Facebook comes along, there are always those who are firm in their belief that “they’ll never use [insert new technology trend here]”. The oft-heard excuse is “it is a fad”, that they’d never have a use for it or just don’t think it is safe, useful, etc.

Who were the original Luddites? Did they simply just hate technology or is that too simple a classification?

The Luddites in early 19th-century England were named after the fictitious leader of the anti-industrialisation movement who was known as General or King Ludd. King Ludd was widely used as a pseudonym in written death threats to magistrates, food merchants and manufacturers at the time. The Luddites actually became a major militia force numbering in the hundreds. In fact, at one time there were more British troops fending off the Luddite protests and action at home than there were fighting Napoleon on the Iberian Peninsula.

By 1812, it had become a capital crime under British law¹³ to break a steam machine or maliciously damage a factory or mill. In a mass trial at York in January 1813, over 60 men

¹² Kirkpatrick Sale, “America’s new Luddites,” *Le Monde diplomatique*, February 1997, <http://mondediplo.com/1997/02/20luddites>.

¹³ Destruction of Stocking Frames, etc. Act of 1812

were charged as Luddites after an attack on a mill at Rawfolds, Cleckheaton. So why did the Luddites take such direct action against the machinery of the time? Were they anti-technology, as the name today implies?

Most of the Luddites were skilled artisans or workers who had made their living in the weaving and textile manufacturing industries. Prior to industrialisation, those sectors required a high level of technical skill, with many years of training, to operate the looms and weaving frames. The automation of factories took away the need for those specialised skills, and in doing so dramatically changed the nature and make-up of employment in the largest industry of the time. *The Luddites weren't against technology; they were simply against losing their jobs, their livelihood.* Unfortunately, they were fighting the inevitable.

The era of mass production accelerated globally in 1913, with the opening of Henry Ford's Model T Assembly Line in Highland Park, Michigan. In the early days, Ford built cars the same way as everyone else—one vehicle at a time, by hand, assembling the car from the chassis up. Ford's innovation was the development of an assembly line where a car was moved from station to station on a track, and at each station a new component of the car was fitted. The process involved a long list of sub-assembly tasks and specialised production of components so that the car could be produced in mass quantities cheaply and quickly. This reduced the price of the Model T to a point where the average family could afford to buy a car for the first time. By 1925, the Model T sold for just US\$260 per unit, leading to 16.5 million units being sold. This record wasn't surpassed until the 1970s by the Volkswagen Beetle.



Ford's website says of the finished assembly line:

"The ultimate step was the creation of the moving final assembly line. Starting with a bare chassis, it moved along the line and through each workstation until a complete car was driven off under its own power. An essential part of this process was that all feeder lines along the route were synchronised to supply the right parts, at the right time."

The Evolution of Mass Production—Ford.co.uk

Mass production pioneered by Ford became a benchmark for manufacturing around the world. Ford established a minimum wage of US\$5 per day for factory workers, and economists frequently cite this as a primary mechanism for the establishment of the US middle class. This is the second trend—new technologies generally create new jobs at a faster rate than those lost by these innovations, given enough time.

Social Effects of the Machine Age

The Industrial Revolution is widely credited with raising the quality of life. Before 1750, the average life expectancy was around 35, even in France and England where the quality of life was generally better. A core element of well-being was better farming and agricultural techniques and more widely available fresh produce, reducing the spoiling of food stuffs. The use of the steam engine and creation of factories enabled mass production of pipes, for example, which were used in agriculture and sanitation.

By the mid-1700s, the largest industry in Europe was farming and agriculture, with over 50 per cent of the population employed

in this sector at the time. The Industrial Revolution resulted in growing unemployment as less manual labour was needed, but soon textiles grew to replace farming as the dominant employer. Between 1800 and 1950, agriculture went from employing more than half of the British and American workforces to less than 10 per cent. Early in the 20th century, the mining and steel industries had become the big employers, only to be replaced by the automobile, oil and gas industries. Later these were impacted by investments in the electronics, telecommunications, computer and information technology (IT) sectors.

At each stage of disruption, workers revolted and unions protested, trying to stave off the inevitable, while politicians and employers tried their best to navigate this shift and stay competitive and relevant. Repeatedly we've seen cities dependent on a single industry or dominated by a single affected corporation negatively impacted by these shifts.

A good illustration of how the introduction of tractors into the US farming community correlated with the reduction of workers employed (as a percentage of total workers in the economy) in the farming sector across the United States from 1900 through to the 1960s can be seen by simply examining the numbers. Farming jobs accounted for 42 per cent of the economy in the year 1900 but had dropped to under 5 per cent by 1970. The mechanisation of farming had a direct impact on employment patterns as we can see from the graph overleaf.

Ironically, preceding the industrial age, there was a massive boom in agriculture in the economies of countries like the United States and the United Kingdom. In fact, technology was at play here too. The agricultural revolution led to improvements such as crop rotation, improvements in plowing implements, more intensive farming techniques with higher labour inputs,

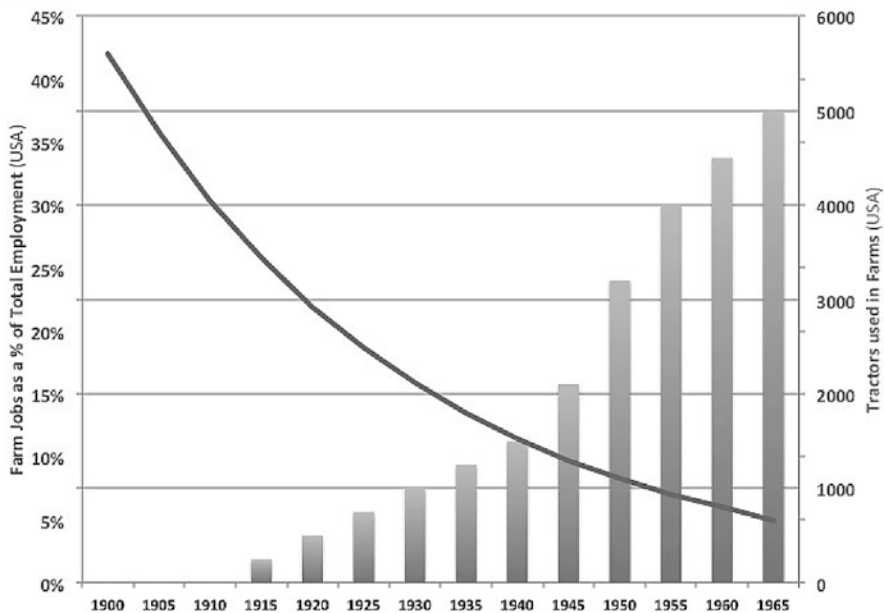


Figure 1.5: The correlation between tractors and reduced employment in farming

better breeding and animal husbandry, along with increases in farm size.

The disruptions in the next age were perhaps a little subtler, although the news of such changes tended to be more dramatic.

The Atomic, Jet or Space Age (1945–1975)

My childhood heroes had the *right stuff*. Neil Armstrong, Chuck Yeager, Yuri Gagarin, Alexey Leonov,¹⁴ Buzz Aldrin, David Scott, Jim Lovell, Gordon Cooper and the other Apollo astronauts (just to name a few) captured our imagination, and pushed us beyond barriers that we could never have imagined. However, none of these amazing feats would have been possible without a supporting cast of thousands, and without leaps and bounds in technological capability. During this period, research and development around particle science was surging ahead, as

¹⁴ Or Alexei Arkhipovich Leonov

was the promise of cheap, near unlimited power from atomic energy. Each of these developments led to some of mankind's greatest achievements, and the most devastating weapons of all time.

Early in the 20th century, a German-born theoretical physicist and scientific philosopher postulated that it might be possible to harness the power of the atom for massive amounts of energy. His paper "Zur Elektrodynamik bewegter Körper" ("On the Electrodynamics of Moving Bodies"), which was published on 26th September 1905, led to both the theory of special relativity, as well as specifically an equation to quantify mass-energy equivalence, known simply as $E=MC^2$. The physicist, of course, was none other than the Nobel laureate Albert Einstein.

Prior to Einstein's revelations, worldwide excitement over Marie and Pierre Curie's discovery of radium in 1898 launched an era of optimism over the potential benefits of nuclear science. However, H. G. Wells' imagining of atomic war in *The World Set Free* in 1914, the Radium Dial Trials of the 1930s and the top-secret Manhattan Project to develop an atomic weapon in 1942 soon revealed a darker side to nuclear science.

At the outset of World War II, Einstein dispatched a letter to President Roosevelt (FDR) about the work of scientists Fermi and Szilard, who had expanded on Einstein's mass-energy equation. Their manuscript—combined with the work of physicist Frédéric Joliot in France—led Einstein to believe that in a nuclear reaction "vast amounts of power and large quantities of new radium-like elements would be generated." The more interesting leap that Einstein made was the understanding that "this new phenomenon would also lead to the construction of ... extremely powerful bombs of a new type."



His letter to FDR can be seen below:

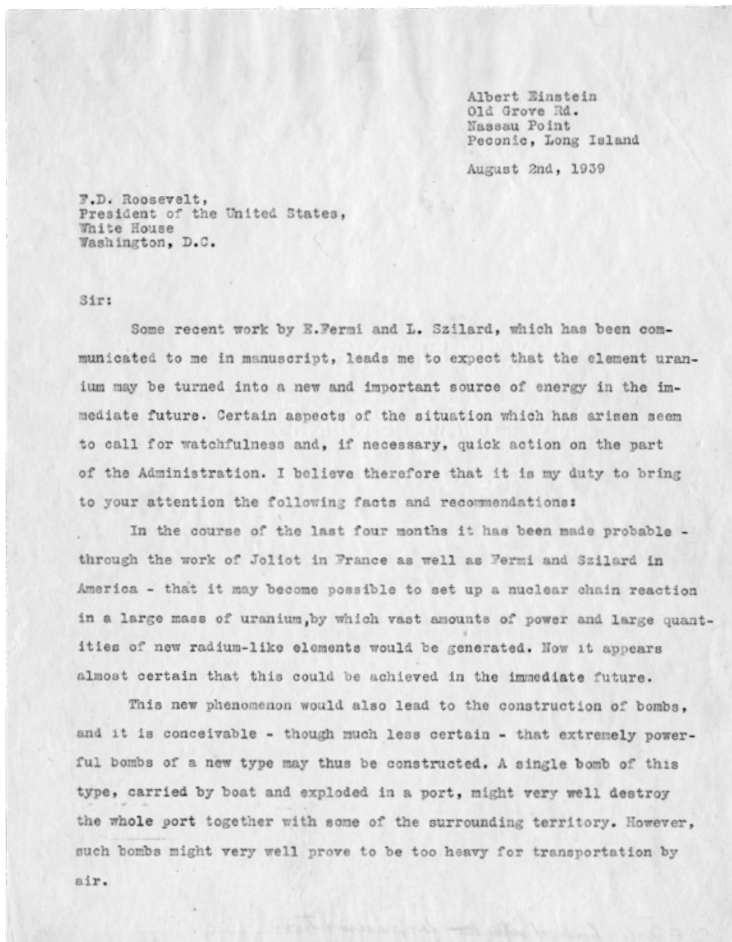


Figure 1.6: Einstein's letter to FDR on nuclear weapons (Source: National Archives)

While this line of research led to the birth of nuclear energy, it also—as Einstein postulated—led to the instigation of the Manhattan Project in 1942. The deployment of nuclear weapons became inextricably linked to advancements in rocket technology.

The V2 rocket (the *Vergeltungswaffe 2* in German, or “Retribution Weapon 2”) was one of the most devastating long-range weapons of World War II. Hitler’s forces successfully fired 3,000 of these weapons at London and its surrounds, Antwerp and Liège. The V2 was not the only advanced weaponry that the Nazis developed, but it was probably the most successful. The Germans also flew the first operational jet fighter and jet-powered bomber aircraft, the Messerschmitt Me 262 in 1941.¹⁵ The Me 262, while a formidable fighter, entered operations too late in the war to have any meaningful impact.

At the end of the war, both the Union of Soviet Socialist Republics (USSR)¹⁶ and the United States rushed to gather as much intelligence on German weaponry research as possible. In the final days leading to the collapse of the German army, there was an all-out effort by both Soviet and US forces to capture any of the rocket scientists who had worked on the V2 rocket and other such efforts. Ultimately, captured scientists were given the option to emigrate and work on US and Soviet rocket programmes or face life imprisonment. One of the leading rocket scientists working on the V2 programme was a German aerospace engineer named Wernher Magnus Maximilian Freiherr von Braun, or simply Wernher von Braun. Von Braun went on to lead the team that built the massive Saturn V rockets that took the Apollo astronauts to the moon.

In March 1946, about six months after the end of World War II, Prime Minister Winston Churchill gave an address at Westminster College during which he used the term “Iron Curtain” in the context of Soviet-dominated Eastern Europe.¹⁷ This political antagonism played out over four decades in a so-called “cold war”, but the most dynamic technological outcome of the period was the **space race**.

15 The He-178, a turbojet aircraft, flew a couple of years earlier in 1939, but was not a pure jet turbine aircraft.

16 Also known as the Soviet Union

17 Winston Churchill, “Sinews of Peace” address, 5th March 1946.



Figure 1.7: The launch of Sputnik started a “race” for space.

On 4th October 1957, the USSR launched a sphere with a diameter of 58 centimetres into an elliptical low earth orbit. It was called Sputnik (official designation “Sputnik-1”). *Sputnik* is a Russian word used to describe “satellites” (спутниковое or Sputnikovoye) but it can also be literally translated as “fellow traveller”. In 1955, US president Dwight D. Eisenhower had announced the intention of the United States to launch an artificial satellite, but the Soviet Union caught the West completely off guard when Sputnik launched in 1957, sparking a rush of analysis and concerns.

Following the launch of Sputnik, the race for low earth orbit and the moon was on. The first man in space—Yuri Gagarin—almost didn’t make it back to earth. As he fired his retro rockets, problems with an equipment module that hadn’t detached meant that Gagarin experienced an uncomfortable ten minutes of wild gyration before the modules broke free of each other and Gagarin’s re-entry capsule settled into a proper orientation.

It was less than five years after Sputnik that US president John F. Kennedy gave his famous “we choose to go to the moon” speech,¹⁸ promising to put a man on the moon by the

18 12th September 1962

end of the decade. This speech launched the Apollo programme, and arguably the greatest single technological achievement of mankind to date. While there are conspiracy theorists who claim that the moon landings were some elaborate hoax, we know now that the technology to “fake” the moon landings simply didn’t exist in the late 1960s. We also know that Chinese, Indian, European and US satellites have since taken photographs of the Apollo landing sites on the moon, showing ample proof that Armstrong and co. did irrefutably walk on the moon. Eight missions in all made it to the moon—Apollo 10 and 13 orbited the moon but did not land—but of the six missions that made it to the moon (i.e., landed), more than 840 pounds of moon rock, soil and core samples (just 48.5 pounds of that material came from the Apollo 11 mission) were collected.

For those who ask why we haven’t returned to the moon, the answer is simple. The Apollo programme was an undertaking of massive proportions involving at its peak 4.4 per cent of the US federal budget, the equivalent of around US\$200 billion in 2015. Less than a decade after the final Apollo mission, the US space agency’s budget had shrunk to less than 1 per cent, and today less than US\$7 billion a year is spent on flight programmes by the National Aeronautics and Space Administration (NASA). Still sounds like a lot of money, right? Not when your gross domestic product (GDP) is US\$17.3 trillion (estimate from the second quarter of 2014).

“Asking if space exploration—with humans or robots or both—is worth the effort is like questioning the value of Columbus’s voyages to the New World in the late 1490s.”

Keith Cowing, founder and editor of
NASAWatch.com and former NASA space biologist



After Sputnik launched, nationalistic pride pushed both the Soviets and the Americans to a focus not seen since, competing against each other for the “firsts” of orbit, space walk, docking, etc. Previously such huge national efforts had been limited to wartime endeavours, but during the cold war, while the arms race was in full swing, the ability to claim the region of space local to earth orbit was just as critical a foothold in the minds of these two competing nations.

The atomic age was an age of massive economic growth. GDP growth hovered between 6 and 10 per cent for most of the 1950s and 1960s, and the demand for electricity growth was running at 7 per cent per year. While coal-fired plants were growing rapidly, projections showed that these facilities would not be able to cater for the growth expected through to the end of the century. Thus, nuclear was considered the more viable long-term option. In 1967, it was estimated that 56 per cent of the US generation capacity would be borne by nuclear power plants by the year 2000. Inflation in the 1970s, followed by the oil crisis, however, played havoc with the economy and the demand for growth of the grid shrunk.

Today, it is solar cell technology that is most likely to take the crown in the energy stakes. Solar was essentially a parallel invention of the space age. Bell Labs produced the first viable solar cell in 1954, and it was just four years later in 1958 that NASA's Vanguard 1, the first solar-powered satellite, launched.

Although solar was invented during the atomic age, it's only now that it has reached a price point where it can compete with the incumbent energy industry. The disruption of technologies borne in the post-war technology boom is set to continue, and by the sounds of it, that's great for all of us.

Social Impact of Rockets, Tronics and Nukes?

At its peak, NASA employed some 400,000 people, and it is said that this extended to another 20,000 universities, contractors and industrial firms around the world. It is said that 4.5 per cent of the US workforce was involved in the space race in some way or another in the mid-1960s. This was an unprecedented outlier in the typical ebbs and flows of various industry sectors and their contribution to economic growth.

To this day, Houston, Texas, and the “Space Coast” of Florida still bear the long-term economic benefits of the investments made in the space programme during the 1960s. A few of the benefits from NASA’s investment in technologies over the last five decades include:

- **Teflon-coated fibreglass** today used as a roofing material
- **Liquid-cooled spacesuits and undergarments** which have been adapted into portable cooling systems for treatment of medical ailments such as burning limb syndrome, multiple sclerosis, spinal injuries and sports injuries
- **Lightweight breathing system for NASA firefighters** now used in fire-fighting apparatuses around the world
- **Robotic spacecraft servicing arms and artificial muscle systems developed by NASA** now used in artificial limbs designed for amputees
- **The design of NASA’s space shuttle main engine fuel pumps** used as the basis to develop an artificial heart pump by Dr Michael DeBakey of the Baylor College of Medicine together with Johnson Space Center engineer David Saucier

Amongst the other cool NASA inventions or contributions we use every day are invisible braces, scratch resistant lenses, memory foam, infrared thermometers, smoke detectors, cordless



tools, water filters, high-performance radial tyres, light-emitting diodes (LEDs), chemical detectors and even video-enhancing and analysis software.

The atomic or space age, while disruptive from a technology perspective, created many more jobs and much more wealth than it displaced.

The Information or Digital Age (1975–2015)

At the centre of technology innovation today lie three core *laws* or principles. Moore's Law, which we covered earlier in the chapter, and two other laws known as Metcalfe's Law (and the closely associated Gilder's Law) and Kryder's Law, a principle

Another way of thinking about it is that if you took every book ever printed throughout history (estimated at about 130 million individual titles), today we produce that same amount of content almost 1,000 times every second, or 80 million times per day!

related to storage mediums. Collectively, they cover the core precepts of the digital age—computing power, networking and storage (or data). Computing and telecommunications have had a profound effect on the world and our behaviour over the last few decades.

To illustrate some of the mind-blowing statistics of the digital age, let's look at data storage and data transmission over networks. Between 1990 and 2005, the capacity of hard disks increased a thousandfold, and it continues to this today.

In 2015, it was estimated that Internet Protocol (IP) networks circling the planet would transmit 10 zettabytes of data. In 2008, we estimated that we would do 1 zettabyte in 2015, so we've already exceeded that tenfold, and we're expected to see another tenfold increase between 2014 and 2019.

To put that into perspective, if you were to size the "data", or content, stored in the entire Library of Congress, the largest

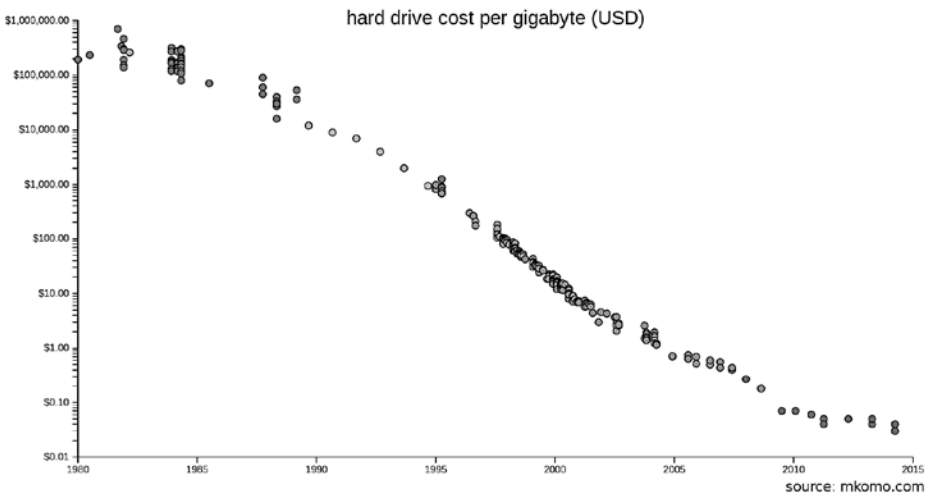


Figure 1.8: Declining cost per gigabyte 1980–2015

library in the world, you'd get approximately 3 petabytes (PB) of data.¹⁹ The Library of Congress doesn't just store books, it also stores 13 million photographs, 4 million maps, 500,000 movies and 3.5 million sound recordings.²⁰ We produce the same amount of content as is stored in the Library of Congress more than 8,500 times per day. Another way of putting this is that if you took every book ever printed (estimated at about 130 million individual book titles),²¹ we now produce that same amount of content *1,000 times every second*, or 80 million times per day!²²

Today, the US National Security Agency (NSA) collects as much information as is held in the entire Library of Congress every six hours. Staggeringly, there is already enough storage or disk space in the world to store everything people write, say, perform or photograph every day—with ease.

When the Internet started, there were a few large servers at universities and such, but most of the computers connected to the

19 There are 1 million gigabytes (GB) in a petabyte. An exabyte (EB) is 1024 petabytes, a zettabyte (ZB) is 1024 exabytes and a yottabyte (YB)—named after the *Star Wars* character Yoda—is 1024 zettabytes.

20 Statistics from the Library of Congress

21 According to Google Books software engineer Leonid Taycher, the actual figure was 129,864,880 books as of 2010.

22 Allowing for an average of 1 megabyte (MB) equivalent of storage required for each book, and accounting for approximately 9 zettabytes of content generated in 2014, we get the above figures.



Internet were small- or mid-range devices. “Data Centres” had existed since the 1970s but the creation of “servers” in the 1990s created commercial data centres used by large corporations, with disaster recovery being a central theme in centralising storage and mirroring platforms across multiple locations. Today, we call all those server farms or data centres connected to the Internet “the cloud”. The word “cloud” comes from network diagrams that used to illustrate offsite storage in the shape of a cloud.

Phil Harrison, the former corporate vice president at Microsoft who led the division responsible for Microsoft’s Xbox, described this dynamic exponential growth in computing as a platform at the launch of the Xbox One at the Electronic Entertainment Expo (E3) in 2013:

“Day one of Xbox One, we will have the [cloud] server power equivalent to the entire computing power of the planet in 1999. There’s a tangible data point for you...”

Phil Harrison, corporate VP of
Microsoft’s Entertainment Division

The sharing economy and the social media collective have produced an explosion of content, bytes/bits and data that we didn’t really see coming ten years ago. We predicted a linear increase in demand for data, and when mobile came along we rightly predicted more data usage, but we didn’t expect the explosion of data that occurred as a result of social media, the amplification of “sharing” and the rise of consumers as producers of content.

Internet sensation PewDiePie, the nom de plume of YouTube vlogger Felix Arvid Ulf Kjellberg, is the epitome of this shift in terms of shifting demand for content. In a little over one month,

PewDiePie averages more views on his YouTube channel than the estimated global audience for the World Cup in 2014. An estimated 26.5 million Americans tuned in to watch the World Cup final between Germany and Argentina, but PewDiePie had already received 20 million views that day.

According to website TheRichest.com, ESPN is the world's most valuable TV network, with Fox News following in third place and CNN in tenth place. Yet the fight for viewer relevance could find no greater battleground than nightly cable news or perhaps sporting events like the World Cup. If you look at TV viewership from 2004 to 2014, it peaked in 2009. The reason for its subsequent decline is a combination of two technologies on top of the IP layer. The first being online video, starting with YouTube and then evolving into services like NetFlix, Hulu and Amazon Prime, and second, mobile and tablet consumption of video moving away from traditional news networks to just chunks of content.

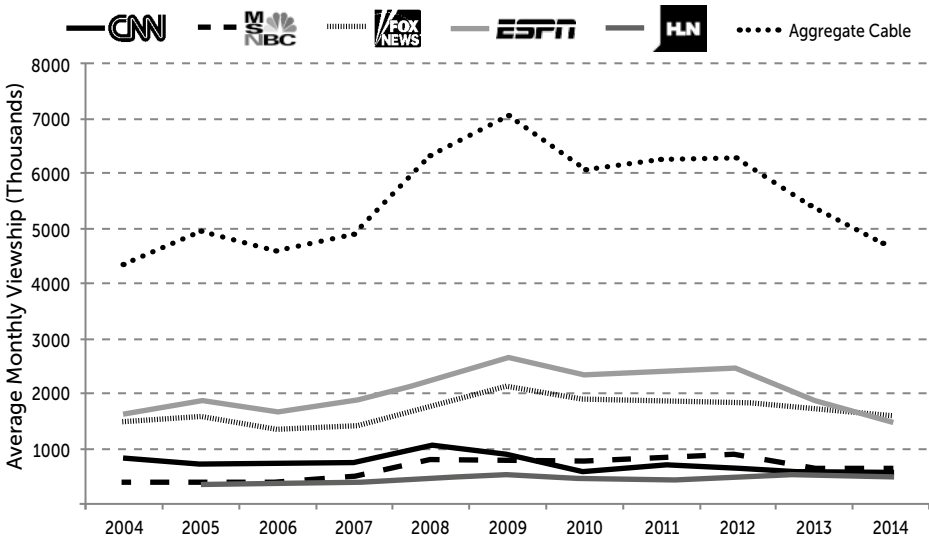


Figure 1.9: Historical monthly traffic (viewers) for major cable networks
(Source: Nielsen, individual network data)

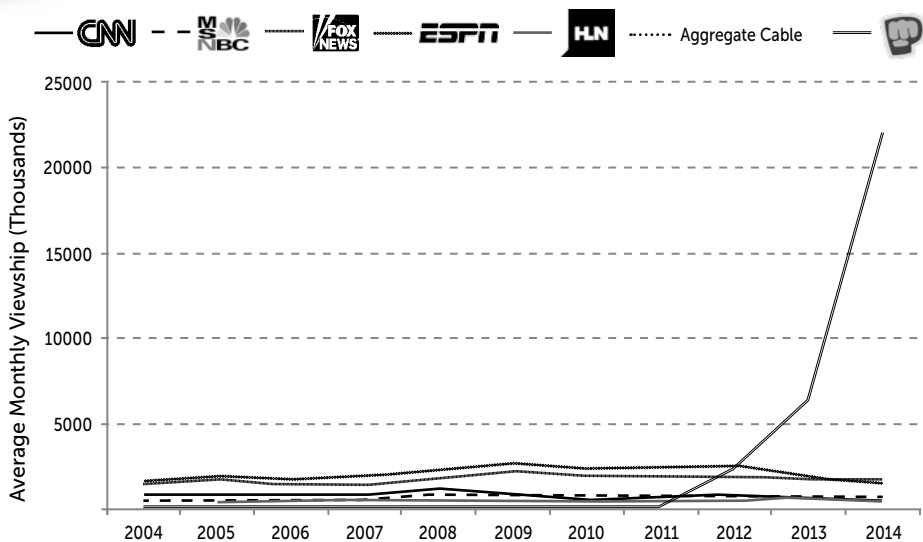


Figure 1.10: PewDiePie's monthly viewers compared with the major cable networks in the United States
(Source: YouTube)

It gets really funky though when you start to try to quantify the effect of YouTube stars or TV shows that are socially enabled, but not through what we would characterise as traditional media forms. The graph above illustrates the incredible influence and reach that just one vlogger like PewDiePie has compared with traditional news networks. In terms of just viewers and traffic, even on an aggregated basis, they don't even begin to come close.

I understand that PewDiePie's viewer base is entirely different to those watching Fox News, ESPN and CNN, but in terms of pure audience reach Felix Kjellberg has them all beat—yes, he gets ten times more views than the entire prime time cable TV base in the United States. If you're arguing that PewDiePie is never going to be as influential as Fox News, you are missing the point entirely. For Gen-Y and Gen-Z, the spheres of influence are entirely different to those of their parents' generation. The interactions within their digitally-powered communities are

growing at a rate we've never seen before in history, and shared video, content and pictures are both essential tools in that behavioural shift. *TV cable is never going to be essential to the Augmented generation.*

For the record, statistically speaking, PewDiePie is definitely more influential than Fox News. In the end, it simply depends on whom you are trying to influence. The generation of consumers who watch TV or the generation who will dominate commerce, industry and demographics in just a few years' time?

Michelle Phan, another YouTube sensation, started blogging on simple make-up tips and tutorials in 2005 but progressed to YouTube video format in May 2007. In 2009 and 2010, BuzzFeed, an American Internet media station, featured her video make-up tutorials, and her YouTube channel went viral. Today, she has 7 million subscribers and an average video post of hers gets 1 million views in the first week. She leveraged her follower base and popularity to bootstrap "Ipsy", a monthly beauty products subscription service, starting in 2011. In 2013, L'Oréal launched a new cosmetic line called "EM•Michelle Phan".

Today, the 27-year-old YouTube star, who was once reportedly rejected for a job at a Sears make-up counter, runs a US\$84-million-a-year cosmetics empire. At the 2014 Code/Mobile conference in Half Moon Bay, California, Phan reported that she'd seen a significant shift in consumption habits over the last 12 months.

"Last year, 60 per cent of [our] traffic came from desktop.

Today, 70 per cent comes from mobile."²³

Michelle Phan

²³ "Michelle Phan: From YouTube Star to \$84 Million Startup Founder," *Re/code*, 27 October 2014.



The Internet is at the heart of some of the most innovative business models we've seen emerge in the last 50 years. It wasn't that long ago that the very first website was published by Tim Berners-Lee, on 6th August 1991. The page simply explained the World Wide Web project and gave information on how users could set up a web server and create their own web pages.²⁴

What we know as the *commercial* Internet is generally recognised as having launched three years later in 1994, with the likes of Yahoo, Lycos, the *Economist*, First Virtual (Bank), LawInfo, Pizza Hut, The Simpsons Archive (the very first fan website), Whitehouse.gov, WebCrawler, *Wired* magazine (hotwired.com back then) and others. Pizza Hut even allowed people in Santa Cruz, California, to order pizzas over the web! Today, the Internet is responsible for an incredible US\$2.6 trillion in e-commerce sales. Before 1994, that figure was exactly \$0. And those global e-commerce sales are still increasing at a healthy 20- to 30-per cent year-on-year growth 20 years on. However, Internet usage is rapidly changing thanks to the smartphone.

The smartphone is obviously the most significant development in personal, networked computing devices that we've seen in the last 50 years. While we might have imagined in 2007 that smartphones were a fashion accessory for the wealthy and middle classes in countries like the United States, the real action today is happening in the developing world. In 2013 alone, China sold more phones than the entire population of the United States, and most of these were smartphones. Smartphones, like the Xiaomi Redmi, Meizu m2, Yu Yunique, Obi Worldphone and Google's Android One, have already begun to fundamentally rewrite the rules on Internet-enabled device access for devices in the US\$100 range. By January 2014, mobile Internet access had already surpassed desktop

²⁴ You can check it out at <http://info.cern.ch/hypertext/WWW/TheProject.html>.

(PC)-based Internet access in terms of time spent²⁵ online.

In India, there are more than 40 different smartphones available for under Rs. 5,000 (approximately US\$100) today. However, according to research by Priceonomics, in just 18 months the projected resale value of these phones will drop on average by more than 60 per cent.²⁶ Extrapolating the current progress in smartphone availability, we know entry-level smartphones will be available for US\$20–25 in most developing nations by 2020. This means that more than 85 per cent of the world will have a mobile device connected to the Internet within just five years. Think about that. Between 2015 and 2020, more users will come online than since 1994 when the Internet emerged onto the world's stage. In that respect, the Internet and mobile commerce is only just in its infancy.

In 50 years' time when we look back at all of the changes that have occurred, we'll certainly identify the Internet as the biggest technology enabler, but when it comes to personal communication and interaction, the smartphone will be the device that really changed the world.

The Most Efficient Profits in History

Tech companies now compete side by side with some of the biggest brands in recent history. Obviously, Apple is a phenomenal example of a tech brand but don't discount Microsoft, IBM and Oracle, all of which continue to lead the world too.

Between them, the top tech companies on NASDAQ employ around 1.3 million people and contribute US\$3 trillion of market cap to the economic landscape. If you include the next tier of players, you have the likes of HP, Baidu, NTT Communications, EMC, Texas Instruments, Yahoo, Salesforce.com, Cognizant, eBay and others in the mix.

25 Kate Dreyer, "Mobile Internet Usage Skyrockets in Past 4 Years to Overtake Desktop as Most Used Digital Platform," *comScore*, 13 April 2015.

26 "Your Phone Loses Value Pretty Fast," *Priceonomics*, February 2012.



Table 1.1: Market Capitalisation of the World's Top Tech Companies

Company	Market Cap (billion)	Employees
Apple	673.91	50,250
Microsoft	406.36	128,000
Google	364.27	53,861
Alibaba	285.14	22,072
Facebook	206	8,348
Oracle	182.22	122,000
Intel Corp	165.6	107,600
IBM	162.38	431,212
Cisco	135.86	74,040
Qualcomm	116.99	31,000
TSMC	112.19	40,483
SAP	83.29	263,000
	2894.21	1,331,866.00

Source: NASDAQ stock quotes

Tech companies are very efficient producers of profit compared with other large listed companies. Walmart, for example, has a market cap that is below Alibaba's but employs more than 1.4 million Americans alone.

The so-called "FANG" stocks of Facebook, Amazon, Netflix and Google created over US\$440 billion of value on the US markets in 2015 alone.²⁷ The FANG stocks comprised just over 3.5 per cent of the weight of the S&P 500 Index at the beginning of the year, but made up 5.1 per cent by the end of the year. For the sake of comparison, the US\$440 billion that these four companies added to the S&P is about two-thirds of Apple's market capitalisation.

In 2013, the four biggest banks in the United States delivered profitability in the range of roughly US\$61,500 per employee annually. In the same year, the four largest tech companies delivered a massive US\$450,000 per employee. That's more than

²⁷ Jeff Desjardins, "The Market has no bite without FANG stocks," *Visual Capitalist*, 20 November 2015, <http://www.visualcapitalist.com/the-market-has-no-bite-without-the-fang-stocks-chart/>.

seven times that of the big banks, and more than ten times that of what retailers and fast-food giants achieved. The implication is simple—the more technology deployed in an industry, the more profitable that industry is at generating profit. Ultimately, this is why every industry must undergo a technology-based transformation in the Augmented Age.

Table 1.2: Comparison of Major US Sectors Earnings Performance (2013)

	Net Income (billions)	Employees	Net Income per Employee
Bank of America	11.4	290,509	\$39,241.47
Wells Fargo	21.9	265,000	\$82,641.51
Citibank	13.9	251,000	\$55,378.49
JP Morgan Chase	17.9	260,000	\$68,846.15
Banking			\$61,526.90
Walmart	27.8	1,400,000	\$19,857.14
The Home Depot	24.27	340,000	\$71,382.35
Target	1.971	361,000	\$5,459.83
Retail			\$32,233.11
Apple	37	50,250	\$736,318.41
Microsoft	7.41	128,000	\$57,890.63
Google	33.91	53,861	\$629,583.56
Facebook	5.97	8,348	\$715,141.35
IBM	47.81	434,246	\$110,098.88
Tech			\$449,806.57
McDonald's	28.1	440,000	\$63,863.64
Yum!	13.1	523,000	\$25,047.80
Fast Food			\$44,455.72

Source: Company annual reports

Such efficiency, while great for shareholders, is not necessarily great for employment. To illustrate, Kodak at its peak employed 140,000 people, whereas Instagram, arguably the Millennials' version of Kodak (acquired by Facebook for approximately



US\$715 million in stock in 2012), only had 13 employees at the time of the acquisition. So it could be postulated that technology is, on a net basis, bad for society when it comes to employment.

Apple creates many jobs in its stores, and Foxconn factories reportedly employ 1.23 million people, the majority of whom are dedicated to Apple product manufacturing and assembly, but in terms of the sheer size of the Apple Inc. economy, the company employs relatively few people. Given the efficiency gains that technology brings, does that mean that as technology displaces historical businesses it inevitably destroys jobs? Actually no, that's not what the research shows at all.

"The Internet's impact on global growth is rising rapidly. **The Internet accounted for 21 per cent of GDP growth over the last five years** among the developed countries MGI studied, a sharp acceleration from the 10 per cent contribution over 15 years. **Most of the economic value created by the Internet falls outside of the technology sector, with 75 per cent of the benefits captured by companies in more traditional industries.** The Internet is also a catalyst for job creation. Among 4,800 small- and medium-size enterprises surveyed, **the Internet created 2.6 jobs for each lost to technology-related efficiencies.**"

"Internet matters: The Net's sweeping impact on growth, jobs, and prosperity," McKinsey Global Institute, May 2011

So that's good news, right? The Internet has created 2.6 jobs for each job it has displaced, and that doesn't necessarily account

for jobs generated by the creation of wealth associated with Initial Public Offerings (IPOs), etc., that have invariably accompanied companies like Facebook, Google and Apple in recent times.

Various organisations have tried to quantify the web's contribution to the global economy. If we limit the assessment to just e-commerce-related expenditure, the web contributes generally between 4 and 8 per cent of GDP annually in developed economies.²⁸ However, that excludes activities like social media use, apps, watching YouTube videos and other activities that, while not having a direct economic impact in a traditional sense, are hugely influential to commerce and employment these days.

The one issue with the creation of jobs in the digital age is that invariably these jobs are centred around wherever the head office of the tech company is. For example, of the 128,000 people that Microsoft employs, more than 40,000 of them are based in Seattle where Microsoft is based. Of the 66 countries that Amazon operates in,²⁹ research based on LinkedIn data suggests that over 90 per cent of Amazon's staff is based in just six countries—the United States, the United Kingdom, India, Ireland, China and Canada.

Certainly the digital age has brought about one of the greatest booms in technology, jobs and wealth creation in all history. However, as highlighted above, the distribution of jobs and wealth from the digital age has tended to be centred more geographically and in more specific demographics (often also location biased). This is in stark contrast to previous booms like the manufacturing boom of the United States in the early 20th century, which was credited for being responsible for the broad creation of the middle class.

The Internet, and with it broad technology automation, has created a more serious problem for employment. Erik Brynjolfsson,

²⁸ 4.7 per cent in the United States and 8.6 per cent in the United Kingdom by 2014

²⁹ Author's own analysis from *Business Insider*, LinkedIn raw data/sources



When Workers Began Falling Behind

Until the 1980s, labour productivity, real GDP per capita, private employment and median family income all rose in tandem in the US. Then median income started to trail, and around 2000 job growth slowed.

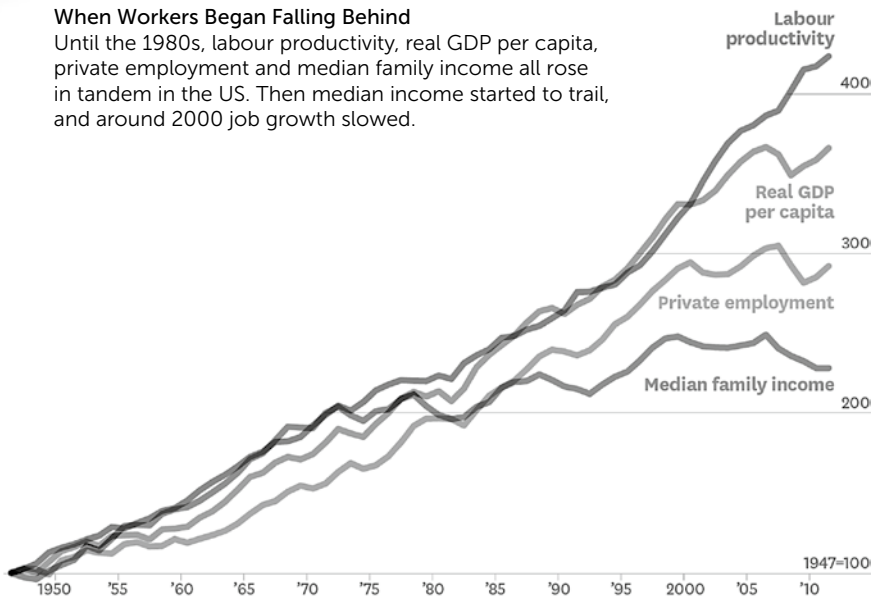


Figure 1.11: Productivity changes related to employment and median family income
(Credit: HBR)

a professor at the MIT Sloan School of Management, and his collaborator Andrew McAfee have been arguing for the last five years that advances in computer technology—from improved industrial robotics to automated translation services—are largely behind the sluggish employment growth of the last 10 to 15 years.³⁰

Brynjolfsson and McAfee analysed the last 70 years of employment data and found that while productivity has continued to improve, employment has not kept up pace in recent years. Since the 1940s, employment growth has very closely followed productivity gains, at least that was true up until 2000. In the Internet era, productivity has grown, as has GDP, but income for the middle class and employment have not grown as quickly. This is an outlier that has only become evident in recent years with the maturation of computing and the evolution of the Internet.

30 Erik Brynjolfsson and Andrew McAfee. *Race Against the Machine: How the Digital Revolution Is Accelerating Innovation, Driving Productivity, and Irreversibly Transforming Employment and the Economy* (Richmond, VA: Digital Frontier Press, 2011). See also Erik Brynjolfsson and Andrew McAfee. *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies* (London: W. W. Norton, 2014).

As agriculture and industry jobs have declined, the services sector has already come to account for 80 per cent of US GDP. The problem we conceivably have now is that technology may, for the very first time in 200 years, disrupt the services sector significantly. So unless we create entirely new industries based on demand for services that don't exist today, it's likely that we'll see significant issues with employment growth.

What sort of disruption to employment and wealth will come over the next 20 to 30 years as we emerge into a new age?

About the Author



Brett King is a four-time Amazon bestselling author, a renowned commentator and globally respected speaker on the future of business. He has spoken in over 40 countries, to half a million people, on how technology is disrupting business, changing behaviour and influencing society. He has spoken at TED conferences, given opening keynotes for *Wired*, Singularity University's Exponential Finance, the *Economist* and many more. He has visited the White House to advise the National Economic Council on the Future of Banking and been invited to meet with regulators from the United States, China, the European Union and the World Bank.

King hosts the world's leading dedicated radio show on technology impact in banking and financial services "Breaking Banks" (72 countries, 1 million listeners). He is also the founder of Moven, a successful mobile start-up, which has



raised over US\$24 million to date, with the world's first mobile, downloadable bank account, available in the United States, Canada and New Zealand.

Named "King of the Disruptors" by *Banking Exchange* magazine, King was voted *American Banker's* Innovator of the Year in 2012, voted the world's #1 Financial Services Influencer by The Financial Brand and was nominated by Bank Innovation as one of the top 10 "coolest brands in banking". He was shortlisted for the 2015 Advance Global Australian of the Year Award for being one of the most influential Australians living offshore. His books have been released in more than a dozen languages and he has achieved bestseller status in 20 countries, with many of his books still appearing in bestseller lists more than 18 months after their initial release. His fifth book is *Augmented: Life in the Smart Lane*.

King has been featured on Fast Company, TechCrunch, *Wired*, *Fortune* magazine, Fox News, ABC, CNBC, Bloomberg, BBC, *Financial Times*, the *Economist*, *ABA Journal*, *Bank Technology News* and many more. He contributes regularly as a blogger in *Huffington Post*.

In his spare time, he is an IFR-rated private pilot, scuba diver and gamer.

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Andy Lark is a globally awarded marketer and business leader. Today, he is the chief marketing and business officer of Xero, the cloud accounting software leader and one of the world's fastest-growing software as a service (SAAS) companies. Xero was named the world's most innovative growth company in 2015 by *Forbes*. For the past two decades, Lark has worked alongside CEOs and their leadership teams to define—and then attain—digital and brand greatness for their institutions. These include Air New Zealand, Brocade, Commonwealth Bank, Coles, Dell, Emirates Team New Zealand, IBM, Simplot, Southwest Airlines, Sun, the New Zealand government, Visa and Xero. As an entrepreneur and marketer, Lark has built some of the world's most successful e-commerce sites, online communities and applications for smartphones.



Alex Lightman

Alex Lightman is an award-winning inventor, artist, entrepreneur and government advisor. He is the author of the first book on 4G wireless, *Brave New Unwired World*, as well as *Reconciliation: 78 Reasons to End the US Embargo of Cuba*. His awards include the first Economist magazine Reader's Award for the Innovation That Will Most Radically Change the World, SGI's Internet VR contest grand prize (out of 800 entries), and Avatars '97. He is the chairman of Witkit, Everblaze, and GINET, and director of a venture fund. He is a graduate of MIT and attended graduate school at Harvard's Kennedy School of Government.

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Born in Calcutta, JP Rangaswami (@jobsworth) read economics and worked as a financial journalist before changing careers over three decades ago to enter that strange space where society, technology and banking converge. Now 58, Rangaswami works as chief data officer at a major financial institution, having previously been chief scientist and chief information officer at a number of global institutions. He is Adjunct Professor at the School of Electronics and Computer Science at the University of Southampton. In addition, he is a Fellow of the British Computer Society, a Fellow of the Royal Society of the Arts and Venture Partner at Anthemis. Rangaswami is a popular keynote speaker, having given a popular TED Talk—Information Is Food, and can be found blogging at ConfusedofCalcutta.com.