Part 2: Report

Table of Contents

Summary

This report will discuss the changes wrought by this Digital Economy, and considerations for businesses and workers to adapt to this new paradigm shift. This paradigm has the potential to alter society significantly, and preparations will need to be made to support both the integration of these new technologies as well as the transition for the human workforce to both develop the new technologies, as well as those who will potentially be displaced by the capabilities.

Introduction

"Who is it?" she called. Her voice was irritable, for she had been interrupted often since the music began. She knew several thousand people, in certain directions human intercourse had advanced enormously. (Forster, 1928).

While over 100 years too early (originally penned in 1909), E. M. Forster words describing an interconnected world, with every person connected to several thousand people, has turned out to be presciently accurate. What was not inferred but also accurate was the case that in this now interconnected world, it is possible to connect to almost 4 billion people as part of the Internet (Meeker, 2019), over half the world's population.
What is also so profound is that this network, the Internet, would not become reality until the late 1960's (*Ars Technica*, 2019) and that this Internet is based on the work of many famous names: Babbage who created the original concept of a programmable computer and Lovelace, Boole, Turing, Cyrus West, Shannon and more who between them developed the concept that would lead to the creation of the physical computer .

Computers

In the time since Babbage's era, "computer performance has improved since manual computing by a factor between 1.7 trillion and 76 trillion." (Nordhaus, 2007) and Moore's Law is still being respected, the doubling of transistors every two years ('Moore's law', 2019). In addition, as part of the wider trend in exponential performance increases in computing performance, the cost of computing and storage is declining at exponential rates due to continued innovation (Deloitte, 2019).

Connecting the Computers

Enabling the connectivity between the computers is based on the outstanding work of Cyrus West Field (the original Atlantic telegraph cable), Shannon and many others, connecting the world through the early communication methods of wired and wireless. Christopher Columbus declared *"there was one world; let there be two"* (as described on his statue in Genoa, Italy), to be followed by Cyrus West Field *"'there were two worlds; he said, 'let there be one again,' and they were one."* (Gordon, 2002) and it this interconnected world we now live in.

While no formal study exists on the transmission capacity of information, Taylor (2014) demonstrates that if we used the communication technology of Explorer 1, the first US satellite, to send a modern digital photo from Earth to Jupiter, it would take the lifespan of the *universe multiplied by 460* for the image to get through, whereas now it would take just a small fraction of that time . Thus sending an image (or any information) a distance anywhere on earth, i.e. much further than Earth to Jupiter, can be treated as almost instantaneous!

And what of the information we transmit on these cables and utilise computers for? This technology is down to the work of Claude Shannon, whose thesis on the Mathematical Theory of Communication (Shannon, 1948) – a thesis cited over 91,000 times! – focused on the transmission of information. He developed the theories that allowed the world to step past the concept that all types of Information "would require different ways of

communicating" – written language, spoken language, pictures, video etc. Shannon *"said no, you can turn all of them into binary digits. And then you can find ways of communicating the binary digits."* (Soni and Goodman, 2018).
What do we mean by binary digits that Shannon referred to? This refers to the bit, zero's and one's, that can be used to infer *any* type of information in a digital format and which laid the foundation for the modern digital era.
These bits therefore enable technologists to build on the "six decades into the computer revolution, four decades since the invention of the microprocessor, and two decades into the rise of the modern Internet" (Marc Andreessen, 2011) and we now are in the position to continue transforming a range of industries through software.

In enabling and blending all these various inventions, we have reached a situation where we have deployed a technological tour-de-force that is now enabling us to consider additional phases. These include new revolutionary concepts such as the development of Artificial Intelligence, Advanced Robotics and Automation, the "Fourth Industrial Age" (Reese, 2018), (World Economic Forum, 2016). Already we are seeing examples where computers will make a telephone call to make a reservation at a restaurant for you, and the early phases of self-driving vehicles are starting to appear.
Recently it has been stated that "basic connectivity is considered a free service on the lowest level of Maslow's hierarchy of needs" (Donovan and Prabhu, 2017)(Saracco, 2017).

Digital Economy Characteristics

Building on Shannon's work referred to previously, this transition to the 'bit' has brought some unique characteristics. While building numerous new systems in the digital world, another economy has been created that is "vast, automatic, and invisible--thereby bringing the biggest change since the Industrial Revolution" (Arthur, 2011). Humanity has moved from a period of time where the world is not only heavily interconnected physically, but now digitally.

This author believes that this new paradigm, The Digital Economy, is a profound re-adjustment to society, both technologically and to all systems and structures that the modern world is currently based on. This is a new Digital Economy that overlaps with our existing economy, and yet also creates whole new economic processes that some consider a second economy (Arthur, 2011). Already, there are signs that this economy is not being correctly captured in economic reports. For example in the United States, "Gross Domestic Product consistently understates US economic growth by 0.75% and overstates inflation by 0.4%, as contributions from the digital sector are routinely mis-measured" (Cocuzzo, 2019). As the digital economy continues to evolve and expand, it will become increasingly more important that will require that these productivity metrics are correctly captured.

What is unique to the Digital Economy is that it flips many existing structures on their heads. From a technical perspective, as previously discussed on the declining cost of computing and increasing performance, in essence the cost of distribution of digital goods is essentially free due to the inherent nature of the 'bit', and the declining cost of computing and transmission. Once a product is created digitally, it is also trivially cheap to replicate and transmit.

From a consumer's perspective, they are now connected to the world's inventory of data. Data can mean basic information, however it also can mean an infinite number of shop fronts, as well as infinite products. In addition, the concept of 'scarcity' existed previously. In the digital era, an infinite number of permutations of any product can now exist customised specifically to every customer thus scarcity as once known is no more.
From a company perspective, this can lead to a fundamental re-think of existing business models. Scale was a competitive 'moat' in the past era based on allowing businesses to lower fixed costs, and through mass marketing via television and radio reach the broadest collection of consumers. The digital era has enabled a collection of new businesses, leveraging digital capabilities in order to attack the fundamental strengths of this business model.

$57 billion versus Dollar Shave Club

An example can be demonstrated in a strong e-commerce market, the USA. Prior to 1995 (the invention of the Internet), the most successful businesses depended on spending significant resources on new products that commanded a price premium, spending more resources on advertising, and spending even more resources to enable maximum visibility. These companies expanded to meet the middle-ground, targeting the broadest swathe of people. As stated above, we are not in an era of 'scarcity' in the Digital Era: anything can be replicated trivially, and a scenario has occurred where new Internet-enabled businesses are in a position to attack distinct products.

Proctor and Gamble (P&G) is just one example of this, building a significant portfolio of products and enabling it to double its revenue every decade for almost 60 years. This scenario was ideal for the era of 'scarcity'. However, P&G is now under significant threat in the Digital Era (CB Insights Research, 2016) by a range of digitally-enabled start-ups.
One specific example is the Dollar Shave Club which significantly disrupted the US razor blade market, capturing 15% of the market before it was acquired for $1 billion in 2016 by Unilever. Utilising new scenarios enabled by Digital, cloud hosting and fulfilment networks, this new start-up was able to directly capture a significant proportion of the market ("blades at a dollar per month!"). What is also notable is the cost it was purchased for. At $1 billion, it was only a fraction of the cost of what P&G's paid for the previous era's leader in shaving, Gillette. This is a perfect example of a disruptive innovation which change the value proposition in a market, appear with lower performance, and open new markets before progressively improving their own performance to taken over older markets (Christensen, 2016).

Newspapers, and a 1,000 True Fans

Another visible example is the current distress of the newspaper industry. Previously, the newspaper publishers controlled the relationship with the public by integrating publications and articles. A small number of papers existed covering the world globally. In the new era, an article has now been modularised and online networks (largely made up of Google and Facebook) now control the relationship, though use of profile data to enable highly, contextualised information directly to the consumer. Every consumer can now read their own personalised newspaper.
In addition, whereas heretofore there were companies such as P&G focusing on producing products for the general masses, we can now consider every possible niche as an

opportunity. With 4 billion people online, even if only one person in a million is interested in a product, that is still an opportunity to sell 4,000 of the product. Businesses at present are set up to produce a small number of products at scale, not a large number of products in small quantities. As aptly described by (Anderson, 2004), "the future….is in the millions of niche markets at the shallow end of the bitstream".

Telecommunications?

Even the companies supplying the connectivity for this new Digital Era have struggled under the transition. Telecommunications companies originally owned every wire in the ground, as well as controlled all the 'bits' (voice) on the wires through their telephony exchanges. In the new era where everything is a bit, and every service can now be offered digitally, new companies have stepped in. Amazon Web Services (and equivalent cloud hosting services) could now be considered the 'Exchange' where the new value of the Internet is controlled and distributed. Telecommunications Companies had fought to avoid becoming 'dumb pipes', however in an unwillingness to disrupt previously profitable lines of business (voice and messages), they have allowed other companies to step in and own these new services. Telecommunications companies are thus having to take on a holistic review to redefine their own technology supply chain as well as retrain their workforce for this new digital era (Donovan and Prabhu, 2017).

What comes next: Artificial Intelligence and increased Automation

In every new era (Agricultural, Industrial and the present, Digital), new economic structures have been required as well as revolutions in social and cultural norms. A strong consensus is emerging that we are increasingly moving towards a new era of 'smart computing' where computers are capable of displacing humans in both lower and higher skilled jobs and this is now something to be considered. One current thesis is that Machine Learning, where computers are able to adapt and are highly capable in the realm of speech and pattern recognition, will likely eliminate white-collar roles (Cascio and Montealegre, 2016). In the next section, this likelihood will be considered and whether this has any new implications for businesses and the workforce.

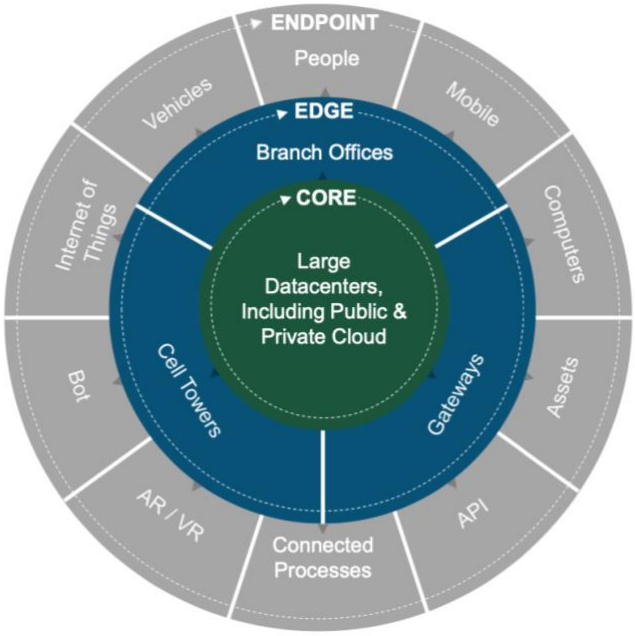

Figure 1: Future networks and connected devices and people. Source: Meeker (2019)

Is this Different to previous Revolutions?

What is described above is the world we live in in 2019, built on computers running software and transmitting the world's information to almost anywhere on the planet instantaneously. This requires a fundamental reassessment of business models and the capabilities required for the modern worker.

What we are potentially entering next is the Artificial Intelligent (AI) world, a world built on systems that, in the past decade, are surpassing Moore's Law (Mizell, 2017), enabling a range of new possibilities. This has led to the situation described by Reese (2018) where describes of dire warnings daily: "Robots. Jobs. Automation. Artificial intelligence. Conscious computers. Super-intelligence. Abundance. A jobless future. Useless humans. The end of scarcity. Creative computers. Robot overlords. Unlimited wealth. The end of work". *The Economist* (2014) and many others would similarly concur. Is it likely that we will face a decline of work such as that experienced by horses after the advent of the automobile, with a decline of 88% from peak usage (Kilby, 2007)?

What is clear in the present era and capabilities of any new machines, which include data collection, processing and analysis, is that they are potentially capable of replacing a significant proportion of work that would not have been considered before such as drivers, waiters and nurses. In addition, as highlighted with the exponential improvements occurring within the AI space, it is likely that AI will become as ubiquitous as databases are in companies: everywhere and yet invisible.

It is evident is that Artificial Intelligence, and automation will replace workers in certain roles, potentially 9% across OECD countries (Arntz, Gregory and Zierahn, 2016). What is not evident is whether they will replace all, and whether this impact on jobs will be different to previous eras. We have declared consistently since the early automated machines that they will be taking our unskilled jobs (Sydney Morning Herald, 1961) and while the equine population did not successfully make the transition, the new capability of the automobile enabled countless new opportunities. The automobile enabled the taxes which paid for roads which enabled companies such as Walmart, the world's largest employer with 2.2 million employees (Walmart, 2019).
Most positively, *McKinsey research from* 2018 shows it is likely that there is foreseeable productivity growth ahead, likely enabled by the very digitalisation techniques that may impact elsewhere. In addition, Felten, Raj and Seamans, (2018) demonstrate that while the nature of future work will change, it will not eliminate work. What will change is that companies will not be able to assume that a business model will be eternal, and they must be willing to stretch their horizons around possibilities of the new era.

In short, while there is cause for concern, this author believes that human ingenuity will create new jobs, industries, and ways to make a living, just as it has been doing since the world began trading, providing the correct policies are put in place. Perhaps we should lean on the words of Vint Cerf, one of the founding pioneers of the Internet, "Historically, technology has created more jobs than it destroys and there is no reason to think otherwise in this case. Someone has to make and service all these advanced devices." (Smith and Anderson, 2014).

Types of Work Impacted

Autor, Levy and Murnane (2003) highlight that 'routine tasks' are most at risk, and these are tasks described as any task that can be 'readily described with programmed rules'. However, the OECD recognises that much research leads to an over-estimation of jobs that are viable to be automated, as many jobs contain a large proportion of work that is challenging to automate. Based on this, the OECD believes that up 9% of jobs are automatable (with differing national averages). In addition, and as highlighted with the automobile introduction described above, we also tend to underestimate the job-creating potential of the new Digital Economy due to a lack of knowledge and imagination from the possibilities, similar to industries created from the invention of the automobile as discussed previously (Arntz, Gregory and Zierahn, 2016).

How to Prepare

"How did you go bankrupt?" Two ways. Gradually, then suddenly."
(Hemingway, 1957)

Already there are suggestions that the types of skills now demanded by employers do not match those of the existing labour force (Katz, 2010) and therefore we will require new policies and education to make the transition. This suggests the potential emergence of structural unemployment problems of mismatches between the potentially unemployed from automation and AI, and the potential new jobs.

Companies will also need to navigate the transition of this disruptive period. Research shows that technology usage does lag before adoption (Comin, Hobijn and Rovito, 2008). It is likely that many companies will not make the early transition as occurs with all disruptive technologies (Christensen, 2016) and to avoid this, a balance between efficiency and innovation that is managed by the senior leadership teams (O'Reilly and Tushman, 2008) is required. Something to consider for senior leadership will be the perspectives of those born exclusively during this new paradigm, and unencumbered with previous perspectives or traits.

Most importantly, (Autor, 2015) correctly surmises that the key focus of long-term strategy should be on human capital investment to enable workers to gain skills that will compliment this new work. Carney (2018) also correctly highlights that 'rate-limiting factor of technology adoption is often the skill-set of existing employees' and while the technology is essential, without humans being brought along on the journey, we will not bear the fruits of the possible opportunities. This is already visible in Ireland where half of Irish adults lack the correct digital skills to compete in the modern workplace (O'Brien, 2019).

"History tells us that innovation is an outcome of a massive collective effort" (Medeiros, 2019). It is thus a necessity that significant government incentives and investments will be required in uncertain technological enterprises in order to spur growth. The Springboard education initiative funded by the Government is an excellent example of Government investment but many more investments are required.

Conclusion

'Engels' pause is described as, a period during the first Industrial Revolution where productivity increased yet labour share fell. As we enter the next phase of the Digital Era with automation and AI, avoiding a new Engels pause will require adjustments in all facets of society: economically, socially, political, education and more.
However, society has made these transitions before when the Agricultural Revolution occurred. With the correct proactive policies in place, opportunities abound for all. Humans decide what systems are put in place, and it will be up to us to decide what political, social and economic systems we wish to put in place. Perhaps there is also an opportunity to consider the vision of John Maynard Keyes from 1930 where the number of working hours were significantly reduced.

The choice is up to us.

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