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The GITR series has been published by the World Economic Forum in partnership with INSEAD since 2002 and since 2013 with Cornell University. The *Report* has monitored ICT progress for more than a decade and raised awareness of the importance of ICTs for long-term competitiveness and well-being.

The Global Information Technology Report 2014 Newsletter is the first in the series of publications to look into the strategic value of ICTs and data rom the lens of the World Economic Forum partners. This edition is focused around leveraging data for growth and transformation.

With the magnitude of data available today—and our capability to process it—it have become a new form of asset class. In a very real sense, data are now the equivalent of oil or gold. And today we are seeing a data boom rivaling the Texas oil boom of the 20th century and the San Francisco gold rush of the 1800s. It has spawned an entire support industry and has attracted a great deal of business press in recent years. This new asset class of big data is commonly described by what we call the "three Vs." Big data is high volume, high velocity, and includes a high variety of sources of information. Next to those traditional three Vs we could add a fourth: value. This is what everyone is looking for, and this is why big data today gets so much attention. In the quest for value, the challenge facing us is how to reduce the complexity and unwieldiness of big data so that it becomes truly valuable.

Data-based value creation requires the identification of patterns from which predictions can be inferred and decisions made. Businesses need to decide which data to use. The data each business owns might be as different as the businesses themselves; these data range from log files and GPS data to customer- or machine-to-machine data. Each business will need to select the data source it will use to create value. Moreover, creating this value will require the right way of dissecting and then analysing those data with the right analytics. It will require knowing how to separate valuable information from hype. This world of big data has also become a source of concern. The consequences of big data for issues of privacy and other areas of society are not yet fully understood the world.

Indeed, we are now living in a world where anything and everything can be measured. "Data" could become a new ideology. We are just at the beginning of a long journey where, with the proper principles and guidelines, we should be able to collect, measure, and analyze more and more information about everyone and everything in order to make better decisions, individually and collectively.

We would like to convey our gratitude to the executives and experts who contributed their essays.
Patricia Florissi (CTO for Sales, EMC), George Demarest (Senior Director of Big Data, EMC) and Jessica Rabe (EMC Research and Development Center, EMC; Ed Gresser (Director of the Progressive Economy Project at the GlobalWorks Foundation in Washington DC), Brian Bieron (Executive director of eBay Inc.'s global public policy lab), Usman Ahmed (Policy counsel at eBay Inc.'s global public policy lab), Andrew Tarver (founder of BOLDROCKET) and Siddhatha Raja (ICT Policy Specialist at the World Bank).

We look forward to the discussion around these innovative insights.

Global IT Report 2014: Results of the Networked Readiness Index

Rank	Country/Economy	Value	2013 rank (out of 144)
1	Finland	6.04	1
2	Singapore	5.97	2
3	Sweden	5.93	3
4	Netherlands	5.79	4
5	Norway	5.70	5
6	Switzerland	5.62	6
7	United States	5.61	9
8	Hong Kong SAR	5.60	14
9	United Kingdom	5.54	7
10	Korea, Rep.	5.54	11
11	Luxembourg	5.53	16
12	Germany	5.50	13
13	Denmark	5.50	8
14	Taiwan, China	5.47	10
15	Israel	5.42	15
16	Japan	5.41	21
17	Canada	5.41	12
18	Australia	5.40	18
19	Iceland	5.30	17
20	New Zealand	5.27	20
21	Estonia	5.27	22
22	Austria	5.26	19
23	Qatar	5.22	23
24	United Arab Emirates	5.20	25
25	France	5.09	26
26	Ireland	5.07	27
27	Belgium	5.06	24
28	Malta	4.96	28
29	Bahrain	4.86	29
30	Malaysia	4.83	30
31	Lithuania	4.78	32
32	Saudi Arabia	4.78	31
33	Portugal	4.73	33
34	Spain	4.69	38
35	Chile	4.61	34
36	Slovenia	4.60	37
37	Cyprus	4.60	35
38	Kazakhstan	4.58	43
39	Latvia	4.58	41
40	Oman	4.56	40
41	Puerto Rico	4.54	36
42	Czech Republic	4.49	42
43	Panama	4.36	46
44	Jordan	4.36	47
45	Brunei Darussalam	4.34	57
46	Croatia	4.34	51
47	Hungary	4.32	44
48	Mauritius	4.31	55
49	Azerbaijan	4.31	56
50	Russian Federation	4.30	54
51	Turkey	4.30	45
52	Montenegro	4.27	48
53	Costa Rica	4.25	53
54	Poland	4.24	49
55	Barbados	4.22	39
56	Uruguay	4.22	52
57	Macedonia, FYR	4.19	67
58	Italy	4.18	50
59	Slovak Republic	4.12	61
60	Georgia	4.09	65
61	Mongolia	4.07	59
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63	Colombia	4.05	66
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67	Thailand	4.01	74
68	Bosnia and Herzegovina	3.99	78
69	Brazil	3.98	60
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75	Romania	3.95	75
76	Sri Lanka	3.94	69
77	Moldova	3.89	77
78	Philippines	3.89	86
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80	Serbia	3.88	87
81	Ukraine	3.87	73
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86	Jamaica	3.77	85
87	Tunisia	3.77	n/a
88	Guyana	3.77	100
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135	Benin	2.82	123
136	Burkina Faso	2.78	130
137	Mozambique	2.77	133
138	Libya	2.75	132
139	Madagascar	2.74	137
140	Yemen	2.73	139
141	Timor-Leste	2.69	134
142	Mauritania	2.61	135
143	Haiti	2.52	141
144	Angola	2.52	n/a
145	Guinea	2.48	140
146	Myanmar	2.35	n/a
147	Burundi	2.31	144
148	Chad	2.22	142

Accelerating Innovation

Patricia Florissi, George Demarest and Jessica Rabe

Introduction

The transition from the 20th century to the 21st century – between 1975 and 2025, to be exact – will forever mark the confluence of a series of innovations that are intimately and symbiotically related, and which led to a greater interconnectedness between the digital and physical worlds.

In the digital world, one of these innovations is big data, the arrival of new types and sets of data that have never before been observed, collected or analysed. Big data spans a broad spectrum of subjects and industries. In life sciences, we decode the big data of our DNA. In business, enterprises collect and monitor the big data of customer activity, compiling and evaluating each mouse click performed during every customer website visit, identifying the various patterns that lie behind transactional success and failure. In the social sphere, big data analysts study mobile application data, tracking millions of geographical patterns and positions in order to guide us towards targeted social encounters.

All this big data can now be generated and collected thanks to the pervasive use of technologies, such as mobile devices and electronic sensors; shared through the rapid adoption of social media and other user-friendly and intuitive applications; and analysed on a massive scale using the enormous processing and storage capacities enabled by cloud computing.

At the same time, in the physical world, a similar revolution is under way. The introduction of nanotechnologies and atomic precision manufacturing (APM) is redefining the production of physical goods – in terms of the exactness achieved in product creation, changes to the types of raw materials used, and a drastic restructuring of the supply chain as we know it.

Immersed in data

Over the past decade, a persistent narrative has developed around rapid data growth – and for good reason. Today, the world produces 1 exabyte (1 billion gigabytes) of data in a little more than a day. But while the "bigness" of big data captures much attention, the size of data sets is but one dimension that challenges this new technology. Another essential dimension is how fast data is created. Machine-to-machine interactions and a vast variety of data-generating sensors – temperature, timing, position and acceleration – can generate staggering amounts of data in seconds. The Large Hadron Collider at CERN on the Franco-Swiss border generates 1 petabyte (1 million gigabytes) per second. At this size and speed, the volume of the data set must be reduced by a factor of 40,000 in order to be manageable by the 11,000 scientists across the globe who run experiments on the data.

Perhaps the most overlooked (or presumed) aspect of the potential of big data is that much of the data being analysed is new data: new data from cloud or consumer applications, social interactions, location information from mobile devices, telemetry from smart machines and sensors. Not only is much of this data new in and of itself, but the permutations of its use can add a new dimension to historical data, such as combining buying patterns with climate trends or political activity.

There are two consequences to this new data. First, it allows us to improve the process of how innovation spreads. Consider, for example, the visibility into our social fabric that can now be obtained by analysing big data collected by Facebook and Twitter interactions. By harvesting this data, we can easily devise social media techniques to spread ideas at a very fast pace and on a global scale. For example, a single video introducing an idea or a product, when targeted at the right channels and influencers, has the potential for going viral, gaining millions or even billions of views within a matter of days.

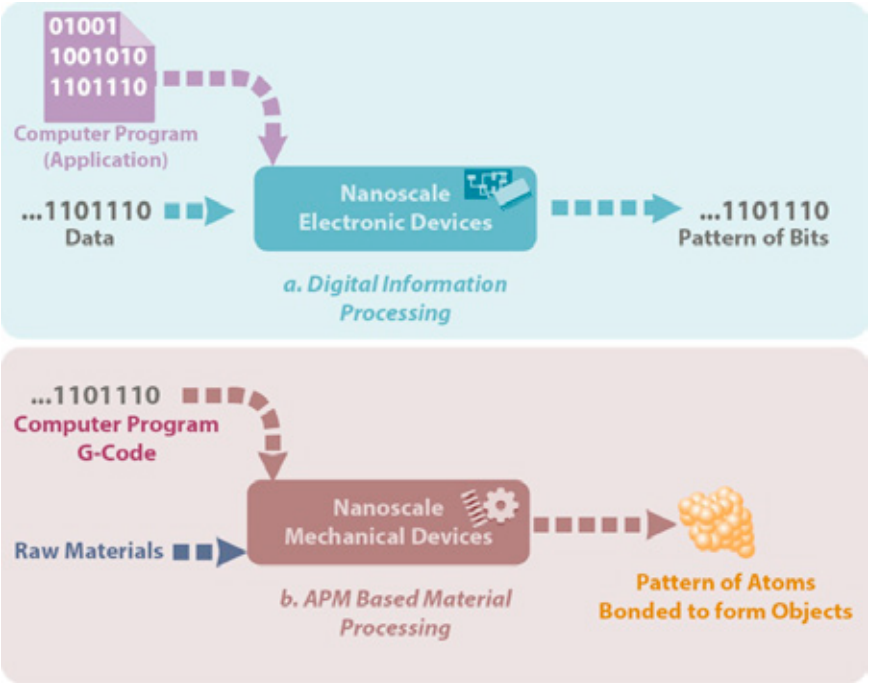
Second, this new data is technology's natural resource, giving us raw material that now makes many technology-driven decisions and innovations possible. Consider, for example, the field of personalized medicine that intends to shift cancer treatment away from chemotherapy, which affects all cells in the human body, towards a more precise treatment that targets only the mutated cells. With the availability of such new technologies, scientists have access to a representative sample of genes, from healthy individuals – the control group – and from individuals affected by a particular disease; they then use a large number of computations to perform the comparisons and identify the specific mutations and understand their side effects.

Global nervous system

Big data is not the only disruptive technology. Cloud computing refers to the extremely large quantities of processing power, storage capacity and networking connectivity that major enterprises, universities, communities and cloud providers are building and aggregating. These providers typically assemble massive infrastructures and offer compute as a service and storage as a service, where consumers pay per usage, on demand, with zero up-front capital investment.

There is a strong symbiotic relationship between cloud technology and big data, with cloud technology enabling and accelerating the creation of big data. The exponential increases in the quantities of big data force the expansion of the cloud, where the heightened demand for processing and storage capacity accelerates technology development and hastens commoditization of technology components. Furthermore, big data and the cloud are accessible to almost everyone thanks to mobile devices and social media.

Figure 1: Digital information processing versus material processing technologies



Nanotechnology

In 1981, K. Eric Drexler [1] introduced the concept of nanotechnology, a technology whose manufacturing is based on mechanical devices operating at nanoscale. To measure something in nanoscale is to measure it in the 10^{-9} of one atomic diameter, a unit named a nanometre, which is one billionth of a metre. Comparatively, a human hair is about 100,000 nanometres wide. Nanotechnology products are built with atomic precision by binding, positioning and combining atoms or molecules to form objects of amazing complexity, a process referred to as APM.

Drexler has also drawn a parallel between the digital and the physical worlds [2], as illustrated in Figure 1. In the digital world, "digital *information* processing technologies employ nanoscale electronic devices that operate at high frequencies and produce patterns of *bits*." In the physical world, "APM-based *materials* processing technologies will employ nanoscale *mechanical* devices that operate at high frequencies and produce patterns of *atoms*." These atoms are combined or assembled together to form objects of an amazing complexity and of sizes varying from nanoscale objects, such as a replica of a race car the size of a grain of sand, to actual size automotive parts.

APM has caused two major disruptions. First, through the rise of 3D printers, APM has indirectly been introduced to the consumer market, as illustrated in Figure 2. 3D printers are devices that use nanotechnology to print not the pictures of objects, but the objects themselves. 3D printers typically deploy an additive manufacturing process whereby they generate, or "print", molecules at atomically precise spots and bind these molecules together to form an object by creating and stacking each one of its layers from bottom to top. CAD software provides 3D printers with information on what to make and how to make it, while "G-Code" is the fabrication language used, which commands the motors.

Second, the types of raw materials used in APM are abundant and inexpensive resources that are easily obtained. Common materials are resin and molten thermoplastics, such as ABS and PLA, due to the ease at which they melt and their ability to be reprocessed. For example, a showerhead can be manufactured from PLA, at a cost of about $2.50. Other materials range from metals, such as steel, gold, silver, bronze and titanium, to glass, nylon, chocolate, and even Bio-Ink.

Conclusion

As cloud, big data, social and mobile innovations become more pervasive and disrupt the digital world, we often divert our attention away from major technology-driven disruptions occurring in the physical world, and fail to see the connectivity between the two. This process is creating a unique, historic momentum leading to the consumerization of innovation in the digital world, via applications on mobile phones, for example, and the consumerization of innovation in the form of physical objects, via APM and 3D printing.

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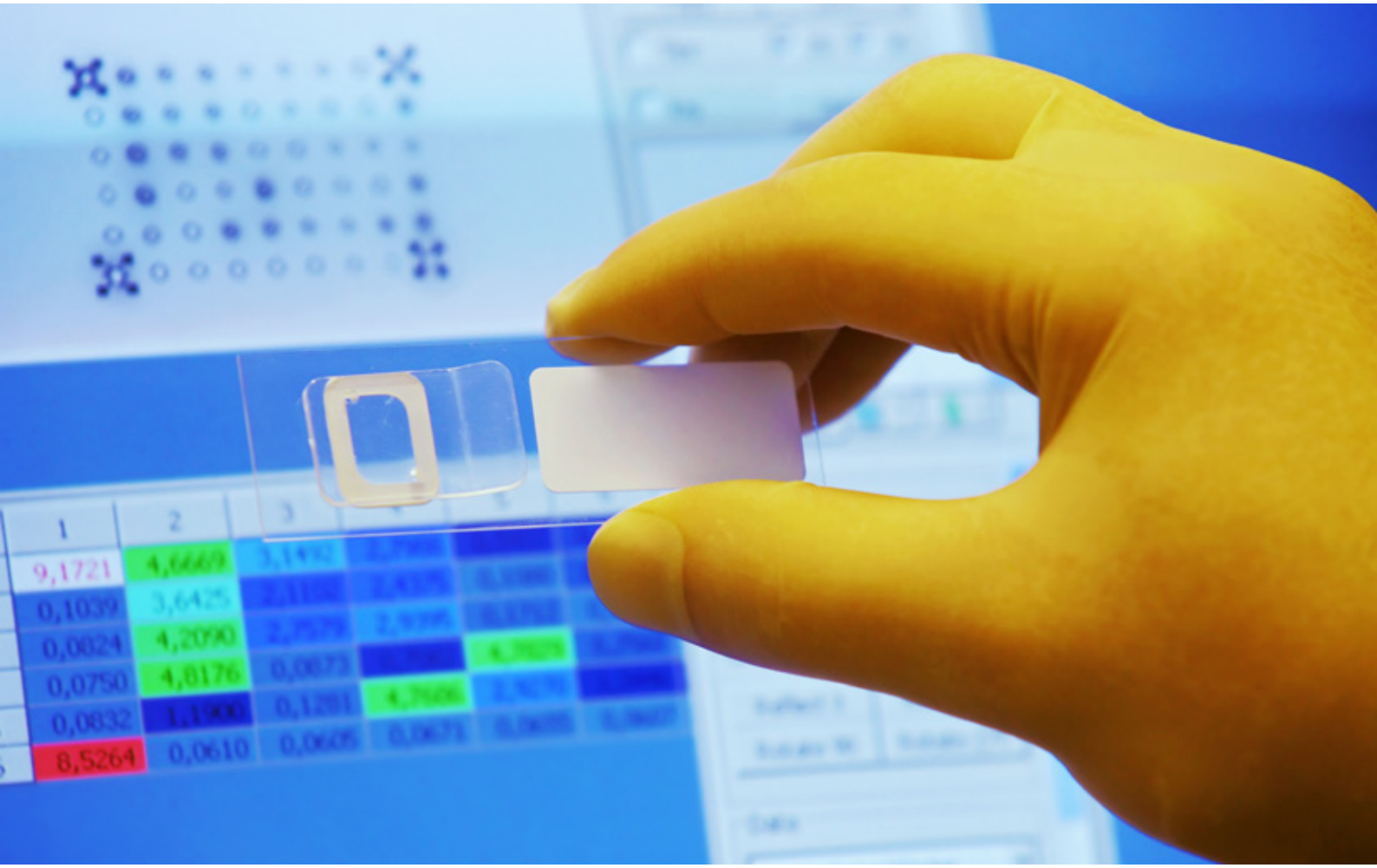

The Internet Economy and the Decline of Poverty

Ed Gresser, Brian Bieron and Usman Ahmed

In June 1998, then-US President Bill Clinton observed in an MIT graduation speech that "it is now possible for a child in the most isolated inner-city neighbourhood or rural community to have access to the same world of knowledge at the same instant as the child in the most affluent suburb." However, he feared that the internet might push rich and poor further apart – that "even as new technologies create growth and new opportunity, they can heighten economic inequalities and sharpen social division."

In 1998, 110 million people, largely in developed countries, used the internet. Today that number is nearly 3 billion, with the largest growth in users coming from emerging markets. Notably, over this same 16-year period, deep poverty around the world has dropped by nearly half. The question is whether the internet has played a part in that decline of poverty.

Global trends: internet access rises and poverty falls

The International Telecommunications Union (ITU) has tracked internet use since the 1990s. It has found that wealthy regions are now nearly fully connected, and the developing world's online public has risen by 100 million people or so each year.

People in emerging markets are skipping the first internet revolution, which was associated with fixed broadband and desktops, and moving directly to wireless connections and smartphones as their primary connection to the global network. The mobile revolution enables cheaper and more efficient access for more people.

Meanwhile, poverty is receding at an apparently unprecedented pace. To use a widely accepted marker, the World Bank defines "absolute poverty" as life on $1.25 per day or less, in constant 2005 dollars. This is roughly enough to provide for very basic food and shelter, and perhaps transport to a day-labour site. Their estimates for populations at this level are complete only through to 2010, but show absolute poverty down from 34.1% of the developing world's people in 1999 to 20.6% in 2010.

And as Tables 3 and 4 show, as poverty wanes the most painful gaps between the poor and the affluent – those of life and health – are rapidly narrowing.

Table 1: Internet access growth, 2000-2012

Year	2000	2005	2010	2012
World population	6.1 billion	6.5 billion	6.9 billion	7.0 billion
World internet users	360 million	940 million	2.0 billion	2.4 billion
Users in developed economies	295 million	510 million	0.85 billion	1.01 billion
Users in China	22 million	110 million	0.42 billion	0.54 billion
Users in developing economies	43 million	320 million	0.70 billion	0.85 billion

Table 2: Mobile subscription per 100 people, 2005-2012

Year	2005	2010	2011	2012	2013
Global	<15	11	17	22	30
Developing countries	<4	4	8	13	20

Table 3: The decline of poverty (%), 1999-2010

Year	1999	2005	2008	2010
Global	29	23.3	19.4	17.5
Developing countries	34.1	25.1	22.42	20.6
South Asia	45.1	39.4	36.0	30.0
Sub-Saharan Africa	58	52.3	49.2	48.5
Latin America/ Caribbean	12	8.7	6.5	5.5

Table 4: Life and health

Year	1998	2000	2005	2010	2011	2012
Developing world life expectancy	65	64	65	68	68	69
Child mortality	79	84	82	63	56	53

Why does poverty decline?

Why does poverty decline? Or to be direct, is the internet one of the factors accelerating its decline? Although the historical decline of poverty and rise of the internet are two trends that have existed largely independent of one another, we think the future of internet proliferation, particularly in developing countries, could have a noteworthy impact on the decline of poverty. The internet helps low-income people – particularly in rural areas, where 70% of the world's poor live – access capital and sell their goods.

Financial inclusion

With a mobile phone and a PIN, users of new mobile-banking businesses like Kenya's mPESA can reach bank representatives, validate their identity, have their salary paid electronically or withdraw cash. New internet-based platforms for global investment like Kiva can help capital reach entrepreneurs in emerging markets more efficiently than ever before.

The innovation in these industries has coincided with increasing financial inclusion in most emerging countries. A striking example comes from Pakistan's development of a mobile banking system known as Easy Paisa, operated by Tameer Bank.

Most of Pakistan's 100 million villagers are outside the financial system, saving money by collecting and safeguarding cash or buying and wearing gold jewellery. Cash-and-barter life means it is difficult to build wealth through savings or investment. Villagers immigrating for work rely on high-priced wires or couriers when they want to send money home, where fees for basic cash transfers often range from 10% to 15%.

Villagers are, however, enthusiastic mobile adopters. Nearly two-thirds of Pakistanis now have subscriptions. In 2010, Tameer Bank, a subsidiary of Telenor, began offering 23 million subscribers a "mobile wallet" service. Each interested subscriber receives a PIN allowing them to receive cash, deposit money, wire a remittance, or apply for a loan by punching in the number and making a request to an operator, who then alerts the nearest in a large array of stores and other enterprises to the request. Thus, villagers can securely store money online, earn interest, find convenient and safe outlets to receive cash, and transfer money at low cost. As Tameer and similar mobile banking firms have grown, the share of Pakistanis with bank accounts has risen by 35% and the cost of remittances has dropped by about half.

This is an indirect use of the internet's capacity to store, manage and transfer data, using a traditional mobile phone interface, a system of connected operators who take incoming calls, and storefronts that accept and disburse money. As the cost of higher-order devices and data plans diminishes, the internet can be used to provide low-income people with greater direct controls over their finances.

Trade for all

Internet access also helps low-income people find markets for their goods. MercadoLibre, launched in 1999 as an online marketplace in Argentina, now facilitates small business and family trade in 12 Latin American countries, Puerto Rico and Portugal. In the United States, Native American reservations provide a particularly exciting example of how the internet is empowering people in a traditionally impoverished region to trade their goods outside of their area.

Geographically far from major markets, reservations struggle to attract investment and jobs. Unemployment rates are commonly above 50%, and income levels far below American averages. The Navajo Division of Economic Development, which manages economic policy on America's largest reservation, explains [1]:

The Navajo Nation has very often been compared to a Third World economy… Our per capita income was $7,121.8 in 2007, which is substantially lower than that of any state, and 36.76% of the Navajo people live below the poverty line.

The internet now offers Navajo businesses, farms and artisans new ways to meet these challenges. For example, the Navajo sustain an internationally famed practice of traditional craft, including pottery, textiles, and silver and turquoise jewellery. But until very recently, off-reservation sales had been hard to arrange and plagued by counterfeiting and piracy. Creative use of the internet helps artisans make the most of their skills and intellectual property. The Navajo Arts and Crafts Enterprise (NACE), a 70-year-old jewellery and craft cooperative, uses www.Gonavajo.com to reach markets around the United States and worldwide. The online store features jewellery works from three reservation silversmiths, and traditional blankets and rugs produced by dozens of women. The site allows part-time employed and elderly people to increase their income, encourages young people to see value in preserving craft tradition, and also helps fight counterfeiting.

Towards policy

Fifteen years after Clinton's talk, the internet remains young, access gaps remain, and policy needs to close them. But the internet can help eliminate old lines of inequity rather than etching them more deeply into society. The internet has spread beyond the wealthy and educated to small businesses, artisans and farmers, and the world's poor. Their creative use of it, we submit, has the potential to bring an end to poverty.

This promising beginning could be slowed by poor policy, or sped up by good policy. Pakistan's villagers rely on old-fashioned phones; the Navajo Nation gets spotty telecom services and still has limited broadband access. Appropriate government and company policy is essential to help communities like these take full advantage of their opportunities. Increasing broadband and mobile access, and improving and expanding digital literacy are the most obvious recommendations. But there are deeper policy principles that should be considered when contemplating how to empower traditionally impoverished people through the internet and technology:

- **Build interconnected internet platforms** – A functional internet requires interconnection between physical wires, devices, operating systems and applications. This interconnectedness can be cut off by both public and private actors, and governments and companies need to make sure this does not happen.

- **Eliminate customs barriers to low-value shipments** – Small internet-based shipments of the sort produced by the Navajo are disproportionately hampered by paperwork, fees and customs. Customs regimes must be reformed to eliminate barriers of this type.

- **Promote smartphone proliferation and education** – Basic mobile phones are limited in capabilities and continue to require labour-intensive services for subscribers. Smartphones are the path to a fully functional internet experience for everyone.

- **Open services markets** – Pakistan's experiment in low-income financial services unites Tameer Bank's local expertise with technology and online financial platforms developed by international firms based in Norway and South Africa. The combination is a lesson in the value of international participation, and of open services markets that encourage creativity and the merging of differing strengths.

The internet is not a panacea for the global problem of poverty. It can, however, be a powerful tool, enabling people in traditionally impoverished regions to enjoy new opportunities, build wealth and make progress for themselves and their families.

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This piece solely reflects the views of the authors and does not represent the views of eBay Inc.

Data and future competitiveness

Andrew Tarver

Big data…

We've all heard the phrase – one of the most overused corporate and academic phrases of the past 24 months. Yes, we can do more with the data we have today, and yes, we will store exponentially larger data sets in the future.

But what opportunities arise as a result of more data, and who will be the real winners from the data revolution?

Let's start at the beginning. We've read the stories about corporations and especially governments collecting massive amounts of data, most of it from personal customers, data about the "people". The quality of this data is questionable. Historically this data has been allowed to become stale, out of date and it has been underutilized. Traditional large corporations have failed to use this knowledge and associated customer intimacy to the customer's advantage. Examples of this are all around us: banks that have all of our transaction data about retail relationships, incomes, expenses, charity payments, our location, our spending patterns. But how do they help us to live an easier and better life?

Advancements in technology are now changing this, with new "big" corporations designing their core business around managing exponentially larger data sets and developing sophisticated data analytics to better use this data.

But here lies the first major flaw in this new economy. These new corporations are using the data to *their* benefit. They are realizing super profits off the availability of an individual's personal data. But what does the individual get in return?

We as individuals need to better define the relationship we have with our own data. Do we want to be in control, or are we happy to continue to live in a world of subservience, slaves to the corporate and government masters? Do we want to enter a new era, one where corporations have to compete for access to our data? Will we enter an era where the people exercise their rights to control their personal data?

We stand at an inflection point, a fork in the proverbial economic highway. A point where we, the people, could allow corporations and governments to use our personal data for free, allowing corporations to better tailor products and services for our consumption, where the people remain the consumers. Or, we can change course, welcoming in a new era, one in which the individual controls and manages their personal data, limiting access to only those organizations that act appropriately with our data. This will see corporations and governments become the consumers. A complete reversal of the current industry model – driven by the data revolution.

The importance of this inflection point cannot be understated. Let's expand on the scenario where an individual allows free access to all of their enriched personal data. Combine this with the assumption that, as Ray Kurzweil states, computational power will increase exponentially, moving from the equivalent of an insect brain today, to a computational power equivalent to all human brains within 30 years. Singularity. The machines will be more intelligent than the humans, than all humans. These same machines will have access to all our data, all of our medical records, financial transactions, relationships, thoughts, feelings, beliefs. It sounds like something from the Terminator trilogy, *Rise of the Machines*. Will this be the reality within 20 years?

In this scenario, given their current operating models and technological maturity, you can predict that Google, Facebook, Amazon and other similar organizations will grow stronger using their advanced algorithms to mine our data and impact our lives.

If you take the second option, one where we welcome a new era, one in which the individual controls their data, limiting and managing access to this data, then our world could look very different. The corporate domination is restricted, assuming a model where data security is dramatically improved. The individual will still be able to access the improvements in computational power and associated machine intelligence, but this would be for their benefit, as they would control their data. This control will allow new organizations to be established, through the maker community, reducing corporate exploitation for four-five large companies, but allowing the individual to potentially build their own services, using the latest technologies.

In order for this to become a reality, education related to the freedom and control of personal data and the use of computational power needs to improve. Without this, we will naturally default to option 1. There is a public and private sector responsibility to improve the level of understanding about our data and the opportunities that exist for the individual to monetize this data. The economic benefit to the individual is enormous. As the World Economic Forum stated in January 2011, "Personal data is the new oil of the economy and the new currency of the digital world." Without the appropriate intervention, we are allowing the theft of this new currency, from every digitally active human being.

The current legislation that governs the use of personal data is fit for the early 1900s, certainly not the global digital world we live in today. Data storage processing power will continue to develop exponentially. The equivalent rate of legislative change is not even linear.

The intelligent analysis of exponentially larger personal data sets will also herald the start of the end for a number of traditional large corporations, including those that reside on the S&P, FTSE and other global indexes. Richard Foster from Yale University has identified that "the average lifespan of an S&P 500 company has decreased from 67 years (1950s) to 15 years today"; this trend will only continue, through the use of data.

Why? Let me elaborate. We are about to experience a fundamental revolution to our existing corporations, disruption on a scale we have not seen since the industrial and internet revolutions. Large corporations and governments do not have the board-level mindset, the necessary variety of skilled personnel, the culture, processes, know-how, but most importantly, the technology platforms or customer focus required to design and build the services required to satisfy the new social communities. Established organizations will not be able to change their technology, their processes or their board-level decision-making quick enough to compete against new start-ups, who are establishing themselves based on the new technology and people-focused processes.

We are entering a new era, one where technology advancements are changing our everyday lives, where our constant collaboration with trusted communities is the key to making decisions, and the movement of data between communities is not only fuelling the "purchase" or the "sale", it is also designing the product and service around the individuals specific need. This use of real time exponentially larger data sets is at the core of how new organizations will be constructed.

The individual will demand new services and better products, where tailoring something for an individual could actually be cheaper and faster than mass production. The competition in the future will be based on which organizations know the individual well enough to tailor the perfect product or service, at the right price. To do this, you require intimacy with the individual, an insight that does not exist today, but is beginning to exist. We will no longer be consumers. In the new world, corporations will understand people's needs, their wants, their desires, the things and people that are most important to them. All of this data will reside in an individual's "digital soul".

A new industry infrastructure is required to support the management and protection of personal data, on behalf of the individual. The future will be about a collection of small start-ups and individual "makers" working together, with the aim to develop a new economic model, one centred around the individual, or more appropriately, 7 billion unique individuals.

So we have established the following:

- All forms of data will grow exponentially; we are now past the "knee" of the curve
- Personal data will be a new currency, with a market value
- Traditional corporations will struggle, based on culture, processes and technology developed before personal data was a core consideration in an organization's architecture
- The new generation of corporations, who design around data analytics and have established customer trust, will prosper
-
- But we are yet to agree on everything.
- Will the customer or the new generation of corporations own the personal data?
- Will governments support the individual or further corporate exploitation?
- Will legislation keep up with technological advancements? Can it?
- Will machines out-think humans by 2040?
- How will the advancements of sensors fuel the collection of personal data?
- Will advancements in data filtering and security keep up with data storage?

We are in a rapidly changing world, where the rules of the game are about to be rewritten.

Vive la révolution!

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The Big Hope for Jobs

By Siddhartha Raja

Children entering school in 2014 will start working in about 2030. By then, the world will rely even more on information and communications technology. After all, technology is already transforming agriculture, manufacturing, healthcare, financial services, and more.

Some technologies will herald significant changes in business and society. Technologies such as 3D printing and big data are already changing how large businesses and garage innovators work. 3D printers are becoming more reliable, sophisticated and cheaper; manufacturing could change as much as publishing did with desktop computers. And big data, as the World Economic Forum's *Global Information Technology Report 2014* explains, will unlock significant opportunities for businesses, governments and researchers because it allows the capture and study of large volumes of interactions between humans and machines.

The impact of such disruptive technologies will be significant. The McKinsey Global Institute identifies 12 such disruptive technologies that could have an economic impact of more than $14 trillion annually in 2025. Their analysis covers the automation of knowledge work, advanced robotics, 3D printing and cloud technologies. They also estimate that big data could improve analysis, decision-making, efficiency and innovation, generating value in the billions of dollars annually.

If the world relies more on technology, young people starting to work in 2030 will face difficult times unless their education and skills also evolve. Developed economies in the European Union and the Unites States already report a shortage of skilled professionals. For example, IT consultancy firm Gartner predicts that 4.4 million IT jobs would emerge to support big data globally by 2015; however, they also predict that only one-third of these jobs will be filled given current skills development trends. The situation will likely be worse in developing countries where schools often rely on an outdated syllabus or impart industrial-age skills.

Not addressing emerging skills gaps will prevent countries from joining the knowledge economy of the future. Being unprepared for 2030 will have serious implications for people, businesses and governments.

Not playing games

It is tempting to say that children today are technology-savvy. But playing games on a smartphone is no preparation for being able to manipulate the game-changing technologies of 2030. And many people still lack access to anything more than a basic mobile phone.

For example, one study conducted at the University of Illinois at Chicago on how students use the internet found that about one-third did not understand the meaning of the bcc email function. More than one-fourth had not adjusted the privacy settings or content of social media profiles for job-seeking purposes.

The deficits become more apparent as technologies become more complex. Members of the digital generation are not automatically equipped with uniform or appropriate skills to leverage technology.

Emptiness in the middle?

Developed economies have already started to see the impact of slowness in adapting to change. A set of studies from researchers at MIT shows how technology poses a challenge for workers today and for the jobseekers of the future.

Erik Brynjolfsson and Andrew McAfee from MIT predict that machines will get smarter and will displace more workers from jobs, at a pace more rapid than in the past. These technologies create a few billionaires or "superstars" and firms that can employ fewer people. Brynjolfsson and McAfee surmise that technological progress is driving a "great decoupling" between job creation and productivity growth. Even as technology improves life, its benefits will not spread evenly and will vary depending on skills and ability. Moreover, only those businesses that invest in organizational change alongside technology will benefit.

David Autor and David Dorn, also of MIT, argue a similar point: employment changes and wage growth in the US over the past three decades follow a U-shape when mapped to skills. Put another way, more jobs have been created – and wages have risen – where either high-level or low-level skills are needed, but the middle is getting squeezed. They argue that this has been because of the growth of lower-wage non-tradable service occupations. Workers shift away from mid-level skill jobs due to falling wages (or job losses) into lower-skill service jobs "that rely heavily on 'manual' tasks such as physical dexterity and flexible interpersonal communication." The mid-level has seen jobs being replaced due to a mix of consumer preferences (for more choices, needing more specialists)

and "non-neutral technological progress", i.e. technologies that replace some jobs – typically those that can be codified, automated or outsourced – but not others. The challenge is income inequality as much as job losses: as high-skilled workers earn more, lower-skilled workers might find only jobs that do not pay as well.

Middle class employees will bear the brunt of the painful transition as machines displace their jobs. This is apparent in the developed world today. In the future, though, developing countries that were counting on being the factories and back-offices of the developed world will also face this constraint: the production and delivery of goods and services will shift back to the developed world if machines or lower wages undermine cost advantages in low-income countries.

A personal touch

What skills will be relevant for workers in 2030? Brynjolfsson and McAfee suggest that prosperous workers in the future will be those who can "race with the machines" (as opposed to against), and be able to complement machines by providing the personal interactions and decisions that are uniquely human (at least for now). Autor and Dorn similarly suggest that "the middle-skill jobs that survive will combine routine technical tasks with abstract and manual tasks in which workers have a comparative advantage – interpersonal interaction, adaptability and problem-solving."

These predictions resonate with those of the Institute for the Future, a Silicon Valley think tank. They forecast that smart machines would need workers with skills such as sense-making, novel and adaptive thinking, and social intelligence. Jobs at the extreme ends of the skills scale will likely grow. It is unlikely that artistic or creative tasks can be automated. As Autor and Dorn find, low-skill and non-tradable service jobs have also grown too. However, wage inequality could rise and the unskilled – young or old – will be affected disproportionately.

What does this mean for big data jobs? Machines alone cannot derive the observations that make big data useful. The findings of the World Economic Forum's *Global Information Technology Report 2014* echo this. One author suggests that "unlike traditional analytics, mining big data requires an extremely diverse set of skills – deep business insights, data visualization, statistics, machine learning and computer programming."

Yet the talent pool is already lacking. McKinsey estimates that in the United States alone, there is a shortage of up to 190,000 people with "deep analytical skills". And Gartner predicts that only one-third of big data jobs globally will be filled by 2015. The forecasts of the Institute for the Future suggest the need for more workers that are skilled in different ways. Few educational systems are training their students or creating the needed foundations for this future.

A challenge for the future

Such a prospect is worrying for governments looking to stem inequality while simultaneously supporting businesses' efforts to compete, often through labour-saving technology.

Centuries of technological progress have not created massive unemployment. But today's rapid changes could threaten employment more than before. Some commentators suggest this is one of the main reasons why since the 1990s, job recovery was slower than economic recovery following recessions. Computers, the internet and consequent automation have led to jobless recoveries like never before.

What, then, can governments do? Certainly retaining the status quo is not an option. The solution seems simple: reform education to develop the needed skills. The reality is more complex: education systems will need to become more flexible and competent to equip students to deal with an unpredictable future. Preparing students for this future will require teachers to have the appropriate training, tools, and tempers.

Skills development will also need to address various job profiles. Those in interaction or service jobs will need critical social skills. Technical skills will also be necessary, with varying levels depending on individual capacity and interest. Some might become highly skilled innovators. In every case, students will need to know about how to use and sometimes create technology. Some could also shift to higher-level jobs through bridging programmes.

The challenge is greater in the developing world, where low labour costs and relatively large but inconsistent talent pools might exist. Lulled into a false sense of security given today's trends towards offshore services or manufacturing, the developing world may face greater risks due to technological progress. If the next generation does not have the appropriate skills, developing countries risk losing out given the possibility of "reshoring", due to capital investments in automation or disruptive innovation. Indeed, for the developing world, 2030 might be closer than it seems. Without the right skills, today's schoolchildren might be facing the most uncertain future of all.

About the author

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Launch of the Global IT Report 2014

World Economic Forum USA, New York

01: Launch of the Global IT Report 2014
02: Soumitra Dutta, Dean, Johnson School of Management, Cornell University
Jeffrey Campbell, Vice President, Government and Community Relations, Cisco
Benat Bilbao, Senior Economist, Global Competitiveness and Benchmarking Network, World Economic Forum
David Meer, Partner, Strategy&
Alan Marcus, Senior Director, Head of ICT Industries, World Economic Forum
03: Jeffrey Campbell, Vice President, Government and Community Relations, Cisco
04: Soumitra Dutta, Dean, Johnson School of Management, Cornell University
05: David meer, Partner, Strategy
06: Robert Pepper, Vice President, Global Technology Policy discusses the findings of the Global IT Report 2014
http://blogs.cisco.com/gov/global-information-technology-report-2014/

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Timeline for Global IT Report 2015

15 July: submission of draft chapter proposals

1 September: Chapters pre-selected

15 November: Submission of final chapters for the Report

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