Technologies in Fourth Industrial revolution

1. **Implantable Technologies, tipping point by 2025:** People are becoming more and more connected to devices, and those devices are increasingly becoming connected to their bodies. Devices are just not being worn, but are also being implanted in bodies serving communication, location, behaviour monitoring, and health functions. These devices will be able to sense parameters of diseases, they will enable individuals to take action, send data to monitoring centres, or potentially release healing medicines automatically
Smart tattoos and other unique chips could help with identification and location. Implanted devices will likely also help to communicate thoughts normally expressed verbally through a 'built in' smart phone, and potentially expresses thoughts or moods by reading brain waves and other signals

2. **Our Digital Presence:** Now people digital presence is regarded as their digital interactions, and traces through a multitude of on line platforms and media. Many people have more than one digital presence, such as Facebook page, Twitter account, Linked In profile, Tumblr blog, Instagram account and often many more
In our increasing connected world, digital
life is becoming, inextricably linked with a person's physical life. In the future, building and managing a digital presence will become as common as when people decide how to present themselves to the world every day through fashion, words, and acts. Positive impacts will be increased transparency, increased and faster interconnection between individuals and groups etc. Negative impacts will include privacy/ potential surveillance etc

3. **Vision as new interface:** 10% of reading glasses connected to internet. Google glass is just the first of many potential ways in which glasses/ headsets, and eye tracking devices can become 'intelligent' and lead to eyes and vision being connected to the internet and connected devices.

   With access to internet applications and data through vision, an individual's experiences can be enhanced, mediated or completely augmented to provide different, immersive reality. Also with emerging eye tracking technologies, devices can feed information through interfaces, and eyes can be source for interacting with and responding to the information.

   Enabling vision as an immediate, direct interface – by providing instruction, visualization and interaction- can change the way that learning, navigation, instruction and feedback for producing goods and services, experiencing entertainment and enabling the disabled are helping people to engage more fully with the world. Positive impacts to include improved capacity to perform tasks or produce goods and services with visual aids for manufacturing, healthcare/ surgery and service delivery. Negative impacts to include mental distraction causing accidents

4. **Shift 4, Wearable internet:** Technology can now be found in people's mobile phones in their pockets, it will soon integrated directly into clothing and accessories. Released in 2015, Apple watch is connected to internet and contains many of the same functional capabilities as a smart phone. Increasingly, clothing and equipment worn by people will have embedded chips that connect the article and person wearing it

   Positive impacts include more positive health outcomes leading to longer lives, more self-sufficiency, better decision making, decrease in missing children. Negative impacts include Privacy/ potential surveillance and data security

5.Ubiquitous Computing: computing is becoming more accessible every day, via a computer with internet connection, a smart phone with 3G/ 4g or services in cloud**.** Today 43% of world's population is connected to the internet. As the internet has been outgrowing every other media channel in speed of adoption, it is expected that, in only few years , three quarters of the world's population will have regular access to the web. In the future, regular access to internet and information will no longer be a benefit developed economies, but a basic rightlike clean water. Because wireless technologies require less infrastructure than many other utilities (Electricity, roads, and water), they will very likely become accessible much quicker than the others. Hence anyone from any country will be able to access and interact with information from the opposite corner of the world. Content creation and dissemination will become easier than ever before

Positive impacts include more economic participation of disadvantaged population located in remote or under developed regions, access to education, health care and government services, expanded market size/ E Commerce. Negative impacts include increased manipulation and echo chambers, political fragmentation

5. **Shift 6. A Supercomputer in your pocket:** Global smart phone subscribers are anticipated to 3.5 billion by 2019, that will equate 59% smartphone penetration by population. GSMA forecasts that Africa will have over half a billion smart phone users by 2020. The shift in devices has already occurred in many countries (with Asia leading the trend today), as more people are using their smart phones than traditional PCs. As technology is progressing to miniaturize devices, increase computing power and, especially, decrease the price of electronics, smartphone adoption will only accelerate, Countries like Singapore, South Korea and UAE are closest to

reaching tipping point of 90% of adult population using smartphones. Society is headed toward adopting even faster machines that will allow users to perform complicated tasks on the go. Most likely, the number of devices that each person uses will grow strongly, not only with new functions performed but also with specialization of tasks

Positive impacts include more economic participation of disadvantaged population. Access to education, healthcare and government services. Access to skills, greater employment, shift in type of jobs. Expanded market size/ E Commerce. Negative impacts to include increased manipulation and echo chambers. Cut both ways to include 24/7 always on, Lack of division between business and personal. Environmental impact from manufacturing

7.**Shift 7- Storage for All:** An estimated 90% of the world's data has been created in past two years, and the amount of information created in past two years is doubling every 1.2 years. Storage has already become a commodity, with companies like Amzon web services and drop box leading this trend. The world is heading towards a full commoditization of storage, through free and unlimited access to users. The best- case scenario of revenue for companies could potentially be advertising or telemetry

Positive impacts include legal systems, History scholarship/ academia, efficiency in business operations, Extension of personal memory limitation. Negative impact is Privacy surveillance. Other impact may be eternal memory, increased content creation, sharing and consumption. Many companies already offer free storage in the cloud, ranging from 2 GB to 50 GB

8. **Shift 8- Internet of and for Things:** By 2025 one trillion sensors expected connected to internet. With continuously increase in computing power and falling hardware prices, it is economically feasible to connect literally anything to internet. Intelligent sensors

are already available at very competitive prices. All things will be smart and connected to internet, enabling greater communication and new data driven services based on increased analytics capabilities. Example- to monitor animal health sensors wired in cattle, can communicate to each other through a mobile phone network, and can provide real time data on cattle condition from anywhere.

Experts suggest that in the future, every physical product could be connected to ubiquitous communication infrastructure, and sensors everywhere will allow people to fully perceive their environment. *Positive impacts* will include increased efficiency in using resources, rise in productivity, improved quality of life, safety, shift in labour markets and skills, creation of new businesses eg. Selling data, addition of digital services on top of the products, digital twin provides precise data for monitoring, controlling and predicting, Digital twin becomes active participant in business, information and social processes. *Negative impacts* to include Privacy, job loss for unskilled labour, hacking, security threat, more complexity and loss of control, Consequences of a potential 'digital Pearl Harbor' by hackers or terrorist.

Shift 9. The Connected home: Very fast changes are already occurring in home automation, enabling people to control lights, shades, ventilation, audio and video, security systems and home appliances. Additional support is provided by connecting robots for all kind of services e.g. vacuum cleaning. *Positive impacts* to include- resource efficiency, comfort, safety/ security and detection of intrusions, home sharing, ability to live independently (Young/ old. Disabled), warning, alarming and emergency request and remote home control. Negative impact to include Privacy, Surveillance, cyberattacks crime, vulnerability, Impact on workforce, change in work' s location

Shift 10- Smart Cities: Many cities will connect services, utilities and roads to internet. These smart cities will manage their energy , material flows, logistics and traffic. Progressive cities , such as Singapore and Barcelona are already implementing many new data driven services, including intelligent parking solutions, smart trash collection, and intelligent lighting. Smart cities are continuously extending their network of sensor technology and working on their data platforms, which will be core of connecting the different technology projects and adding future services based on data analytics and predicting modelling. *Positive impacts* – increase efficiency in using resources, rise in productivity, increased density, improved quality of life, effect on the environment, increased access to resources for the general population, lower cost of delivering services, decreased crime, increased mobility, increased resilience to impact of climate change, reduced pollution, increased access to population, more employment, smarter e governance. Negative impact includes surveillance, privacy, risk of collapse (to total black out), increased vulnerability to cyber attacks

Shift 11- Big data for decisions

More data exists about communities than ever before. And the ability to understand and manage this data is improving all the time . Governments may start to find that their previous ways of data collection are no more needed, and may turn to big data technologies to automate their current programs and deliver new and innovative ways to service citizen and customers

Leveraging big data will enable better and faster decision making in a wide range of industries and applications. Automated decision making can reduce complexities for citizens and enable business and governments to provide real time services and support for everything from customer interactions to automated tax filings and payments

The risk and opportunities in leveraging big data for decision making are significant. Establishing trust in data and algorithm used to make decision will be vital. Citizens concern over privacy and establishing accountability in business and legal structure will require adjustments in thinking, as well as clear guidelines for use in preventing profiling and unanticipated consequence. Leveraging big data to replace process that today are done manually may render certain jobs obsolete, but may also create new categories for jobs and opportunities that currently do not exist in the market

Positive impacts: Better and faster decisions, more real time decision making, open data for innovation, Jobs for lawyers, reduced complexity and more efficiency for citizens and new job category

Negative impacts: Job losses, privacy concerns, accountability (who owns algorithm?), Trust (how to trust data), Battle over algorithm

Action: It needs change in regulatory, business and legal structures, the volume of business data worldwide doubles every 1.2 years. Farmers are using data from seeds, satellite sensors, and tractors to make better decision about what to grow, when to plant, how to track food freshness from farm to fork, and how to adapt to changing climate

Shift 12: Driverless Cars: Trials of driverless cars from large companies such as Audi and Google are taking place, with a number of other enterprises ramping up efforts to develop new solutions. These vehicles can be potentially be more efficient and safer than cars with people behind the steering wheel. Moreover, they could reduce congestion and emissions, and upend existing models of transportation and logistics

Positive impacts: Improved safety, more time for focussing on work and / or consuming media content, less stress and road rage, improved mobility for those older and disabled, among others and adoption of electric vehicles

Negative impacts: Job Losses (taxi and truck drivers, car industry) , decreased revenue from traffic infringements, less car ownership, Legal structure for driving. Upending of insurance and roadside assistance, hacking and cyber attacks

Shift 13-Artificial Intelligence and decision making

Beyond driving cars , AI can learn from previous situations to provide input and automate complex future decision processes, making it easier and faster to arrive at concrete conclusions based on data and past experiences

Positive impacts: Rational data driven decisions; less bios, removal of "irrational exuberance", reorganization of outdated bureaucracies, job gains and innovation, Energy independence, advances in medical science, disease eradication

Negative impacts: Accountability (who is responsible, fiduciary rights, legal), Job losses, Hacking/ cybercrime, increased inequality, Existential threat to humanity

Action: If Moore's law continue to develop with the same speed as it has been for the past 30 years, CPU will reach same level of processing power as the human beings

Shift 14: AI and White -Collar jobs: AI is good at matching patterns and automating processes, which makes the technology amenable to many functions in large organizations. An environment can be envisioned in the future in which AI replaces a range of functions performed today by people

An Oxford Martin School study looked into the susceptibility of jobs to computerization from AI and robotics, and came up with some sobering result. Their model predicted that upto 47% of US jobs in 2010 were highly likely to become computerized in next 10to 20 years

Positive impacts: cost reduction, efficiency gain, Unlocking innovation, opportunities for small business, start-ups, smaller barrier to entry, 'Software as a service' for everything

Negative impacts: Job losses, accountability and liability, change to legal, financial disclosure, risk, job automation

Action-"IBM's Watson, well known for its stellar performance in the TV game show *Jeopardy*, has already been demonstrated far more accurate diagnosis rate for lung cancers than humans-90% versus 50%in some tests. The reason is data. Keeping pace with the release of medical data could take doctors 160 hours / week, so Doctors cannot possibly review the amount of new insights or even bodies of clinical evidence that can give an edge in making a diagnosis. Surgeons already use automated systems to aid in low invasive procedures"

Shift 15-Robotics and Services: Robotics is beginning to influence many jobs, from manufacturing to Agriculture, and retail services. According to the International Federation of Robotics, the world now (2016) includes 1.1 million working robots and machines account for 80% of the work in manufacturing car. Robots are streamlining supply chain to deliver more efficient and predictable results.

Positive impacts: supply chain and logistics, elimination, more leisure time, improved health outcomes (Big data for pharmaceutical gains in research and development), Banking ATM as early adopter, more access to materials, Production 're-shoring' (i.e. , replacing overseas workers with robots

Negative impact: Job losses, Liability, accountability, day to day social norms, end of 9-to-5 pm and 24- hour service, hacking and Cyber risk

Action: An article in Fiscal Times on CNBC.com states that " Rethink Robotics released Baxter (in the fall of 2012) and received an overwhelming response from the manufacturing industry, selling out

their production capacity in April. Rethink launch a software platform that allows Baxter to do a complex sequencing of tasks- for example, picking up a part, holding it in front of an inspection station and receiving a signal to place it in a good or not good pile. The company also released a software development kit…. That will allow third parties – like University robotics researcher- to create applications

Shift 16- Bitcoin and Blockchain:

The tipping point: 10% of global GDP stored in Blockchain technology by 2025

Bitcoin and digital currencies are based on the idea of a distributed trust mechanism called the "blockchain", a way of keeping track of trusted transactions in a distributed fashion. Currently, the total worth of Bitcoin in blockchain is around $20 billion or about 0.025% of global GDP of around $80 trillion

Positive impacts: increased financial inclusion in emerging markets, as financial services on the blockchain gain critical mass, Disintermediation of financial institutions, as new services and value exchanges are created directly on the blockchain, An explosion in tradable assets, as all kinds of value exchange can be hosted on the blockchain, Better property records in emerging markets, and the ability to make everything tradable asset, Contacts and legal services increasingly tied to code linked to the blockchain, to be used as unbreakable escrow or programmatically designed smart contracts, Increased transparency, as blockchain is essentially a global ledger storing all transactions

The shift in action: Smartcontracts.com provides programmable contracts that do pay outs between two parties once certain criteria have been met, without involving middleman. These contracts are secured in the blockchain as "self-executing contractual states," which eliminate the risk of relying on others to follow through on their commitments

Shift 17: The Sharing Economy:

The tipping point- Globally more trips/ journeys via car sharing than in private cars, expected by 2025

The common understanding of this phenomenon is the usually technology-enabled ability for entities (individual or organizations) to share provide a service, at a level that was not nearly as efficient or perhaps even possible before. The sharing of goods or services is commonly possible through online marketplaces, mobile apps/ location services or other technology -enabled platforms. These have reduced the transaction costs and friction in the system to a point where it is an economic gain for all involved, divided into much finer increments.

Well known examples of sharing economy exist in the transportation sector. Zipcar provides one method for people to share vehicle for shorter periods of time and more reasonably than traditional car companies. Turo (formerly RelayRides) provides a platform to locate and borrow someone's personal vehicle for a period of time. Uber and Lyft provide much more "taxi- like" service from individuals, but aggregated through a service, enabled by location services and accessed through mobile application. In addition, they are available at a moment's notice

Sharing economy has any number of ingredients, characteristics or descriptors: technology enabled, preference for access over ownership, peer to peer , sharing of personal assets (versus corporate assets), ease to access, increased social interaction, collaborative consumption and openly shared user feedback (resulting in increased trust). Not all are present in every 'sharing economy' transaction

Positive impact- Increased access to tools and other useful physical resources. Better environmental outcomes, more personal services

available, Increased ability to live off cash flow 9 with less need for savings to be able Better asset utilization to afford use of assets).

Negative impacts- Less resilience after a job loss (because of less savings), more contract task based labour (vs typically more stable long term employment)

Shift in action- The largest retailer does not own a single store? (Amzon), Largest provider of sleeping rooms does not a single hotel, Largest provider of transportation does not own a single car (Uber)

Shift 18: **Governments and the Blockchain**

The tipping point – tax collected for the first time by a government via a block chain, expected by 2025

The blockchain creates both opportunities and challenges for countries. On the one hand, it is unregulated and not overseen by any central bank, meaning less control over monetary policy. On the other hand, it creates the ability for new taxing mechanisms to be built into the blockchain itself (e.g. small transaction tax)

Unknown impacts- Central Bank and monetary policy, Corruption, Real time taxation, role of Government

The shift in action- In 2015, the first virtual nation, BitNation, was created using blockchain as foundation identification technology for citizen's identity cards. At the same time, Estonia became the first real government to deploy the blockchain technology

Shift 19: **3D Printing and manufacturing**

3D Printing or additive manufacturing, is the process of creating a physical object by printing it layer upon layer from a digital 3D drawing or model. Imagine creating a loaf of bread, slice by slice. 3D printing has potential to create very complex products without complex equipment. Eventually, many different kind of materials will be used in the 3D printer, such as plastic, aluminium stainless steel, ceramic or even advanced alloys, and the printer will be able to do what a whole factory was once

required to accomplish. It is already being used in a range of applications, from making wind turbines to toys

Over time, 3D printers will overcome the obstacles of speed and become more pervasive. Gartner has developed a 'Hype Cycle', chart showing various stages of different 3D printing capabilities and their market impact, and plotting most business uses of technology as entering the slope of enlightenment.

Positive impacts: Accelerated product development, Reduction in design-to- manufacturing, Easily manufactured intricate parts, Rising demand for product designers, birth of a new industry supplying printed materials, environmental benefits from reduced transportation

Negative impact: Growth in waste for disposal, and further burden on environment, Primacy to intellectual property as a source of value in productivity

Figure VI: Hype Cycle for 3D Printing
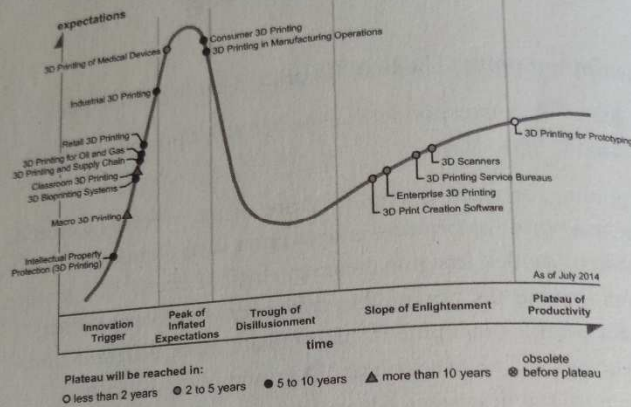
Source: Gartner (July 2014)

Positive impacts

- Accelerated product development
- Reduction in the design-to-manufacturing cycle
- Easily manufactured intricate parts (difficult or not possible to do earlier)
- Rising demand for product designers
- Educational institutions using 3D printing to accelerate learning and understanding
- Democratized power of creation/manufacturing (both limited only by the design)
- Traditional mass manufacturing responding to the challenge by finding ways to reduce costs and the size of minimum runs
- Growth in open-source "plans" to print a range of objects
- Birth of a new industry supplying printing materials
- Rise in entrepreneurial opportunities in the space[96]
- Environmental benefits from reduced transportation requirements

Unknown or cuts both ways: Potential that an innovation can be instantly copied

The shift in action: As per *Fortune, May12,2015 example has been recently covered as follows*

General Electric's Leap jet engine is not only one of the company's best sellers, it is going to incorporate a fuel nozzle produced entirely through additive manufacturing. The process popularly known as 3D printing, involves building up layers of material (in this case alloyed metals) according to precise digital plans. GE is currently completing testing of the new Leap Engines, but benefits of additive manufactured parts has already been proven on other models

Shift 20: 3D Printing and human health:

The tipping point- The first transplant of a 3D printed liver, expected by 2025

One day , 3D Printers may create not only things, but also human organs- a process called bioprinting. In much the same process as printed objects, an organ is printed layer by layer from a 3D model. The material used to print an organ would obviously be different from what is used to print a bike, and experimenting can be done with the kinds of materials that will work, such as titanium powder for making bones. 3D printing has great potential to serve custom design needs; and there is nothing more custom than a human body

Positive impacts: addressing the shortage of donated organs (an average of 21 people die each day waiting for transplants that can't take place because of lack of organs), Prosthetic printing- limb/body part replacements, Hospital printing for each patient requiring surgery (e.g. splints, casts, implants ,screws), personalized medicine-3D printing growing fastest where each customer needs a slightly different version of a body part(e.g. crown of a tooth), printing components of medical equipment that are difficult or expensive to source, such as transducers, printing for example, dental implants, pacemakers and pens for bone fracture at local hospitals instead of importing them, to reduce cost of operations, fundamental changes in drug testing, which can be done on real human objects given the availability of fully printed organs, printing of food, thus improving food security

Negative impacts: Uncontrolled or unregulated production of body parts, medical equipment, Growth in waste disposal, and further burden on environment, Major ethical debates stemming from printing of body parts and bodies- who will control the ability to produce them? Who will ensure the quality of resulting organs?, Perverted disincentives for health- if every thing

can be replaced , why live healthy way?, impact on agriculture from printing food.

The shift in action: The first use of a 3D printed spine implant was reported by Popular Science, Aug26,2014 as follows. " In 2014, doctors of Peking University Third hospital successfully implanted the first ever 3D printed section of vertebra into a young patient to replace a cancerous vertebra in his neck. The replacement vertebra was modelled from the boy's existing vertebra, which made it easier for them to integrate

Shift 21: **3D Printing and Consumer Products:**

The tipping point: 5% of consumer printed in 3D, expected by 2025

Because 3D printing can be done by anyone with a 3D Printer, it creates opportunities for typical consumer products to be printed locally and on demand, instead of having bought at shops. A 3D Printer will eventually be an office or even a home appliance. This further reduces the cost of accessing consumer goods and increases the availability of 3D printing objects. Current usage area for 3D printing indicate several sectors related to developing and producing consumer products (proof of concept, prototype and production), percentage are of respondents from the sculpteo survey

	Total %	Power users %
Proof of concept	21	59
Prototypes	39	83
Production	17	50
Education	4	13
Marketing samples	9	31
hobby	3	2
Art	2	4
Other	4	9

Positive impacts: More personalised products and personal fabrication. Creating niche products, making money selling them. To meet demand of each customer's different need, e.g. a particular shaped foot requires a special size shoe. Reduce logistics costs, with possibility of huge energy savings. Contributing to abundant local

activities; crafting own goods that benefit from the removal of logistics cost (Circular economy).

Negative impacts: Global and regional supply and logistics chain, lower demand resulting in job losses. Gun control, opening opportunities for printing objects with high levels of abuse, such as guns. Growth in waste for disposal, and further burden on environment. Major disruption of production controls, consumer regulations, trade barriers, patents, taxes and other government restrictions and struggle to adapt

The shift in action: Almost 133000 3D printers were shipped worldwide in 2014. The majority of printers, selling under $10000, are thus suitable for applications from laboratories and schools to manufacturing businesses. As a result, the size of 3D materials and services industry grew strongly, to $3.3 billion

Shift 22: Designer Beings

The tipping point- The first human whose genome was directly and deliberately edited is born.

Since the turn of century, the cost of sequencing an entire human genome has fallen by almost six orders of magnitude. The human genome project spent $2.7 billion to produce the first entire genome in 2003. BY 2009 the cost per genome was down to $ 100K while it is possible today it is possible for researchers a lab specializing in such matters only $1000 to sequence a human genome. A similar trend has occurred recently in genome editing with the development of the CRISPR/cas9 method, which is widely adopted due to its higher effectiveness and efficiency and lower cost than previous approaches.

The real revolution is hence not the sudden ability for dedicated scientists to edit genes of plants and animals, but rather the increased ease that new sequencing and editing technologies

provide, vastly increasing the number of researchers who are able to to conduct experiments

Positive impacts: Higher agricultural yields thanks to crops and crop treatments that are more robust, effective and productive. More effective medical therapies vis personalized medicine. Faster, more accurate, less invasive medical diagnostics. Higher level of understanding of human impact on nature. Reduced incidence of genetic disease and related suffering

Negative impacts: Risk of interaction between edited plants / animals and human/ environmental health. Exacerbated inequality due to high cost of access to therapies. Social backlash or rejection of gene editing technologies. International disagreements about ethical use of genome editing technologies.

Unknown or cuts both ways: Increased longevity. Ethical dilemmas regarding nature of humanity, Cultural shifts

The shift in action: In March 2015, leading scientist published a *Nature* article calling for a moratorium on editing human embryos, highlighting "grave concerns regarding ethical and safety implications of this research" Only one month later , in April 2015, "Researchers led by Junjio Huang of Yat-sen University in Guangzhou published the world's first scientific paper on altering the DNA of human embryos"

Shift 23: Neuro Technologies:

The tipping point: The first human with fully artificial memory implanted in the brain

There is not one area of our personal and professional lives that can not benefit from a better understanding how our brain functions-n at both the individual and collective levels. This underscored by the fact that -over the past few years – two of the most funded research programs in the world are brain scientists. Two of the world's brain sciences viz. The human brain project (a euro 1 billion project over

10 years funded by European Commission and President Obama's Brain research through Advancing innovative Neuro technologies (BRAIN) initiative. Although these programs are primarily focussed on scientific and medical research, we are also witnessing the rapid growth (and influence) of neuro technologies in non- medical aspects of our life. Neuro technologies consist of monitoring brain activity and looking at how the brain changes and / or interfaces with the world

In 2015, for example, the portability and affordability of neuro-headsets (which already cost less than a gaming console) offer unprecedented possibilities- marking what is likely to be not only a neuro-revolution, but a social one

Positive impacts: Disabled people can now control prosthetic limbs or wheel chairs" with their minds". Neuro feedback , the possibility to monitor brain activity in real time, offers countless possibilities to help fight addictions, regulate food behaviour, and improve performance ranging from sports to classroom. Being able to collect, process, store and compare large amount of brain activity related data allows us to improve diagnostic and treatment efficiency of brain disorders and mental health related issues. The law will be able to provide customised processing on cases and address responsibility issues in criminal cases in a differential fashion than a generic one now. The next generation of computers, whose design has been informed by brain science, may reason, predict and react just like the human cortex (an area of the brain known as seat of intelligence).

Negative impacts: Brain based discrimination- individuals are not just their brains, as such there is risk for decisions to be made in a context -independent fashion, based only on brain data in fields ranging from the law to HR, consumer behaviour or education. Fear of creativity or the human touch to slowly but surely disappear, mainly carried so far by overselling what brain science can do. Fear of

what thoughts/ dreams/ desires to be decrypted and for privacy to no longer exist. Blurring lines between man and machines

Unknown, or cuts both ways: cultural shift, disembodiment of communications, improvement of performance, extending human cognitive abilities will trigger new behaviours

The shift in action: Critical computing algorithms have already shown an ability to solve modern CAPTCHAs (widely used tests to distinguish humans from machines). The automotive industry has developed systems monitoring attention and awareness that can stop cars when people are falling asleep while driving. An intelligent computer system in China scored better than many human adults on an IQ test. IBM's Whatson super computer , after sifting through through millions medical records and data, has begun to help doctors choose treatment options for patients with complex needs. Neuromorphic image sensors (those inspired by howwill have impact ranging from battery usage ton robotics. Neuroprosthetics are allowing disabled people to control artificial members and exoskeletons, some blind will be able to see (again). Restoring active memory (RAM) program by DARPA is a precursor to memory restoration and enhancement. Depression symptoms in mice could be cured by the artificial reactivation of happy memories as evidenced by neuro scientist at MIT the eye and brain communicate) bases