SPEED

World Economic Forum			Category									Enabler			
Year of raport	Tech	Summary	IoT	AI	CLOUD	MOBILITY	BC	AR/VR	RPA	3D/Aman	QC	Processing Power	Price	Miniaturization	ICT
2012	Informatics for adding value to information	The quantity of information now available to individuals and organizations is unprecedented in human history, and the rate of information generation continues to grow exponentially. Yet, the sheer volume of information is in danger of creating more noise than value, and as a result limiting its effective use. Innovations in how information is organized, mined and processed hold the key to filtering out the noise and using the growing wealth of global information to address emerging challenges.		1								1	1		1
	Synthetic biology and metabolic engineering	The natural world is a testament to the vast potential inherent in the genetic code at the core of all living organisms. Rapid advances in synthetic biology and metabolic engineering are allowing biologists and engineers to tap into this potential in unprecedented ways, enabling the development of new biological processes and organisms that are designed to serve specific purposes – whether converting biomass to chemicals, fuels and materials, producing new therapeutic drugs or protecting the body against harm.													
	Green Revolution 2.0 – technologies for increased food and biomass	Artificial fertilizers are one of the main achievements of modern chemistry, enabling unprecedented increases in crop production yield. Yet, the growing global demand for healthy and nutritious food is threatening to outstrip energy, water and land resources. By integrating advances across the biological and physical sciences, the new green revolution holds the promise of further increasing crop production yields, minimizing environmental impact, reducing energy and water dependence, and decreasing the carbon footprint.													
	Nanoscale design of materials	The increasing demand on natural resources requires unprecedented gains in efficiency. Nanostructured materials with tailored properties, designed and engineered at the molecular scale, are already showing novel and unique features that will usher in the next clean energy revolution, reduce our dependence on depleting natural resources, and increase atom-efficiency manufacturing and processing.													
	Systems biology and computational modelling/simulation of chemical and biological systems	For improved healthcare and bio-based manufacturing, it is essential to understand how biology and chemistry work together. Systems biology and computational modelling and simulation are playing increasingly important roles in designing therapeutics, materials and processes that are highly efficient in achieving their design goals, while minimally impacting on human health and the environment.													
	Utilization of carbon dioxide as a resource	Carbon is at the heart of all life on earth. Yet, managing carbon dioxide releases is one of the greatest social, political and economic challenges of our time. An emerging innovative approach to carbon dioxide management involves transforming it from a liability to a resource. Novel catalysts, based on nanostructured materials, can potentially transform carbon dioxide to high value hydrocarbons and other carbon-containing molecules, which could be used as new building blocks for the chemical industry as cleaner and more sustainable alternatives to petrochemicals.													
	Wireless power	Society is deeply reliant on electrically powered devices. Yet, a significant limitation in their continued development and utility is the need to be attached to the electricity grid by wire – either permanently or through frequent battery recharging. Emerging approaches to wireless power transmission will free electrical devices from having to be physically plugged in, and are poised to have as significant an impact on personal electronics as Wi-Fi had on Internet use.													
	High energy density power systems	Better batteries are essential if the next generation of clean energy technologies are to be realized. A number of emerging technologies are coming together to lay the foundation for advanced electrical energy storage and use, including the development of nanostructured electrodes, solid electrolysis and rapid-power delivery from novel supercapacitors based on carbon-based nanomaterials. These technologies will provide the energy density and power needed to supercharge the next generation of clean energy technologies.													
	Personalized medicine, nutrition and disease prevention	As the global population exceeds 7 billion people – all hoping for a long and healthy life – conventional approaches to ensuring good health are becoming less and less tenable, spurred on by growing demands, dwindling resources and increasing costs. Advances in areas such as genomics, proteomics and metabolomics are now opening up the possibility of tailoring medicine, nutrition and disease prevention to the individual. Together with emerging technologies like synthetic biology and nanotechnology, they are laying the foundation for a revolution in healthcare and well-being that will be less resource intensive and more targeted to individual needs.													
	Enhanced education technology	New approaches are needed to meet the challenge of educating a growing young population and providing the skills that are essential to the knowledge economy. This is especially the case in today's rapidly evolving and hyperconnected globalized society. Personalized IT-based approaches to education are emerging that allow learner-centred education, critical thinking development and creativity. Rapid developments in social media, open courseware and ubiquitous access to the Internet are facilitating outside classroom and continuous education.													
2013	OnLine Electric Vehicles (OLEV)	Wireless technology can now deliver electric power to moving vehicles. In next-generation electric cars, pick-up coil sets under the vehicle floor receive power remotely via an electromagnetic field broadcast from cables installed under the road. The current also charges an onboard battery used to power the vehicle when it is out of range. As electricity is supplied externally, these vehicles need only a fifth of the battery capacity of a standard electric car, and can achieve transmission efficiencies of over 80%. Online electric vehicles are currently undergoing road tests in Seoul, South Korea.													
	3-D printing and remote	Three-dimensional printing allows the creation of solid structures from a digital computer file, potentially revolutionizing the economics of manufacturing if objects can be printed remotely in the home or office. The process involves layers of material being deposited on top of each other in to create free-standing structures from the bottom up. Blueprints from computer-aided design are sliced into cross-section for print templates, allowing virtually created objects to be used as models for "hard copies" made from plastics, metal alloys or other materials.								1		1	1	1	1
	Self-healing materials	One of the defining characteristics of living organisms is their inherent ability to repair physical damage. A growing trend in biomimicry is the creation of non-living structural materials that also have the capacity to heal themselves when cut, torn or cracked. Self-healing materials which can repair damage without external human intervention could give manufactured goods longer lifetimes and reduce the demand for raw materials, as well as improving the inherent safety of materials used in construction or to form the bodies of aircraft.													
	Energy-efficient water	Water scarcity is a worsening ecological problem in many parts of the world due to competing demands from agriculture, cities and other human uses. Where freshwater systems are over-used or exhausted, desalination from the sea offers near-unlimited water but a considerable use of energy – mostly from fossil fuels – to drive evaporation or reverse-osmosis systems. Emerging technologies offer the potential for significantly higher energy efficiency in desalination or purification of wastewater, potentially reducing energy consumption by 50% or more. Techniques such as forward-osmosis can additionally improve efficiency by utilizing low-grade heat from thermal power production or renewable heat produced by solar-thermal geothermal installations.													
	Carbon dioxide (CO2) conversion and use	Long-promised technologies for the capture and underground sequestration of carbon dioxide have yet to be proven commercially viable, even at the scale of a single large power station. New technologies that convert the unwanted CO2 into saleable goods can potentially address both the economic and energetic shortcomings of conventional CCS strategies. One of the most promising approaches uses biologically engineered photosynthetic bacteria to turn waste CO2 into liquid fuels or chemicals, in low-cost, modular solar converter systems. Individual systems are expected to reach hundreds of acres within two years. Being 10 to 100 times as productive per unit of land area, these systems address one of the main environmental constraints on biofuels from agricultural or algal feedstock, and could supply lower carbon fuels for automobiles, aviation or other big liquid-fuel users.													
	Enhanced nutrition to drive health at the molecular level	Even in developed countries millions of people suffer from malnutrition due to nutrient deficiencies in their diets. Now modern genomic techniques can determine at the gene sequence level the vast number of naturally consumed proteins which are important in the human diet. The proteins identified may have advantages over standard protein supplements in that they can supply a greater percentage of essential amino acids, and have improved solubility, taste, texture and nutritional characteristics. The large-scale production of pure human dietary proteins based on the application of biotechnology to molecular nutrition can deliver health benefits such as muscle development, managing diabetes or reducing obesity.													
	Remote sensing	The increasingly widespread use of sensors that allow often passive responses to external stimulae will continue to change the way we respond to the environment, particularly in the area of health. Examples include sensors that continually monitor bodily function – such as heart rate, blood oxygen and blood sugar levels – and, if necessary, trigger a medical response such as insulin provision. Advances rely on wireless communication between devices, low power-sensing technologies and, sometimes, active energy harvesting. Other examples include vehicle-to-vehicle sensing for improved safety on the road.	1		1	1						1		1	1
	Precise drug delivery through nanoscale engineering	Pharmaceuticals that can be precisely delivered at the molecular level within or around a diseased cell offer unprecedented opportunities for more effective treatments while reducing unwanted side effects. Targeted nanoparticles that adhere to diseased tissue allow for the micro-scale delivery of potent therapeutic compounds while minimizing their impact on healthy tissue, and are now advancing in medical trials. After almost a decade of research, these new approaches are finally showing signs of clinical utility.													
	Organic electronics and photovoltaics	Organic electronics – a type of printed electronics – is the use of organic materials such as polymers to create electronic circuits and devices. In contrast to traditional (silicon-based) semiconductors that are fabricated with expensive photolithographic techniques, organic electronics can be printed using low-cost, scalable processes such as ink jet printing, making them extremely cheap compared with traditional electronics devices, both in terms of the cost per device and the capital equipment required to produce them. While organic electronics are currently unlikely to compete with silicon in terms of speed and density, they have the potential to provide a significant edge in cost and versatility. The cost implications of printed mass-produced solar photovoltaic collectors, for example, could accelerate the transition to renewable energy.													
	Fourth-generation reactors and nuclear-waste recycling	Current once-through nuclear power reactors use only 1% of the potential energy available in uranium, leaving the rest radioactively contaminated as nuclear "waste". While the technical challenge of geological disposal is manageable, the political challenge of nuclear waste seriously limits the appeal of this zero-carbon and highly scalable energy technology. Spent-fuel recycling and breeding uranium-238 into new fissile material – known as Nuclear 2.0 – would extend already-mined uranium resources for centuries while dramatically reducing the volume and long-term toxicity of wastes, whose radioactivity will drop below the level of the original uranium ore on a timescale of centuries rather millennia. This makes geological disposal much less of a challenge (and arguably even unnecessary) and nuclear waste a minor environmental issue compared to hazardous wastes produced by other industries. Fourth-generation technologies, including liquid metal-cooled fast reactors, are now being deployed in several countries and are offered by established nuclear engineering companies.													
2014	Body-adapted Wearable Electronics	Wearable computers and their interfaces are designed to be worn on the body, such as a wrist-mounted screen or head-mounted display, to enable mobility and hands-free/eyes-free activities.	1			1						1	1	1	1
	Screenless Display														
	Human Microbiome Therapeutics														
	RNA-based Therapeutics														
	Quantified Self (Predictive Analytics)	People collect data in terms of food consumed, quality of surrounding air, mood, skin conductance as a proxy for arousal, pulse oximetry for blood oxygen level, and performance, whether mental or physical. Wolf has described quantified self as "self-knowledge through self-tracking with technology".	1	1	1	1						1			1
	Brain-computer interfaces	Computer-brain interface is a type of user interface, whereby the user voluntarily generates distinct brain patterns that are interpreted by the computer as commands to control an application or device. The best results are achieved by implanting electrodes into the brain to pick up signals. Noninvasive techniques are available commercially that use a cap or helmet to detect the signals through external electrodes.	1	1		1						1		1	1
	Nanostructural Carbon Composites														
	Mining Metals from Desalination Brine														
	Grid-scale Electricity Storage														
	Nanowire Lithium-ion Batteries														
2015	Fuel Cell Vehicles	Zero-emission cars that run on hydrogen													
	Next-generation robotics	Rolling away from the production line	1	1	1	1			1			1	1	1	1
	Recyclable thermoset plastics	A new kind of plastic to cut landfill waste													
	Precise genetic-engineering techniques	A breakthrough offers better crops with less controversy													
	Additive manufacturing	The future of making things, from printable organs to intelligent clothes								1		1	1		1
	Emergent artificial intelligence	What happens when a computer can learn on the job?	1	1	1				1			1	1		1
	Distributed manufacturing	The factory of the future is online – and on your doorstep	1	1	1	1						1	1		1
	Sense and avoid' drones	Flying robots to check power lines or deliver emergency aid	1	1		1			1			1	1	1	1
	Neuromorphic technology	Computer chips that mimic the human brain													
	Digital genome	Healthcare for an age when your genetic code is on a USB stick													
2016	Nanosensors and the Internet of Nanothings	Tiny sensors that can connect to the web	1		1	1						1		1	1
	Next Generation Batteries	Making large-scale power storage possible													
	The Blockchain	A revolutionary decentralized trust system					1					1	1		1
	Two-Dimensional Materials	"Wonder materials" are becoming increasingly affordable													
	Autonomous Vehicles	Self-driving cars coming sooner than expected	1	1	1	1						1	1	1	1
	Organs-on-chips	Using chips instead of organs for medical testing purposes													
	Perovskite Solar Cells	Making progress towards ubiquitous solar power generation													
	Open AI Ecosystem	From artificial to contextual intelligence		1	1							1	1		1
	Optogenetics	Using light to control genetically modified neurons													
	Systems Metabolic Engineering	Chemicals from renewable sources' microorganisms													
2017	Noninvasive Biopsies for Identifying Cancer	Ultra-sensitive blood tests known as liquid biopsies promise to improve diagnosis and care													
	Harvesting Clean Water from Air	New materials are making sunlight-powered, moisture-absorbing technologies economical													
	Deep Learning for Visual Tasks	AI now rivals or exceeds the ability of experts in medicine and other fields to interpret what they see		1	1							1	1		1
	Liquid Fuels from Sunshine	Artificial-leaf technology converts carbon dioxide to fuels and more													
	The Human Cell Atlas	An international project is set to detail how every cell type in the body functions													
	Precision Farming	Combining sensors and real-time data analytics improves yields	1	1	1	1			1			1	1	1	1
	Affordable Catalysts for Green Vehicles	Reducing the platinum in fuel-cell catalysts could help bring hydrogen-powered vehicles to the mass market													
	Genomic Vaccines	Vaccines composed of DNA or RNA instead of proteins could enable the rapid development of preventives for infectious diseases													
	Sustainable Design of Communities	Moving beyond a focus on solar roofs for single-family homes, ambitious projects are attempting to join blocks of buildings into sustainable units													
	Quantum Computing	With quantum computing available to many, progress towards solving hard problems seems inevitable			1						1	1		1	1
2018	Augmented Reality Everywhere	Coming soon: the world overlaid with data	1	1	1	1		1				1	1		1
	Advanced Diagnostics for Personalized Medicine	A new generation of tools could help end one-size-fits-all therapeutics													
	AI for Molecular Design	Machine-learning algorithms are speeding up the search for novel drugs and materials		1	1							1	1		1
	AI That Can Argue and Instruct	New algorithms will enable personal devices to learn any topic well enough to debate it		1	1							1	1		1
	Implantable Drug-Making Cells	Releasing drugs directly into patients' bodies as they are needed is fast becoming feasible													
	Lab-Grown Meat	Meat produced without killing animals is heading to your dinner table													
	Electroceuticals	Nerve-stimulating therapies could soon replace drugs for many chronic conditions													
	Gene Drive	A genetic tool that can alter – and potentially eliminate – entire species has taken a dramatic leap forward													
	Plasmonic Materials	Light-controlled nanomaterials are revolutionizing sensor technology													
	Algorithms for Quantum Computers	Developers are perfecting programs meant to run on quantum computers			1						1			1	1