Imperial College
London

SHIFTING REALITIES:

PREPARING FOR TOMORROW'S TECHNOLOGIES

BY IAN MUNDELL

Technology foresight is about getting people to think about the future and how innovation might change society and the economy. The buzz word is disruption, in more ways than one.


Professor David Gann

"Everyone has a particular view of the future and it's extremely difficult to decommission that mental map," says Professor David Gann, Imperial's Vice-President (Innovation). "By bringing people together we can challenge each other's mental maps, and that helps shake up people's thinking, guided by some expertise about where the current science is."

Imperial Tech Foresight helps the College's partners in the business community think about the future, by using bespoke tools and methodologies to devise foresight workshops, providing consultancy services, and organising a flagship event each year. This year's event, Tech Foresight 2038 is themed around Shifting Realities. It will gather some 150 scientists, engineers and executives from industry to talk about technologies likely to hit home in the next 20 years.

Imperial's Tech Foresight team has also produced speculative pieces to shape discussion, such as the Table of Disruptive Technologies, which sets out 100 technologies capable of producing significant social, economic or political upheaval. Designed to resemble the Periodic Table, one axis ranks potential for disruption from high to low, while the other ranks the time of impact, from sooner to later (see centre pages).

While Professor Gann is forward looking, he is not interested in fantasising about the future. "We're a deep science institution, and very quantitative and evidence-based. So we build our foresight ideas on a robust understanding of what exists at the moment, in terms of scientific knowledge and technical capability," he says.

That means there is less futurology, in a pejorative sense, than in some predictive exercises. "Our scientists just will not go there. They talk about ideas that have some plausibility based on current evidence, and it's from there that we lift off."

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Dr Mark Kennedy

AI ARRIVES IN THE WORKPLACE

Just how disruptive technologies can be is a focus for Dr Mark Kennedy, Associate Professor in the Imperial College Business School and Director of Imperial Business Analytics. With Drs Julio Amador and Miguel Molina-Solana, he has been working on a model to help organisations assess the impact of artificial intelligence (AI) on their workforces.

“Current research gives users economy-wide data that provides high-level guidance to senior leaders in business and government but that stops short of defining the impact of AI for a specific organisation,” he says.

To help organisations prepare for AI-based digital transformations, they use company data, such as job descriptions and enterprise resource planning data, to link the tasks involved with existing jobs to tools based on different forms of artificial intelligence. “Rather than predicting jobs that will be lost to robots, we take a tools-for-tasks approach to anticipating workforce changes,” he explains.

The Future of Organisations Forecaster, or FOO.CASTR for short, has been tested on real data from the Royal Bank of Canada, where the tasks that might be replaced include loan approval, fraud detection, and many aspects of customer service. The result was a predicted headcount reduction of 12–35%.

“That gives me a feeling that the truth probably will be a reduction somewhere in the high teens to mid-twenties,” Dr Kennedy says. “It won't happen all at once, but we will see the early phases of this change starting to hit in 12–18 months’ time.”

The result comes with a number of health warnings, but it is more precise than studies considering the whole economy. It also points to places in the company where the transition might begin, vendors who might help, and the skills needed to make the change. “That's enough for them to get their toes in the water and start building some trial systems.”

UNDERSTANDING HUMAN FACTORS

The interaction of people and technology is also on the mind of Dr Weston Baxter, from the Dyson School of Design Engineering. “There are examples of really great technologies that have failed, in part, because the human element has not been considered,” he says. “In many cases, understanding the human is a prerequisite to defining what you need to achieve as an engineer, but it is often overlooked.”

He is particularly interested in rituals and their relationship with new technologies. “Rituals are one of the key ways that we infuse meaning into our individual lives and our social spheres, and we are still learning how rituals occur with new technology.”

Many of us have already seen rituals change as family members take part in celebrations through video links rather than in person. Bigger changes lie ahead. “If we're looking forward to maturing technologies like conversational agents, artificial intelligence or mixed realities, we must consider how interactions change. What do rituals look like in those environments? Can we design them into the products or services of the future?”

Some rituals will emerge on their own, but Dr Baxter is also interested in how they can be created. For example, people who eat alone often have poor eating habits such as eating too much, or eating unhealthy foods, particularly if they are distracted by mobile devices and social media. Could rituals be designed to encourage more mindful eating?

Similarly, what kind of rituals might you have with a conversational agent (the descendants of Siri and Alexa) and could these be designed so that they contribute to feelings of personal wellbeing?

“Ritual provides a context in which disruptive technology can be used,” Dr Baxter says. “If you can provide meaningful experiences grounded in these individual and social rituals, then it is easier to see how technology will be integrated into our everyday interactions.”

Dr Weston Baxter

Light trapping in the optical maze formed by many scattering particles (Dr Riccardo Sapienza).

Dr Riccardo Sapienza

LIGHT AT THE NANOSCALE

Some disruption is about overturning traditional approaches to science, and Dr Riccardo Sapienza from the Department of Physics is not keen on classical optics. He explains why with a musical analogy. “A violin is the right size to produce a certain sound through acoustic waves, but in classical optics it's as if we are using violins that are a thousand times too big for the sound we want.”

Instead, light should be handled at the nanoscale. “With that comes a very strong interaction between light and matter, and we can produce and control many new phenomena.”

One line of research aims to develop unconventional lasers. Instead of creating a laser beam by bouncing light back and forth between mirrors, this is done at the nanoscale by trapping light inside a structured material. By selecting materials that retain this function in a biological setting, without adverse effects such as toxicity, it should be possible to build bio-compatible lasers.

“We are making our very small lasers out of biomaterials such as silk, cellulose or sugars,” Dr Sapienza says. “Then we are trying to use these lasers as sensors, to report on something that is happening in the body.”

In tests these biolaser sensors perform 200 times better than fluorescent sensors currently in use. “The biosensor works, but we are limited in what we can sense,” Dr Sapienza explains. “Development now lies in the hands of the chemists to find useful applications.”

Possibilities include spraying these biosensors over an open wound to detect infection or monitor healing, or implanting them in the skin to indicate when diabetics need to address adverse glucose levels. Being biocompatible, they could also be incorporated into food packaging to monitor quality or freshness.

All that is needed now is demand. “We can fabricate these systems, so if there is a real interest in developing one of these technologies, then our research will fly.”

PREDICTING CHEMICAL SYNTHESIS

Dr Mimi Hii

Data is behind many disruptive technologies, but some disciplines seem to have been left behind. Synthetic chemistry, for example, sometimes feels as if it builds molecules by trial and error rather than by design, using equipment little changed since the age of alchemy.

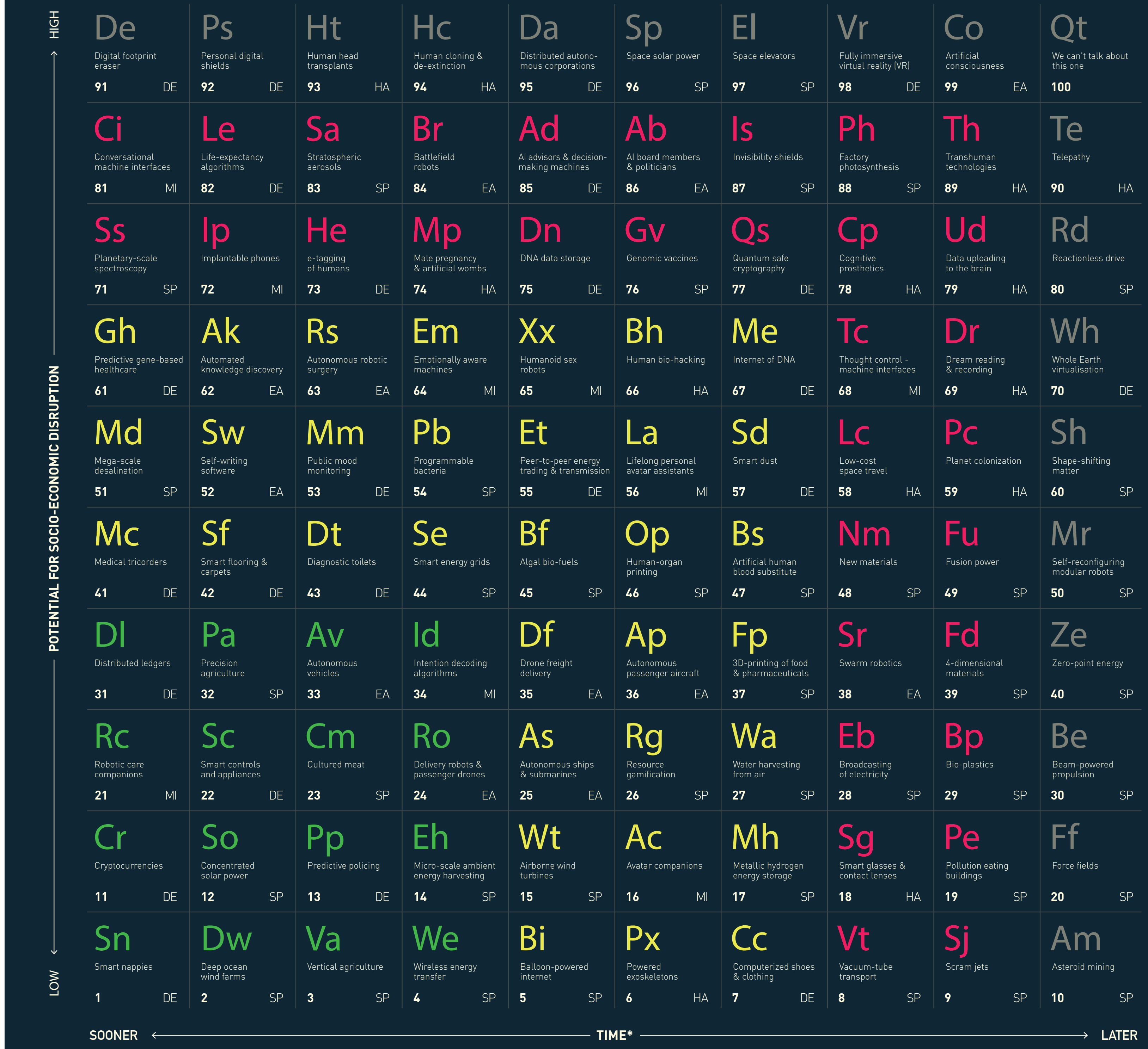
“We are not making use of data as much as we should,” says Dr Mimi Hii, Professor of Catalysis in the Department of Chemistry. “We should be able to predict more accurately the outcomes of what we are doing.”

Bringing chemistry up to date is the idea behind the Dial-a-Molecule Grand Challenge Network, a research

Imperial College London

TABLE OF DISRUPTIVE TECHNOLOGIES

From smart nappies to buildings that eat pollution, this table was developed by Imperial Tech Foresight to highlight 100 future technologies with potential to cause major social or economic upheaval.



HIGH ↑ POTENTIAL FOR SOCIO-ECONOMIC DISRUPTION ↓ LOW

De Digital footprint eraser 91 DE	Ps Personal digital shields 92 DE	Ht Human head transplants 93 HA	Hc Human cloning & de-extinction 94 HA	Da Distributed autonomous corporations 95 DE	Sp Space solar power 96 SP	El Space elevators 97 SP	Vr Fully immersive virtual reality (VR) 98 DE	Co Artificial consciousness 99 EA	Qt We can't talk about this one 100
Ci Conversational machine interfaces 81 MI	Le Life-expectancy algorithms 82 DE	Sa Stratospheric aerosols 83 SP	Br Battlefield robots 84 EA	Ad AI advisors & decision-making machines 85 DE	Ab AI board members & politicians 86 EA	Is Invisibility shields 87 SP	Ph Factory photosynthesis 88 SP	Th Transhuman technologies 89 HA	Te Telepathy 90 HA
Ss Planetary-scale spectroscopy 71 SP	Ip Implantable phones 72 MI	He e-tagging of humans 73 DE	Mp Male pregnancy & artificial wombs 74 HA	Dn DNA data storage 75 DE	Gv Genomic vaccines 76 SP	Qs Quantum safe cryptography 77 DE	Cp Cognitive prosthetics 78 HA	Ud Data uploading to the brain 79 HA	Rd Reactionless drive 80 SP
Gh Predictive gene-based healthcare 61 DE	Ak Automated knowledge discovery 62 EA	Rs Autonomous robotic surgery 63 EA	Em Emotionally aware machines 64 MI	Xx Humanoid sex robots 65 MI	Bh Human bio-hacking 66 HA	Me Internet of DNA 67 DE	Tc Thought control - machine interfaces 68 MI	Dr Dream reading & recording 69 HA	Wh Whole Earth virtualisation 70 DE
Md Mega-scale desalination 51 SP	Sw Self-writing software 52 EA	Mm Public mood monitoring 53 DE	Pb Programmable bacteria 54 SP	Et Peer-to-peer energy trading & transmission 55 DE	La Lifelong personal avatar assistants 56 MI	Sd Smart dust 57 DE	Lc Low-cost space travel 58 HA	Pc Planet colonization 59 HA	Sh Shape-shifting matter 60 SP
Mc Medical tricorders 41 DE	Sf Smart flooring & carpets 42 DE	Dt Diagnostic toilets 43 DE	Se Smart energy grids 44 SP	Bf Algal bio-fuels 45 SP	Op Human-organ printing 46 SP	Bs Artificial human blood substitute 47 SP	Nm New materials 48 SP	Fu Fusion power 49 SP	Mr Self-reconfiguring modular robots 50 SP
Dl Distributed ledgers 31 DE	Pa Precision agriculture 32 SP	Av Autonomous vehicles 33 EA	Id Intention decoding algorithms 34 MI	Df Drone freight delivery 35 EA	Ap Autonomous passenger aircraft 36 EA	Fp 3D-printing of food & pharmaceuticals 37 SP	Sr Swarm robotics 38 EA	Fd 4-dimensional materials 39 SP	Ze Zero-point energy 40 SP
Rc Robotic care companions 21 MI	Sc Smart controls and appliances 22 DE	Cm Cultured meat 23 SP	Ro Delivery robots & passenger drones 24 EA	As Autonomous ships & submarines 25 EA	Rg Resource gamification 26 SP	Wa Water harvesting from air 27 SP	Eb Broadcasting of electricity 28 SP	Bp Bio-plastics 29 SP	Be Beam-powered propulsion 30 SP
Cr Cryptocurrencies 11 DE	So Concentrated solar power 12 SP	Pp Predictive policing 13 DE	Eh Micro-scale ambient energy harvesting 14 SP	Wt Airborne wind turbines 15 SP	Ac Avatar companions 16 MI	Mh Metallic hydrogen energy storage 17 SP	Sg Smart glasses & contact lenses 18 HA	Pe Pollution eating buildings 19 SP	Ff Force fields 20 SP
Sn Smart nappies 1 DE	Dw Deep ocean wind farms 2 SP	Va Vertical agriculture 3 SP	We Wireless energy transfer 4 SP	Bi Balloon-powered internet 5 SP	Px Powered exoskeletons 6 HA	Cc Computerized shoes & clothing 7 DE	Vt Vacuum-tube transport 8 SP	Sj Scram jets 9 SP	Am Asteroid mining 10 SP

SOONER ← TIME* → LATER

Example of organizations active in each area

1 Monit (South Korea), Abena Nova (Denmark), Siempre Secos (Spain)

2 Statoil (Norway), Siemens (Germany), Volturn (US), UMaine (US)

3 Green Skies Vertical Farms (US), Aero Farms (US), Neo Farms (Germany), Urban Crop Solutions (Belgium)

4 WiTricity (US), Powermat (Israel), Apple/Power By Proxi (US), Qualcomm (US), Mojo Mobility (US), Mopar (US), Fulton Innovation (US)

5 Google/Alphabet (US)

6 ReWalk (US), Rex Bionics (US), SuitX/US Bionics (US), Ekso Bionics (US), Lockheed Martin (US)

7 Google/Alphabet (US), Samsung (Korea), Hexoskin (Canada) Owlet (US), Komodo Tech (Canada), Shiftwear (US), Lechal (India), OM Signal (Canada)

8 The Boring Company/Elon Musk (US), China Aerospace Science and Industry Corporation (China)

9 Reaction Engines (UK), NASA (US), Boeing (US), Lockheed Martin (US), Airbus (France)

10 Deep Space Industries (US), Planetary Resources (US), Made in Space (US)

11 Bitcoin (Japan), Ripple (US), Litecoin (US)

12 Solarreserve (US), Abengoa (Spain), North China Power Engineering (China), Shanghai Electric (China), Zhejiang Supcon Solar (China), NWEPDI (China)

13 PredPol (US), ECM Universe (US)

14 Pavegen (UK), ECEEN (China)

15 Google/Alphabet (US), Joby Energy (US), Altaeros (US), Kitegen (Italy), Enerkite (Germany)

16 Pullstring (US), Amazon (US), Alphabet/Google (US), Nintendo (Japan), Invisible Girlfriend/Boyfriend (US)

17 NASA (US)

18 Alphabet/Verily (US), Amazon (US), Vuzix (US), Everysight (Israel)

19 Elegant Embellishments (Germany), iNova (Spain), Studio Roosegaarde (Netherlands), Prosolve 370e (Germany)

20 Dstl (UK), Boeing (US)

21 Softbank (Japan), AIST (Japan), Blue Frog Robotics (France), Care-o-bot (Germany), Riken/Sumitomo Riko (Japan), Mayfield Robotics (US)

22 Amazon (US), Google/Alphabet (US), Philips (Netherlands), Samsung (South Korea), Dyson (UK), Miele (Germany), iRobot (US)

23 Impossible Foods (US), Memphis Meats (US), Super Meat (Israel), Finless Foods (US), New Harvest (US)

24 Wing/Alphabet (US), Starship Technologies (UK), Volocopter (Germany), eHang (China), Piaggio (Italy)

25 Leidos (US), Boeing (US), Rolls Royce (UK)

26 Joulebug (US), Waterpebble (UK)

27 Permalution (US), Sun to Water (US)

28 Powercast (US)

29 NatureWorks (US), Gruppo MAIP (Italy), Genomatica (US), Green Dot Bioplastics (US)

30 NASA (US)

31 Everledger (UK), Stampery (Spain), Brickblock (Germany), Slock.it (Germany)

32 Blue River Technology (US), Hortau (Canada)

33 Google/Waymo (US), Voyage (US), Nvidia Automotive (US), most major auto-makers

34 Amazon (US), Google/Alphabet (US), Philips (Netherlands), Samsung (South Korea), Dyson (UK), Miele (Germany), iRobot (US)

35 Google/Alphabet (US), Amazon (US), Flirtey (US)

36 Airbus (France), Boeing (US)

37 FabCafe (Japan), NASA (US)

38 SRI International (US)

39 Stratasys (US), Autodesk (US)

40 NASA (US)

41 Basil Leaf Technologies (US), Dynamical Biomarkers Group (US/Taiwan), Scanadu (US)

42 Starwood Hotels (US), MariCare (Finland), Scanalytics (US), Futureshape (Germany)

43 Flowsky (Japan), Scanadu (US)

44 Tesla (US), ABB (Switzerland), Siemens (Germany), IBM (US), Itron (US)

45 Synthetic Genomics/ExxonMobil (US), Global Algae Innovations (US), Algenol (US)

46 Organavo (US), Envision TEC (Germany), RegenHU (Switzerland), Cellink (Sweden), Seraph Robotics (US)

47 HbO2 Therapeutics (South Africa), Biospace (US)

48 For example Vantablack by Surrey NanoSystems (UK)

49 ITER (EU/France), Tokamak Energy (UK), Alphabet/Google/Tri Alpha Energy (US), General Fusion (Canada), Helion Energy (US), Lockheed Martin (US)

50 Festo (Germany)

51 Israel Desalination Enterprises Technologies (Israel), Acciona (Spain), Fluence Corporation (US)

52 Microsoft (US), Google/Alphabet (US), Open AI (US)

53 Open Utility/Essent (UK/Netherlands), Knowelsys (China)

54 Gingko Bioworks (US), US Naval Research Laboratory (US), US Army Research Lab (US), Darpa (US)

55 Open Utility (UK/Netherlands), Power Ledger (Australia), LO3 energy (US), Energy Web Foundation (Switzerland)

56 Konami Corp (Japan), Mitsuku (UK)

57 MOOG (US), Darpa (US)

58 Space X/Elon Musk (US), Blue Origin (US), Virgin Galactic (UK), Rocket Lab (US), Axiom Space (US), SpaceIL (Israel), Firefly Aerospace (US)

59 Space X (US), UAE Mars Mission (UAE), NASA (US)

60 Intel (US)

61 Kite Pharma/Gilead Sciences (US), 23andMe (US), Phenogen Sciences (US), Regeneron (US), Veritas Genetics (US)

62 IBM (US)

63 Intuitive Surgical (US), Verb Surgical/Alphabet/Johnson & Johnson (US), Da Vinci Surgery (US)

64 IBM (US), Toyota (Japan), Mimosys (Japan), Persado (US), Joy AI (US)

65 Realbotix (US), True Companion (US)

66 BioTeq (UK), Grindhouse Wetwear (US), Dangerous Things (US), see also The Eyeborg Project and the Cyborg Foundation

67 Alphabet/Google Genomics (US), Amazon (US), Illumina (US), Oxford Nanopore Technologies/Metrichor (UK)

68 CTRL-Labs (US), Emotiv (US), Neuralink (US), maybe Facebook (US)

69 No example found

70 Improbable (UK)

71 European Organization for Astronomical Research in the Southern Hemisphere (European consortium of 16 countries)

72 No example found

73 Epicenter (Sweden) and Three Square Market 32M (US) are close

74 No example found

75 Twist Bioscience (US)

76 Vaccinogen (US), EpiVax (US), IBM (US), Juno Therapeutics (US)

77 Alphabet/Google (US), KETS (UK), IDQ (Switzerland), Isara (Canada)

78 Darpa (US)

79 Kernel (US), Neuralink/Elon Musk (US), 2045 Initiative (Russia), Darpa (US), General Electric/Braingate (US), possibly Facebook (US)

80 NASA (US), Cannae (US)

81 Apple (US), Amazon (US), Alphabet/Google (US), Microsoft (US)

82 No example found

83 CIA (US)

84 Lockheed Martin (US), QinetiQ (UK), Boston Dynamics/Softbank (US/Japan)

85 Woebot (US), Pefin (US), LV (UK)

86 Deep Knowledge Ventures (Hong Kong), Tieto (Finland)

87 BAE Systems (UK), Toyota (Japan). NB. Big difference between optical camouflage and bending light to make things disappear

88 Breakthrough Energy (US), RIPE (US), Joint Centre for Artificial Photosynthesis (US)

89 SENS Research Foundation (US), Methuselah Foundation/Peter Thiel (US)

90 Facebook (US), Neuralink/Elon Musk (US)

91 Suicide Machine (Netherlands), Just Delete Me (US)

92 No example found

93 Turin Advanced Neuromodulation Group (Italy)

94 Sooam (South Korea), Revive and Restore (US)

95 No example found

96 Rebeam (US), Solaren Corp (US)

97 Thoth Technology (Canada)

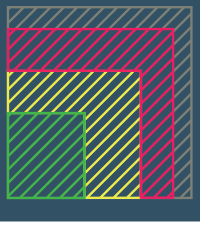
98 Improbable (UK), HelloVR (US), Magic Leap (US), Microsoft (US). See also Mind Maze (US), Facebook (US) and possibly Apple (US)

99 Possibly Alphabet/Google (US)

100 As it says, we can't say

* Time is defined as ubiquity or mainstream use not invention

Legend



Ghost Technologies: Fringe science & technology. Defined as highly improbable, but not actually impossible. Worth watching.

Horizon 3: Distant future 20 years + (Explore).

Horizon 2: Near future 10-20 years hence (Experiment).

Horizon 1: Happening now (Execute).

How to read entries

Sn — Abbreviation of technology

Smart nappies — Description of technology

1 DE — Theme (See next right)

Examples (See right hand panel)

Themes

Each of the 100 technologies has been subjectively categorised according to five broad themes, which are:

DE Data Ecosystems
SP Smart Planet
EA Extreme Automation
HA Human Augmentation
MI Human-Machine Interactions

The Small Print

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The purpose of this publication is to make individuals and institutions future ready. Also, to make people think, at least periodically.

It is a mixture of prediction and provocation intended to stimulate debate, but be aware that other elements should always be considered when assessing potential impact, especially the wider psychological and regulatory landscape in which technologies exist. Most importantly, the technologies highlighted on this table appear without any discussion of moral or ethical factors.
Generally speaking, no technology should be used unless it improves the human condition and with potentially disruptive technologies always remember that "with great power comes great responsibility". (There are various attributions for this quote ranging from Spiderman, Dr Spock, Yoda, Churchill, Roosevelt and possibly the French Revolution).

Examples are purely illustrative and do not constitute any form of recommendation, validation or investment advice. Also note that with smaller companies and start-ups in particular the landscape is continually changing so treat examples with caution. There will also undoubtedly be errors and misjudgements, so please use a bit of common sense.
If you'd like to contact us to congratulate us, criticise us or buy us lunch our address is techforesight@imperial.ac.uk. You can also reach Richard via richard@nowandnext.com.

Version 1 (Beta). London, January 2018.

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council initiative that has been running since 2010. Its ambition is to make the synthesis of any desired molecule as easy as dialling a number. One result of this initiative has been the decision to set up a national facility for data-rich chemistry: the Centre for Rapid Online Analysis of Reactions (ROAR), at Imperial's White City campus.

“We've commissioned all the big-ticket items and we are waiting to move in,” says Professor Hii, the Centre's director. Its resources will include systems for chemical synthesis, reaction analysis, laboratory automation and optimisation, and – of course – data analysis.

Defining the data required and a system smart enough to use it are the challenges that lie ahead. “How can we build a synthesis machine intelligent enough not only to perform known chemical reactions, but also to predict unknown chemical reactions, try them and tell you what the outcome is?”

The impact of having such a machine would be enormous, Professor Hii says, removing bottlenecks to the development of new materials and making chemical production more democratic and local. “You will just make what you need, when you need it and where you need it, rather than having to outsource production to a huge, polluting factory somewhere half way around the world.”


Dr Connor Myant

PRINTING SHAPE MEMORY MATERIALS

Dr Connor Myant, of the Dyson School of Design Engineering, is working with two disruptive technologies, bringing together 3D printing and shape memory materials. “This means that you can 3D print an object that, once it is finished, can change its shape and assemble into something else.” This addition of time as a fourth dimension has led some to call this 4D printing.

The properties that allow a shape memory material to move between a temporary shape and a programmed permanent shape are often down to its formulation, but Dr Myant has other ideas. “We want to show that you can get the same control – over the speed at which it changes, when it is going change, the stimulus it reacts to, and so on – through the internal structure of the object rather than by changing its chemistry.”

Shape memory materials already have some uses. Many are decorative, such as synthetic flowers that open in response to a stimulus. Other ideas are more ambitious, such as designing a shape memory hinge that would open the solar panels on a space craft without involving a motor or any articulated parts.

But combining shape memory materials with 3D printing opens up a host of new possibilities for customising objects. For instance, a medical insert intended for someone's windpipe could be 3D printed with a programmed shape personalised to the patient. It could then be squashed into a much smaller temporary shape to make it easy to insert.

“You would then give it the trigger to make it return to its programmed state, and that would happen inside the body,” says Dr Myant. “This would be a far less painful process of operation, and it would be completely patient specific.”

LEARNING THROUGH DIGITAL TWINS


Professor Mark Girolami

Working on a project to build a pedestrian bridge in Amsterdam gave Mark Girolami, Professor of Statistics in the Department of Mathematics, an idea for making predictions about complex systems. More than simply modelling, it involves constructing a digital twin of the system in question.

“The digital twin captures the essence of the operation of these complex systems,” Professor Girolami explains. “It allows us to ask questions and play them forward in time and space.”

The Amsterdam bridge that has inspired him is being 3D-printed in stainless steel. This construction method means the bridge can have a sinuous, organic form, but it raises questions about its structural performance. “To all intents and purposes this is a completely new material. Therefore the challenge in developing the digital twin of this bridge will be understanding and characterising what we do and don't know about the material's properties.”

Once the bridge is installed, sensors attached to the structure will provide data to verify and improve the digital twin's predictions. “This is the first time that something of this size has been printed and used in an urban setting, so there's a huge amount that we can learn.”

The digital twinning approach is now being extended to other settings, such as retail activity in London. Once built, this digital twin will allow the effects of different policies and economic stimuli to be tested. Another idea is to build a digital twin of criminal activity in the city, which could be used to test different policing policies.

"Handling the data is a challenge, but it's one you can get around with some brute force," Professor Girolami says. "But the real intellectual and philosophical challenge is understanding how the components of the systems are formed and interact."

PERSONALISED NUTRITION

And for every disruptive technology there is an alternative view. While predictive gene-based healthcare features on the Table of Disruptive Technologies, Dr Isabel Garcia-Perez in the Department of Cancer and Surgery argues that genes are not the answer to everything. She thinks it will also be possible to develop a personalised approach to healthcare based on observations of an individual's metabolism.

Her work sets out to answer a persistent problem in public policy on diet. "We cannot define healthy eating because there is a huge difference between what people say they eat and what they really eat," she says. Error rates in surveys of eating habits range from 33% to 80%, with the highest mismatch among people at the greatest risk, for instance with obesity or cardiovascular disease.

Dr Isabel Garcia-Perez

To address this, Dr Garcia-Perez is developing a system that can tell what someone has been eating based on the chemicals in their urine. Some of these markers relate to a person's metabolism, some relate to microbial interactions in the gut, and others indicate specific foods or food groups in the diet. So if you have been eating grapes, tartaric acid will appear in the urine.

"We are not at the point where we can say how many chips someone has been eating, but we are getting there," she says.

Foods are extremely complex, so it will not be possible to find markers for everything, but it will be possible to register a person's dietary pattern. This in turn will help answer the question of what people eat and how that real diet lines up with health outcomes.

It will also be possible to use this approach to improve the health of individuals. "I want to empower clinicians, dieticians and policy makers by giving them the objective information they need to access the full potential of precision medicine," she says. "It's not just about monitoring dietary habits, but also telling the dietitian how a person is responding to a personalised diet."

REALITY CHECK

While Professor Gann is happy for foresight to explore all possibilities the future may have to offer, he also wants it to have a built-in reality check. "We can talk about technologies that could be disruptive or may change the way we do things, but there is a bigger question about what success and failure look like," he says.

He likes to cite the cautionary tale of Thomas Midgley Jr, the American engineer who developed both leaded petrol and the first chlorofluorocarbons, both highly successful innovations in the short term but ultimately catastrophic for human health and the environment.

"Innovation has some very strange endings," he goes on. "It doesn't matter how much foresight you've got, it might not work out the way you planned. Part of our role as educators is to keep people asking questions."

Ian Mundell is a journalist who specialises in research and higher education. He divides his time between London and Brussels.

Tech Foresight 2038: Shifting Realities is curated by Imperial Tech Foresight, which enables business leaders to immerse themselves in the fringes of disruption, explore breakthrough technology and research through visionary academic perspectives, and connect with challenging, proactive and engaging visions of the future. Imperial Tech Foresight can help your business navigate the rapidly shifting technology landscape, enabling you to make better decisions on the future of your organisation.

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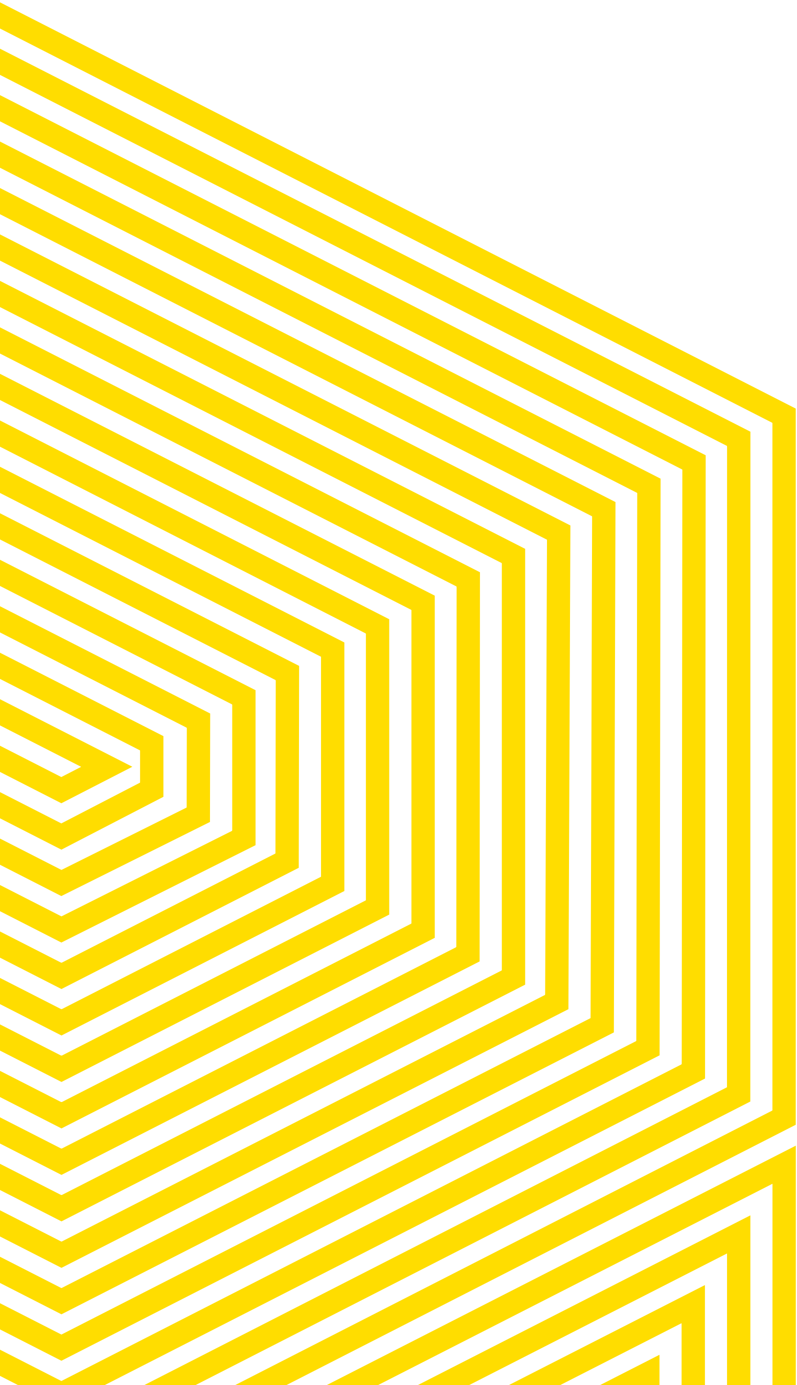
SHIFTING REALITIES



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Enter 2038;
a world of shifting realities, where things are not always what they seem to be, and where technological breakthroughs could change the very fundamentals of how we engage with and see the world.

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