



**Deliverable 4.3 OBSERVE Toolkit
Deck of Cards and Manual for using them**

Project Name	Observing Emergence OBSERVE
Project No.	665136
Project Type	Coordination and Support Action
Project Duration	01/06/2015-30/05/2017 (24 Months)
Project Coordinator	Philine Warnke, Fraunhofer ISI
Funded under	Horizon 2020 Future and Emerging Technologies FET OPEN CSA
Work package	WP4 Dissemination
Deliverable	D4.3 OBSERVE Toolkit Deck of Cards & Manual
Submission Date	11/07/2016
Version	1
Authors	Philine Warnke, Elna Schirrmeister, Aaron Rosa, Fraunhofer ISI



Part 1 Manual:

Working with the OBSERVE Deck of Cards of Emerging Topics

1 Background

The Future & Emerging Technologies (FET) program of the European Commission invests in transformative frontier research and innovation with a high potential impact on technology, to benefit our economy and society. FET provides a unique combination of high risk, long term, multidisciplinary and collaborative frontier research, which lays the foundations for radically new, next generation technologies. It converts proofs of concept into industrial applications and systems.¹ The OBSERVE project supports FET by screening emerging developments that could be relevant to be taken up in the FET funding activities. In the screening phase the team generated a set of 171 emerging topics that are documented in the OBSERVE Horizon Scanning Report (Deliverable 1.2). Complementary to the report the topics were printed on a deck of cards to support the use of the emerging topics in strategic processes of actors across the R&I landscape. The deck of cards can be downloaded at the OBSERVE Website.








This manual outlines some suggestions on how to use the cards in a strategic process.

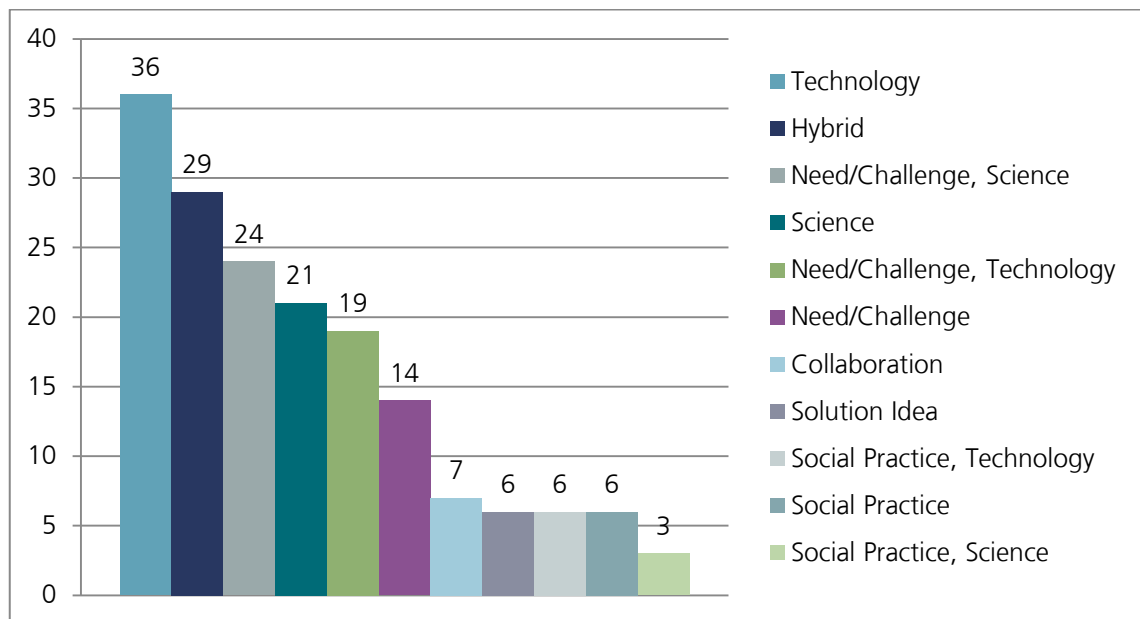
The cards can be found in the second part of this document.

¹ <https://ec.europa.eu/digital-agenda/future-emerging-technologies-fet>, last access: 27/04/2016

2 The cards

The deck contains 171 cards. The different symbols indicate the basic types of change. Combinations of different types are indicated by combined symbols:

Symbol	Type of Change	No. of Cards
	Solution Idea: Emerging technological or social innovation or combination of both addressing a certain problem	6
	Science: Emerging research fronts	21
	Technology: Emerging frontiers technology development	36
	Challenge/Need: Challenge or need with long term relevance for society newly emerging or gaining a new dynamics	19
	Social Practice: Emerging change in social practices (new ways of doing) including policy practices	6
	Collaboration: New formats of collaboration in research and innovation and new constellations of actors collaborating in particular across disciplines	7
	Hybrid: Developments spanning all the above types	29



The cards are numbered within each type (e.g. Technology 1 – Technology 36).

Each Card gives a title, a short description and the source where this item was first identified. In addition, four impact levels are distinguished:

- “Local”: impact in a specific domain (e.g. health)
- “Mid Range”: impact across several domains, e.g. new materials with applications in health, ICT and energy
- “Widespread”: impact across society, e.g. fundamental changes in communication patterns
- “Fundamental”: impact on the long-term future of the civilisation

3 Suggestions for using the OBSERVE cards in strategic debates

The cards are meant to be used for inspiring strategic conversation. They give only very basic information on the emerging topics. Further material can be found in the OBSERVE Database. For deeper engagement, additional research is required.

In the following paragraphs, we outline three basic types of strategic conversations that we think are the most broadly useful ones: the strategic orientation workshop, the idea generation & inspiration workshop, the system mapping workshop.

3.1 Strategic orientation workshop

3.1.1 Purpose

The purpose of this type of workshop is strategic orientation of a group such as a department of a ministry, a business unit of a company or an NGO. It can also be applied for setting up a new field of activity. The workshop will usually be followed by a strategy building exercise such as roadmapping, scenario development, SWOT exercise or idea generation to address the strategic issues identified.

3.1.2 Participants

This workshop is especially effective if actors from diverse perspectives within the organization are involved. For example, in a company, it could be marketing, R&D, controlling, production, human resources. Next to the strategic orientation, it underpins the group cohesion and team spirit as people get to know each others' perspective.

3.1.3 Process

Participants are asked to select a limited number of cards (e.g. 5) they see as the “tallest trees”, i.e. the ones with the highest impact on the long term future of the organisation or the organisations domain of activity. Depending on the timing available, this can be done previous to the workshop, so participants come “prepared”. In the workshop, each participant introduces his/her “tallest trees” and pins the respective card on the board. If two people have the same card, they are placed together.

In a second step, other cards relating to the “tallest trees” are assigned to form a “forest” of developments relating to the tallest tree. This step can be limited to those “tallest trees” that have been mentioned by more than one participant. Alternatively, a voting exercise can serve to select the ones to be tackled.

The elaboration of clusters can be done in the plenary or in small group work. Another possibility is to ask people to prepare not only a set of “tallest trees” but also already select related issues of this “forest”.

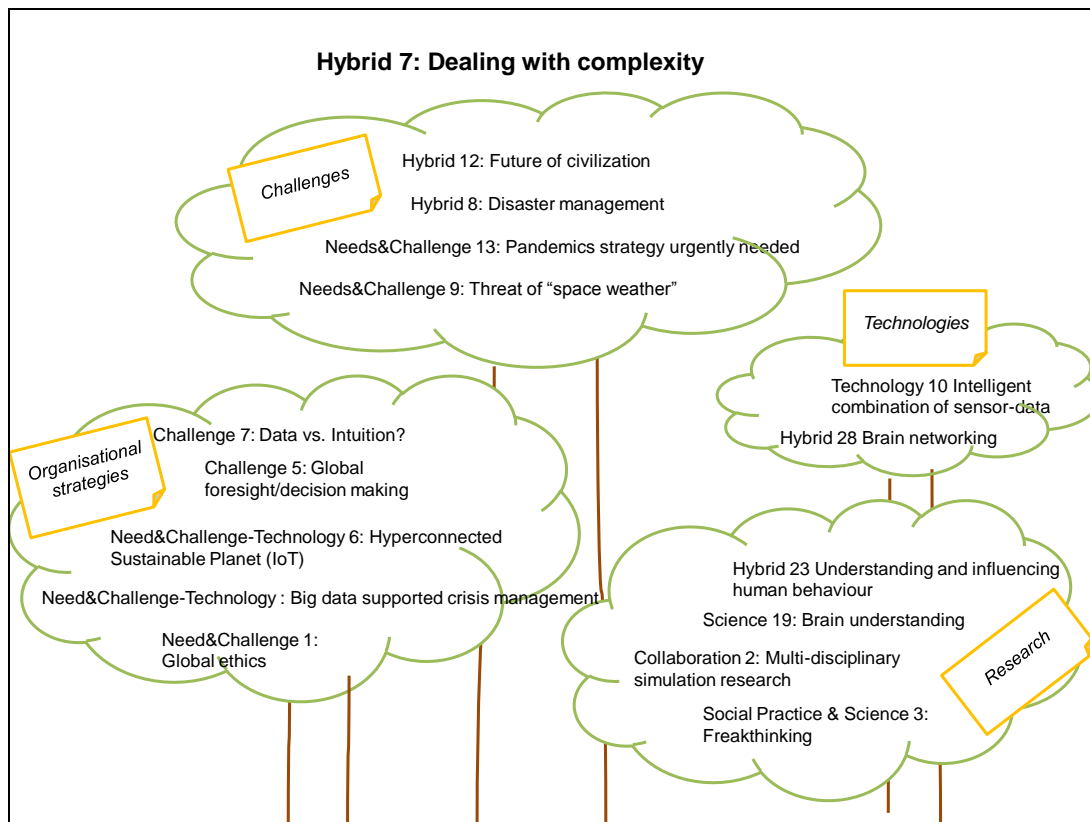


Figure 1: Example "Forest" around the tallest tree "dealing with complexity".

Variation:

For a faster selection and less time for the preparation, the following proceeding is possible: Several sets of cards are distributed among all participants, so each card is assigned several times and each participant has a pile of about 10 cards. Everybody is asked to select the 5 „most relevant“ for the issue at stake (e.g. future of the organisation) and to pass them on to the next participant with a few notes on the reasons for selecting them. The next person then selects another three and the third one selects one card. Then the remaining cards are assessed. Depending on the group size and time, all can be treated as “tallest trees”. Alternatively, the ones that appear several times are selected or a voting exercise is carried out as above.

Add-on 1: Three Horizon Scanning

A useful format for analysing a cluster of developments is provided by the “three Horizon Framework”. Cards can be placed on this scheme to discuss what the transformative long term developments (level three) are and which aspects are rather parts of the current paradigm. The impact level assigned to each card may serve as an orientation.

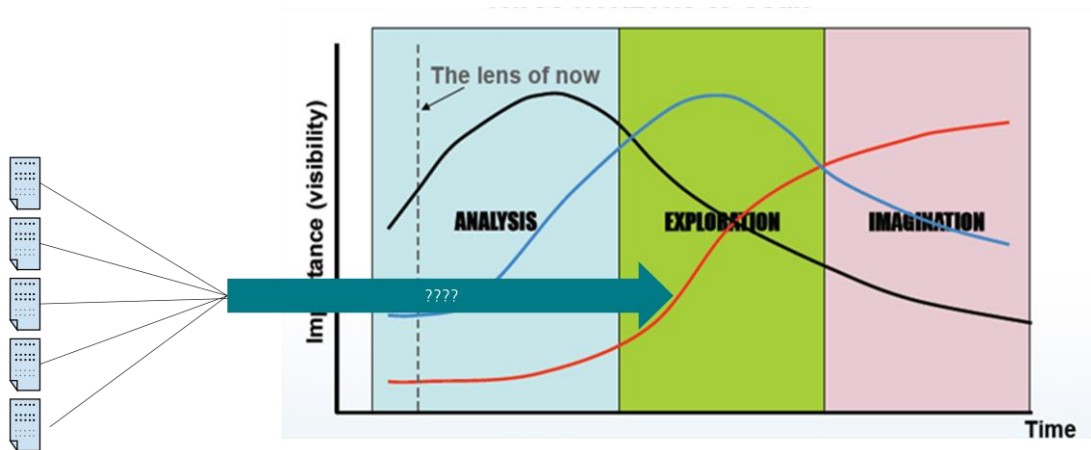


Figure 2: Use of Three Horizon Framework for Assessment of Cards²

Add-on 2: Awareness-raising

The selected „tallest tree cards“ can be used throughout the organisation or even with external actors (e.g. research partners or clients) to inspire a debate on strategic implications, e.g. in a World Café setting where the card is placed and people spend a limited time (e.g. 30 Minutes) to brainstorm on risks and opportunities emerging from this card. For this purpose, a more detailed card can be elaborated.

3.2 Idea generation & inspiration workshop

3.2.1 Purpose

The purpose of this type of discourse is to generate new ideas across and beyond established silos and well trodden pathways.

² <https://paul4innovating.com/2010/09/10/the-three-horizon-approach-to-innovation/>, last access: 27/04/2016

3.2.2 Participants

This workshop can be carried out by any type of group. In order to have a large diversity of ideas and to maximise the process benefit of mutual inspiration it makes sense to have people from a wide range of backgrounds. As an example if a new solution is to be developed it makes sense to involve people from the context of use and daily life together with developers of technologies and services.

3.2.3 Process

Each participant gets one set of cards (e.g. of one type). Everybody is asked to select a certain number of cards he or she sees as of particular disruptive potential for the domain of interest (e.g. specific line of activity of an organization).

One person starts by introducing one of the selected cards. All others add one card from their pile fitting to the first card. This is done again and again until all selected cards are assigned to piles. After this matching phase, a high number of diverse piles are generated. Participants are asked to select the most interesting ones (e.g. by voting or assignments of dots). The most highly ranked piles are assigned to small groups who then elaborate one idea in response to the respective set of cards, e.g. within a structured template.

Add on: The ideas can be assessed using a set of criteria relevant for the group, e.g. societal benefit, market potential, fitting with group identity etc.



Figure 3: Illustration for use of the cards³ for idea generation

³ The following cards are depicted: T8, N&C-T18,H9,S12, S14, N&C14, N&C-S15,Col3

3.3 System mapping workshop

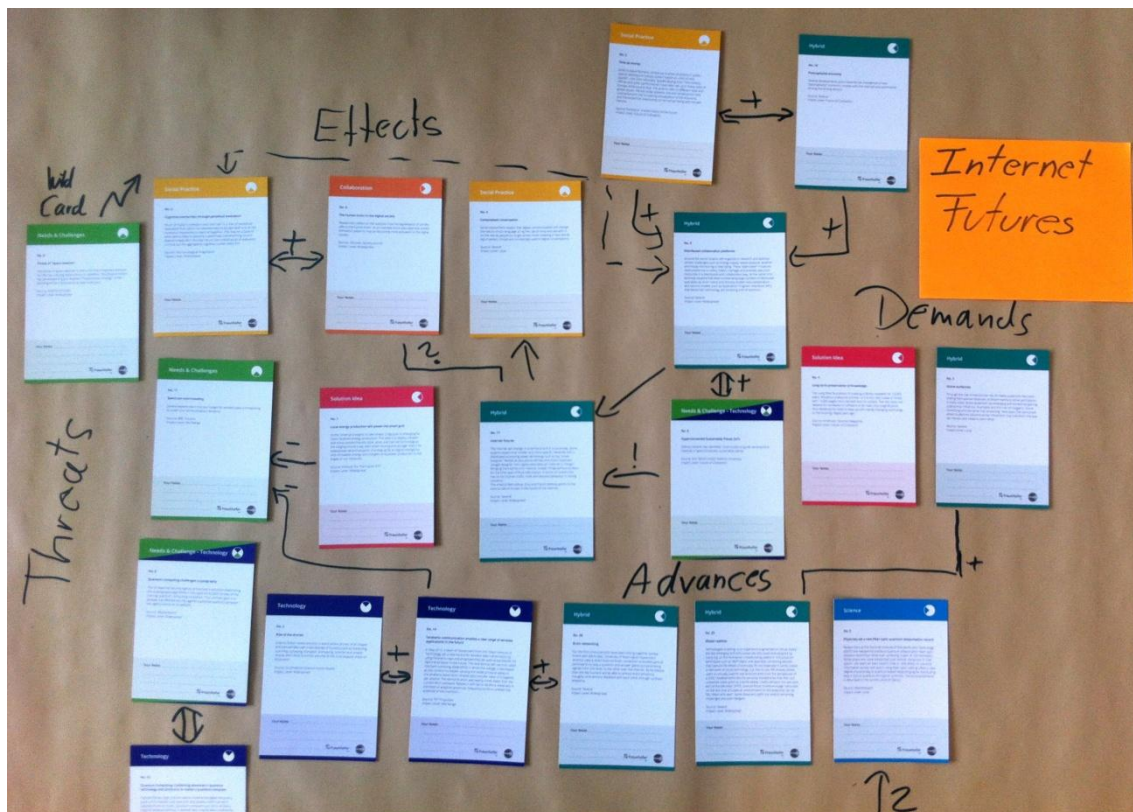


Figure 4 Use of the OBSERVE cards for system mapping

3.3.1 Purpose

This workshop underpins the analysis of the dynamics of change within a certain system. In many cases, this type of dialogue will form the first phase of a scenario exercise. It is however also useful on its own to underpin the group's systemic thinking and responsiveness towards changes in different areas.

3.3.2 Participants

For this workshop, it is important to have experts for all relevant aspects of the system of stake. If for example the system is "e-mobility" participants should cover such diverse aspects as battery technology, infrastructure, business models, user preferences, city development and policy framework conditions. Accordingly a pre-workshop analysis is required. The OBSERVE cards are not developed for a specific system and can therefore only form part of the input – participants should be encouraged to add cards, system specific studies should be screened to add missing developments. As a

framework STEEP⁴ or similar approaches can be used to ensure that all domains are covered.

3.3.3 Process

In a group process, the most important developments influencing the future of the system are selected. Then, the impact of each factor on the others is systematically assessed. This can be done within a matrix template. The factors with the highest influence within the system (the most active ones) are selected. Jointly, the group creates a map of the system specifying the influence of the factors on each other.

⁴ Society, Technology, Environment, Economy, Policy

Part 2

OBSERVE Deck of Cards of Emerging Topics

Note for users:

The PDF document with the cards can also be downloaded individually from the OBSERVE Website.

The following complementary documents are available on the OBSERVE website:

- D1.2 OBSERVE Horizon Scanning Report: Lists the 171 emerging topics with some additional information on the overall set.
- D1.3 Methodology Report: Explains the methodology used for identifying the topics.
- D4.4 User Brief 1: Listing 34 clusters formed out of the 171 topics





No. 1

Digital humanities

The humanities and social sciences increasingly use digital media and computing methods. Two of many examples are the use of sensory postcards in ethnography to capture people's everyday experiences by recording sensory impressions or the automatic parsing of textual corpora for extraction of actors and their relational networks on a vast scale, turning textual data into network data.

Source: Several
Impact Level: Local

Your Notes
.....
.....
.....



No. 2

Multi-disciplinary simulation research

There is a call for better modeling, simulation and visualization of complex multi-disciplinary systems such as turbulent aerodynamics. At the same time philosophers and social scientists point to the societal transformations associated with simulation based technology.

Source: FastCoexist
Impact Level: Widespread

Your Notes
.....
.....
.....



No. 3

Urban catalysts

Architects and designers around the globe are adopting a new mode of intervention into urban development called tactical urbanism. At the core is the use of micro interventions that function as catalysts for change. A creative and resourceful appropriation of the city's conflictual conditions expressed in terms of informal urban objects and habitats.

Source: Vienna Biennale/MoMa
Impact Level: Local

Your Notes
.....
.....
.....



No. 4

Bio-manufacturing

Living organisms such as viruses are genetically modified to create materials eg for semiconductors or batteries. Biomanufacturing has advantages such as non toxic, low energy. Medical applications are also explored (eg finding and fighting tumors). With the development of pharmaceuticals and artificial organisms, new biology-based processes will do things that only machines have previously done. For example, scientists have recently been able to modify cells to act like fully functional computers.

Source: The Economist Technology Quarterly
Impact Level: Widespread

Your Notes
.....
.....
.....





No. 5

Rising interest in traditional medicine

There is rising interest from science, society and companies in investigating traditional medicines such as recipes from monasteries.

Source: Several
Impact Level: Local

Your Notes
.....
.....
.....



No. 6

The human brain in the digital society

Researchers reflect on the question how the digitalisation of society affects the human brain. As an example some speculate that autistic behaviour patterns may be becoming more prevalent in the digital society.

Source: Discover Society Journal
Impact Level: Widespread

Your Notes
.....
.....
.....



No. 7

Astronomy and geology collaborate

Geologists have found iron 60 in a rock sample from the sea floor. This has given new insights on the dying of supernovas. The link between geology and astronomy is little exploited yet but could be more relevant in the future.

Source: Intelligent Life
Impact Level: Local

Your Notes
.....
.....
.....



No. 1

Human enhancement

Various technologies, techniques and drugs are emerging, that can enhance bodily functions and in particular cognitive performance (neuroenhancement). There are microchip implants, smart contact lenses which can monitor blood values or advanced prosthetic technologies (bionic eyes, extreme knees etc.). Severable applications serve to support blind and deaf people to navigate. Biohackers modify themselves with RFID-Chips or other technologies. Science fiction writers envision even more extreme forms such as chips that can set emotional mind states or interact with body cells eg fighting cancer cells. Also artworks like "Anke" (Hans Op de Beeck) investigate the theme of the enhanced superhuman and the quest for immortality. This trend (in particular cognitive enhancement) could change the way we work, we think or how we communicate.

Source: Several
Impact Level: Widespread

Your Notes
.....
.....
.....





No. 2

Biomimicry new frontiers

Increasingly technologies are inspired by biological functions and solutions. One driver of the new momentum for biomimicry are the advances in simulation and freeform manufacturing (3D printing). Current examples of cutting edge biomimicry innovations include jellyfish inspired locomotion, insect inspired robot design (vision and movement) and research into animal system behavior (eg. ants) that could help us develop the internet – or even understand how cancer spreads. Furthermore, biological principles and characteristics are used for better computing. There are attempts to emulate biological systems in order to enhance computer chip performance or communication processes such as bio-inspired parallel and neuromorph computing. In the 2015 Lift China Conference there was a focus in biomimicry as the next generation sustainability concept.

Source: Several
Impact Level: Mid Range

Your Notes

.....
.....
.....
.....



No. 3

Active audiences

Through the rise of web2.0 the role of media audiences has been shifting from passive observers of distant events to active participants. In many areas “active audiences” are emerging and sometimes gaining substantial influence. Examples are the rise of vloggers, movie fanediting and personal live streaming. New apps like periscope where audiences become active influencers may transform the way we interact and relate to each other.

Source: Several
Impact Level: Local

Your Notes

.....
.....
.....
.....



No. 4

Automation

Automation is fast progressing in ever more domains of human activity (medical research; sewing, software managing processes, trash collection, drone ships, automated hiring; automatic ordering/replenishment; robo journalism; science). This comes with a number of social, economic and ecological consequences. Humanity needs to understand and actively shape this development eg. by controlling the power of algorithms and learning to deal with unexpected events. One of the key challenges will be to build a workable future for all.

Source: Several
Impact Level: Widespread

Your Notes

.....
.....
.....
.....



No. 5

Circular material flows

Circular economy approaches are on the rise. More and more designers adopt “upcycling” approaches and use more second-hand materials. Waste materials will become increasingly valuable as new technologies offer better ways to extract reusable substances like rare metals from discarded products (waste mining). Several examples for circular economy products emerge. At the same time, Europe only correctly recycles 35 percent of its E-Waste – a radical change is needed here. Also, the global plastic production increases rapidly. Plastics and microplastics in the ocean are causing severe problems.

Source: Several
Impact Level: Widespread

Your Notes

.....
.....
.....
.....





No. 10

Postcapitalist economy

Several developments point towards the emergence of new "postcapitalist" economic models with the internet and automation among the driving factors. Sources state that almost unnoticed, in the niches and hollows of the market system, whole swaths of economic life are beginning to move to a different rhythm. Parallel currencies, time banks, cooperatives and self-managed spaces have proliferated, barely noticed by the economics profession, and often as a direct result of the shattering of the old structures in the post-2008 crisis.

Source: Several
Impact Level: Fundamental

Your Notes

.....
.....
.....
.....



No. 11

Food systems

In the near future we have to produce 70% more food than today without harming the environment. Furthermore the decrease in variety in plant and animal based food (eg rice/apples) is making food systems more susceptible to pests and diseases. Globally dependency on grain imports is on the rise. Production of meat and fish is rising steeply. Technical approaches to food production such as smart floating farms, high-tech urban farming (e.g. vertical aquaponic growing system) and artificial food abound. Another angle is the reduction of food waste. At the same time there is a growing threat from foodborne diseases. Research addressing infection or intoxication caused by pathogenic factors entering into human bodies through food is one of the most dynamic fields in agricultural, plant and animal sciences.

Source: Several
Impact Level: Widespread

Your Notes

.....
.....
.....
.....



No. 12

Future of civilization

The future of our civilization could be fundamentally affected by developments in different categories.
1) Change of nature: 6th mass extinction, dying of butterflies and bees, long term ocean transformation, climate change
2) Developments and technologies: rise of the solar age, living below the sea, in space or supported by artificial life support systems for interstellar flights.
3) Mankind: the rising average of age (nearly 100 soon)
4) higher risk of collapse through catastrophic food shortages triggered by a combination of climate change, water scarcity, energy crisis and political instability.
Artwork like David LaChapelle's Utopia: Gas Shell is reflecting on a world where nature reasserts itself in the world.

Source: Several
Impact Level: Future of Civilisation

Your Notes

.....
.....
.....
.....



No. 13

Gendering in research innovation

The awareness for the need for gender specific approaches in research and innovation in domains like health and communication is growing. As an example starting in October, biomedical researchers will have to counterbalance their use of male animals and cells with the equivalent in female biological tissues and test subjects if they want to get funding from the US National Institutes of Health (NIH), the largest source of medical-research funding in the world. This change, NIH researchers announced in Nature today, will help close the sex gap that continues to exist in preclinical research — the research stage in which drugs and medical interventions are tested on animals and biological tissues. Also prostheses that are tailored to women's requirements are being developed.

Source: Several
Impact Level: Local

Your Notes

.....
.....
.....
.....





No. 14

Plant communication

Scientists have discovered that plants have at least 20 different senses used to monitor complex conditions in their environment including humidity, gravity and electromagnetic fields. Moreover, several studies point out that plants weave complex social relations and can communicate with themselves and with animals through diverse means such as electrical signals and even vibrations. Evidence is increasing that the key to plant intelligence is in the complex network of root apices. Some argue that plants' rights should be more considered especially in the midst of the Sixth Mass Extinction.

Source: theguardian, Brilliant Green (Book)
Impact Level: Widespread

No. 15

Human animal relationship

The relationship between animals and human beings is changing. Firstly, there is a kind of technical domestication apparent in developments like remotely controlled bugs (biodrones), fish-guiding robots or genetically altered pets. With science increasingly pointing to animal culture and self awareness there is debate on (human) rights for animals and ever more people adopt vegetarianism and veganism. Furthermore, some people modify their body in order to become like animals.

Source: Several
Impact Level: Mid Range

Your Notes

.....
.....
.....
.....



Your Notes

.....
.....
.....
.....



No. 16

Technological Singularity

The technological singularity is a hypothetical event in which artificial general intelligence would be capable of recursive self-improvement and thereby ultimately surpass human control or understanding. This expectation has long been voiced in Science Fiction but is also expected and discussed by several researchers. More and more such as physicist Stephen Hawkin warn that the development of full artificial intelligence could spell the end of the human race. FET proposals point out that groundwork in fields like ontologies, knowledge representation, computational linguistics and cognitive systems is still necessary.

Source: Several
Impact Level: Future of Civilisation

No. 17

Internet futures

The internet will change, in a technical and in a social way. Some experts expect that smaller and more specific networks with a distributed processing power will emerge such as e.g. "smart-hotspots". Mobile access points will become more important. Google designer Tom Uglow advocates an "Internet in Things": Bringing the internet into "natural, simple" things without screens for the time span of fluid information. In terms of content the rise of non human traffic, trolls and abusive behaviour is raising concerns.

The artwork Biennale.py. (Eva and Franco Mattes) points to the central role of viruses in the future of the internet.

Source: Several
Impact Level: Widespread

Your Notes

.....
.....
.....
.....



Your Notes

.....
.....
.....
.....





No. 18

Machine society

New forms of machine-human-symbiosis emerge on all levels of society from manufacturing to intimate situations. More and more decisions and activities are done by algorithms and machines (hiring, investment, robo-journalism, poetry, recognition and reproduction of facial expressions, identification). Deep learning further extends the range and depth of human machine interactions. This requires collaborative and interdisciplinary research to reap the benefits, prevent failures and chaos and to counteract risks. Issues like trust and responsibility in hybrid human-machine ensembles need to be explored.

Source: Several
Impact Level: Widespread

Your Notes

.....
.....
.....
.....



No. 19

Mobility futures

There is plenty of discussion on disruptive changes in human mobility. The most discussed development is the self-driving vehicle and its interaction with the human. Other emerging concepts are improved solar-powered vehicles, personal balance-vehicles (like segways), vacuum hyperloop-tube for transport and hypersonic-flights. For ships the old approach of wind powering is explored afresh.

Source: Several
Impact Level: Widespread

Your Notes

.....
.....
.....
.....



No. 20

Solar age

Due to the reinforced search for renewable energy sources research in solar energy is highly dynamic. Key topics in the current debate were: New designs and materials for solar cells, solar powered devices and monitoring of favorable conditions for solar panel installation (e.g. in space). Several research fronts in chemistry and material science dealing with solar applications emerged: The Polymer solar cell, the bulk heterojunction polymer solar cells and high performance perovskite-sensitized solar cells. Further hot research topic are more efficient, affordable and benign materials for photoelectrodes and photocatalysts for splitting water (solar fuel, artificial photosynthesis). Finally, social scientists are discussing patterns of life in solar age e.g. new strategies to better use daylight.

Source: Several
Impact Level: Widespread

Your Notes

.....
.....
.....
.....



No. 21

Space exploration

New ideas and developments concerning outer space abound: life support space suits, space mining concepts, future space shuttle designs with a biosphere on it, outer space villages or nanosats which observe earth from space and an inflatable space elevator. Space related topics are one of the most popular domains on Kickstarter.

Source: Several
Impact Level: Local

Your Notes

.....
.....
.....
.....





No. 22

Synthetic food

In the face of a looming food crisis artificial substitutes are developed such as a food powder that provides 100% of an adult's daily nutrients. Some experts expect that within 10 years synthetic biology will be able to produce different kinds of food, including meat and drinks at lower costs than today. By manipulating genes, brand-new foods can be created with new properties or flavours. Agricultural biofactories which use glass or plastic vats (bioreactors), and needs only sun or sugar, algae and nutrients, can be located anywhere.

Source: Several
Impact Level: Local

Your Notes
.....
.....
.....



No. 23

Understanding and influencing human behavior

Several researchers across disciplines are investigating ways to understand and influence human thinking and behavior; The field is highly interdisciplinary ranging from AI, NPL, data analytics, game design and neuroscience to sociology, education and economics. Computational neuroscience in particular aims for a better understanding of the human brain and cognition.

Source: Several
Impact Level: Widespread

Your Notes
.....
.....
.....



No. 24

Underwater

Several underwater operations are researched and developed. Key issues are underwater: - gardening, - living, - (mini)robots, - cities, - streetview, - radio (graphene), - chemical plants, - charging, - flight, - volcanoes, - farms, - archaeology, - screening radar, - energy (wave/wind farms) and materials.

Source: Several
Impact Level: Mid Range

Your Notes
.....
.....
.....



No. 25

Mixed realities

Technologies enabling us to experience augmented or virtual reality are fast emerging and enthusiastically discussed and adopted by many e.g. on the Kickstarter crowdfunding platform. Virtualization techniques such as 360°videos and wearable computing devices that capture the details of everyday life are expected to jointly create a new wave of social technology. E.g. the Oculus Rift already allows users to virtually explore real environments from the perspective of a child. Developments like the personal headphones that filter out unwanted noise point to a world where "reality will be in the eye (and ear) of the beholder" (IFTF). Science fiction novels envisage nano-cells on the skin that simulate an environment for the body that can be felt, heard and seen. Some observers point out several remaining challenges and even dangers.

Source: Several
Impact Level: Widespread

Your Notes
.....
.....
.....





No. 26

Robot reasoning

A new generation of robots with cognitive planning and reasoning capabilities is being developed. They can handle uncertainty, act in messy unpredictable situations and carry out creative tasks like participating in a cartoon contest. Furthermore some researchers focus on a kind of artificial consciousness and self awareness – a concept that is highly contested eg by some philosophers.

Source: Several
Impact Level: Mid Range

Your Notes
.....
.....
.....



No. 27

Forest health

Forests and woodlands cover about 20% of Earth's land surface, and only a small fraction is undisturbed by humans. There is a need for a "future health care plan". Forests still have an important function in the future, sustaining wildlife, producing timber, sequestering carbon, and performing other services. Tree mortality attributed to drought and heat stress has become a hot topic in environmental science. Studies suggest that at least some of the world's forested ecosystems already may be responding to climate change and raise concern that forests may become increasingly vulnerable.

Source: Several
Impact Level: Mid Range

Your Notes
.....
.....
.....



No. 28

Brain networking

For the first time scientists have been linking together animal brains with electrodes. University of Washington researchers recently used a direct brain-to-brain connection to enable pairs of participants to play a question-and-answer game by transmitting signals from one brain to the other over the Internet. Some believe that one day humans will be able to directly share emotions, thoughts, and sensory feedback with each other through synthetic telepathy.

Source: Several
Impact Level: Widespread

Your Notes
.....
.....
.....



No. 29

Sustainable Housing

Advanced concepts of sustainable and practicable housing are fast emerging. Especially themes like natural materials, zero impact living, safety, movability, environmental fitting, gentrification and social housing are addressed by highly interdisciplinary teams of developers. Examples are the "Energy Positive" house in Wales, sustainer homes and urban campsite in Amsterdam, the future box in Berlin, the Ultra Light Construction Systems developed by MIT POPlab, the movable skip-garden in London and efforts in Indonesia towards buildings that withstand natural disasters.

Source: Several
Impact Level: Local

Your Notes
.....
.....
.....





No. 1

Prevent/repair heart attack

Heart disease is the leading cause of death across the globe. Research is underway for preventing or repairing heart-attacks with new technologies like biodegradable microstructures to repair heart tissue and injection of exosomes from stem cells to induce self-repair.

Source: Science Daily, Gizmag
Impact Level: Local

Your Notes

.....
.....
.....
.....



2016



No. 2

Yeast that makes opiate-like molecules out of sugar

A strain of yeast engineered in a lab was able to transform sugar into a pain-killing drug – called hydrocodone – for the first time. And a second strain was able to produce thebaine, an opiate precursor that drug companies use to make oxycodone. The findings, published in Science, could completely change the way drug companies make pain-relieving medicine. Unfortunately, it may also open the door to less positive outcomes, like “home-brewed” heroin.

Source: The Verge
Impact Level: Local

Your Notes

.....
.....
.....
.....



2016



No. 3

Antibacterial bio-microfilm

Infections from medical implants are rare but they can still occur. To guard against this infection risk, scientists have developed a thin, silver-coated biofilm to prevent bacteria adhering and surviving on the device. Silver has good antibacterial and antifungal properties. As well as silver, antimicrobial peptides, including catestatin, are included within the chemical matrix. The findings are published in the journal Advanced Healthcare Materials. Practical applications are expected in a couple of years.

Source: Trends der Zukunft
Impact Level: Mid Range

Your Notes

.....
.....
.....
.....



2016



No. 4

Brain cell transplantation

Lorenz Studer, Director of Memorial Sloan-Kettering Cancer Center’s Center for Stem Cell Biology and new MacArthur Foundation “genius” grant recipient is exploring transplantation of cells generated from embryonic and induced pluripotent stem cells to heal e.g. Parkinson’s disease.

Source: Washington Post
Impact Level: Local

Your Notes

.....
.....
.....
.....



2016



No. 5

Nano needles in regenerative medicine

In a trial with mice described in Nature Materials nano needles prompted parts of the body to generate new blood vessels. The idea is to help damaged organs and nerves repair themselves and help transplanted organs thrive. The nanoneedles are tiny porous structures that act as a sponge to load significantly more nucleic acids than solid structures. This makes them more effective at delivering their payload. They can penetrate the cell, bypassing its outer membrane, to deliver nucleic acids without harming or killing the cell. The nanoneedles are made from biodegradable silicon, meaning that they can be left in the body without leaving a toxic residue behind. The silicon degrades in about two days, leaving behind only a negligible amount of a harmless substance.

Source: Kurzweil Accelerating Intelligence
Impact Level: Local

Your Notes
.....
.....
.....
.....
.....



No. 6

Water based nano bacteria shields

Water particles could provide a powerful airborne shield against bacteria (including antibiotics resistant ones). Recent research showed that water-based "nano droplets" carrying reactive oxygen species can decimate bacteria on surfaces, reducing them by a factor of between ten and nearly 100.

Source: The Economist Technology Quarterly
Impact Level: Local

Your Notes
.....
.....
.....
.....
.....



No. 7

Organic flow batteries

Research has shown the possibility of a new type of flow battery resting on organic molecules (quinones). This may revolutionize battery technology and form the missing piece of the renewable energy jigsaw.

Source: The Economist Technology Quarterly
Impact Level: Mid Range

Your Notes
.....
.....
.....
.....
.....



No. 8

Bioprinting

Recent advances have enabled 3D printing of biocompatible materials, cells and supporting components into complex 3D functional living tissues. Addressing the complexities of bio-printing requires the integration of technologies from the fields of engineering, biomaterials science, cell biology, physics and medicine. A long term vision is the printing of human organs suitable for transplantation.

Source: The Economist Technology Quarterly
Impact Level: Local

Your Notes
.....
.....
.....
.....
.....





No. 9

New methods for drug delivery inside the body

New ways to deliver drugs inside the body are being researched:
- Capsuled microneedle patches travel to the intestines via the stomach.
- Selfrepairing hydrogel carrying drugs can be injected through needles.
- From fine coils of silicone tubes inserted into the body drugs are forced out through osmosis.

Source: The Economist Technology Quarterly
Impact Level: Local

Your Notes
.....
.....
.....
.....



No. 10

Decline of microscopic plant-life in oceans

The world's oceans have seen significant declines in certain types of microscopic plant-life at the base of the marine food chain, according to a new NASA study. The research, published in Global Biogeochemical Cycles, a journal of the American Geophysical Union, is the first to look at global, long-term phytoplankton community trends based on a model driven by NASA satellite data.

Source: Science Daily/NASA/Goddard Space Flight Center
Impact Level: Widespread

Your Notes
.....
.....
.....
.....



No. 11

Spontaneous regression

After a few cases of unexpected regression of tumors scientists are looking to the underlying biology of so-called "spontaneous regression" to hunt for clues that could make these rare cases of self-healing more common. One line of research for replicate spontaneous remission in a cure is infecting patients with dengue fever.

Source: BBC Futures
Impact Level: Mid Range

Your Notes
.....
.....
.....
.....



No. 12

Post antibiotics

Infections that are resistant to antibiotics and other antimicrobial medicines are increasing fast due to the massive use of such medicines not only for humans but also for livestock. The malaria parasite for instance has a new resistance to the malaria-drug spreading over South and East Asia. Bacteria that are immune to antibiotics might actually be deadlier than bacteria that aren't. This is posing many threats such as increasing risk of infection after operations. Some actors are already wondering how post antibiotic societies may look like.

Source: Nesta infectious futures and several
Impact Level: Widespread

Your Notes
.....
.....
.....
.....





No. 13

Emerging research front: Control and treatment of schistosomiasis in Africa using the drug praziquantel

Schistosomiasis is a chronic parasitic disease caused by bilharzia fluke of genus Schistosoma, which is prevalent in tropical and subtropical areas with poor sanitation, especially in Asia, Africa, and Latin America. Studies address treatment mainly of African children with the drug praziquantel.

Source: Research Fronts 2014
Impact Level: Local

Your Notes

.....
.....
.....
.....



2016



No. 14

Water challenge

Water and especially clean water is becoming a scarce resource in ever more areas as climate change threatens water security. We need global strategies to prevent this or deal with it. Water was one of the most addressed topic in 2015 tweets. Issues were water: – generation, – cleaning, – recycling, – pollution, – splitting, – based energy generation, – saving and – quality monitoring as well as measures dealing with droughts. Ways of measuring the quality of oceans, coastal and transitional waters is becoming an important topic in ecology. The utilization of aquatic biological communities to assess the ecological status of European surface waters is emerging as a research front. Artists such as Maarten Vanden Eynde (plastic reef) point towards the rise of plastic debris in the ocean – a topic that was also highly prominent in the webmining.

Source: Several
Impact Level: Widespread

Your Notes

.....
.....
.....
.....



2016



No. 15

Research front: Models for predicting potential distributions of species

Species distribution models (SDMs) that help to estimate the development of ecological niches of species and their preference for habitats are an increasingly hot research area in environmental science with many practical application.

Source: Research Fronts 2014
Impact Level: Mid Range

Your Notes

.....
.....
.....
.....



2016



No. 16

Research front: Atmospheric aerosol nucleation and growth

The formation and growth of new atmospheric aerosol particles has become an important research area in geosciences in recent years.

Source: Research Fronts 2014
Impact Level: Local

Your Notes

.....
.....
.....
.....



2016



No. 17

Research front: Newly emerging psychoactive substances (new designer drugs)

New psychoactive substances (new designer drugs) such as herbal marijuana alternatives, like K2 or Spice and synthetic cathionones ("bath salts") have been emerging in many countries. These drugs often have adverse effects, which range from minimal to life-threatening that are little known by health care providers and the public. In biological sciences the investigation of these substances in particular their effects and detection methods has become a hot research front.

Source: Research Fronts 2014
Impact Level: Mid Range

Your Notes

.....

.....

.....



2016



No. 18

Research front: Human disease analysis using Genome Wide Association studies

Genome Wide Association Studies (GWAS) apply genetic statistics to analyze human diseases. Further developing these methods including analytic tools and software has become an important research front in the biological sciences.

Source: Research Fronts 2014
Impact Level: Widespread

Your Notes

.....

.....

.....



2016



No. 19

Research front: Electrode materials for sodium-ion batteries

In chemistry and material sciences interest has soared in electrode materials for batteries to enable new qualities such as longer life and cost effectiveness.

Source: Research Fronts 2014
Impact Level: Mid Range

Your Notes

.....

.....

.....



2016



No. 20

Research front: Functional metal organic frameworks

Metal-organic frameworks (MOFs) are one type of solid porous materials formed by the selfassembly of metal ions or ion clusters and organic ligand complexes. MOFs have the merits of a rich composition and structure, a large specific surface area, adjustable pore sizes, and a modifiable skeleton. MOFs have been widely applied to multiple aspects of absorption and separation, hydrogen storage, chemical sensors, fluorescence, catalysis, and biological medicine. Currently, more than 6,000 new structures are reported every year. MOFs have become a hot research front in the field of chemistry.

Source: Research Fronts 2014
Impact Level: Mid Range

Your Notes

.....

.....

.....



2016



No. 21

Research front: Graphene-based photocatalysts

Graphene-based photocatalysts have been attracting ever-increasing research attention in chemistry and material science. Applications of GR-based nanocomposites in photocatalysis, range from degradation of pollutants, selective transformations for organic synthesis and water splitting to clean hydrogen energy by converting solar energy into chemical energy.

Source: Research Fronts 2014
Impact Level: Mid Range

Your Notes

.....

.....



2016



No. 22

Emerging research front: Supercapacitors based on nanoporous carbon electrodes

Supercapacitors are electricity storage systems with high power performances. Lightweight, low-cost supercapacitors with the capability of rapidly storing a large amount of electrical energy can contribute to meeting continuous energy demands and effectively leveling the cyclic nature of renewable energy sources. The excellent electrochemical performance of supercapacitors is due to a reversible ion adsorption in porous carbon electrodes. Studies strive to understand the molecular dynamics of such electrodes. Supercapacitors and other energy storing materials were also a prominent topic in the webmining.

Source: Research Fronts 2014
Impact Level: Mid Range

Your Notes

.....

.....



2016



No. 23

Emerging research front: Enhanced Visible Light photocatalysts

Photocatalysis is a science of employing catalyst that is utilized for speeding up a chemical reaction that requires or engages light. A photocatalyst is defined as a material that is capable of absorbing light, producing electron-hole pairs that enable chemical transformations of the reaction participants and regenerate its chemical composition after each cycle of such interactions. Papers in this field investigate ways to enhance photocatalysts that work in visible light.

Source: Research Fronts 2014
Impact Level: Mid Range

Your Notes

.....

.....



2016



No. 24

Effects of climate change

The dynamics and effects of climate change are still not well understood. While some threats such as rising sea levels are already widely discussed, other aspects like rise of wildfires, superstorms and effects on forests and soil bacteria are less explored. Researchers worldwide point to the increasing likelihood of yet unknown catastrophic events and recommend acting now. The following research fronts emerged in this context:

- Effects of ocean acidification on marine ecosystems
- Greenland ice sheet dynamics
- Global sea level change
- Regional climate models
- Model analysis of non-CO₂ greenhouse gases

Source: Several

Impact Level: Widespread

Your Notes

.....

.....



2016



No. 1

Global Challenge: Global ethics

Global challenge: How can ethical considerations become more routinely incorporated into global decisions? Unethical decisions (like economical ones) are mostly independent from ethics. Collective responsibility for global ethics issues like waste handling is needed. As an example Demos Helsinki has identified 10 principles to guide development towards a hyper-connected, sustainable planet.

Source: Our State of the Future, World United Nations University, Demos Helsinki
Impact Level: Future of Civilisation

Your Notes

.....
.....
.....
.....



No. 2

Global Challenge: Sustainable Energy Provision

Meeting global energy demands safely and efficiently while respecting the limits of the earth's carrying capacity is one of the most pressing challenges of our times. Renewable sources and innovative ways to produce energy are essential to reduce related CO2 emissions.

Source: State of the Future
Impact Level: Widespread

Your Notes

.....
.....
.....
.....



No. 3

Global Challenge: Transnational organized crime

Global challenge: Problems of organized crime show themselves in many views: drugs (trade), trafficking, corruption, cyber-criminality. The total organized crime income could be over \$3 trillion. We need global strategies!

Source: State of the Future
Impact Level: Widespread

Your Notes

.....
.....
.....
.....



No. 4

Global Challenge: Education and learning

There are a lot of research projects to understand the brain: brain diseases, enhancement, computer designs, new brain-computer synergies. These outcomes should be included in education and learning.

Source: State of the Future
Impact Level: Widespread

Your Notes

.....
.....
.....
.....





No. 5

Global Challenge: Global foresight/decision making

Global challenge: Decision makers need tools to analyze, synthesize, and make good decisions. We need collective intelligence systems, that we may know, what is truly significant and to create synergies among brains, software, and information for securing agreement to make necessary changes.

Source: State of the Future
Impact Level: Widespread

Your Notes
.....
.....
.....
.....



No. 6

Noise pollution in sea threatens whales

Michel Andre says the noise of ships can be more than annoying to whales – it can be deadly. The amount of noise can desensitize the whales over time, making them more likely to swim into the path of a ship – with possibly fatal results.

Source: BBC Futures
Impact Level: Local

Your Notes
.....
.....
.....
.....



No. 7

Data vs. Intuition?

With ever more data available the question arises how to strike the right balance between data and intuition in decision-making. Data seems the way to go; but data can only go so far. Data-driven decision-making relies on intuitions about what to measure and why; it tends to overweight things because they are measurable; and data sees only the past, the future involves guesswork.

Source: Intelligent Life
Impact Level: Widespread

Your Notes
.....
.....
.....
.....



No. 8

Universal software bug

Integer overflow, essentially meaning that numbers are too big to be stored in a computer system, can cause severe malfunction such as in the case of the failed Ariadne 5 rocket launch. This problem is often neglected by programmers.

Source: BBC Futures
Impact Level: Mid Range

Your Notes
.....
.....
.....
.....





No. 9

Threat of "space weather"

The threat of space weather is more and more important because our life has a strong dependence on satellites. The UK government has developed a Space Weather Preparedness Strategy. Understanding of the mechanisms at play is still poor.

Source: DEEPSTUFF.ORG
Impact Level: Widespread

Your Notes

Four horizontal dotted lines for taking notes.



2016



No. 10

Decline in solar activity by 2030

A new model of the Sun's solar cycle is producing unprecedentedly accurate predictions of irregularities within the Sun's 11-year heart-beat. The model draws on dynamo effects in two layers of the Sun, one close to the surface and one deep within its convection zone. Predictions from the model suggest that solar activity will fall by 60 per cent during the 2030s to conditions last seen during the 'mini ice age' that began in 1645.

Source: Science Daily/Royal Astronomical Society
Impact Level: Future of Civilisation

Your Notes

Four horizontal dotted lines for taking notes.



2016



No. 11

Spectrum overcrowding

Several experts warn that our hunger for wireless data is threatening to crash our communication networks. Many governments are looking for ways to alleviate the problem before the wireless signal to our electronic devices starts failing.

Source: BBC Futures
Impact Level: Mid Range

Your Notes

Four horizontal dotted lines for taking notes.



2016



No. 12

Mental illness controversy

Some critics argue that the upsurge in mental disorder is pushed by pharmaceutical industry. Meanwhile the real underlying causes of behavioural problems and human misery are often left untreated. Others argue that human suffering will never be eradicated but evidence shows that pharmaceutical drugs have improved the lives of millions around the world.

Source: Intelligencesquared
Impact Level: Widespread

Your Notes

Four horizontal dotted lines for taking notes.



2016



No. 13

Pandemics strategy urgently needed

According to Nathan Myhrvold at Bill Gates Global Good Lab, strategies for pandemics are lacking globally. The lab is working on some aspects of this such as effective protection suits.

Source: Intelligent Life
Impact Level: Widespread

No. 14

Particle pollution may be the main cause for brain degenerative diseases

Scientists have collected evidence that particle pollution may be the main cause for brain degenerative diseases. A recent study in the peer-reviewed journal Environmental Health and Technology estimated that we could avoid two million deaths globally by cleaning up the world's air.

Source: Mother Jones
Impact Level: Widespread

Your Notes

.....
.....
.....
.....



2016

Your Notes

.....
.....
.....
.....



2016



No. 1

Reversible heat pump for energy storage

A reversible heat pump promises a cheap way to store renewable energy on the grid. The pump consists of two silos filled with gravel connected with argon filled pipes.

Source: The Economist Technology Quarterly
Impact Level: Local

No. 2

Decentralisation of energy supply

Big utility companies are finding that small, local solutions might be the future of energy. Through small investments in GSEP (Global Sustainable Electricity Partnership) projects, these high-voltage utilities are experimenting with generating energy from renewable feed stocks available locally, such as biogas, hybrid wind-diesel micro-grids, solar powered water pumps, mini hydro power.

Source: FastCoexist
Impact Level: Widespread

Your Notes

.....
.....
.....
.....



2016

Your Notes

.....
.....
.....
.....



2016



No. 3

Electric bio rocks save coral reefs

Electrically charged steel shapes have been implemented in Indonesia to evoke growth of coral reefs. Biorock technology was originally developed by marine scientists Thomas Goreau and Wolf Hilbertz. A low-voltage direct current is run through the steel. This electricity interacts with the minerals in the seawater and causes solid limestone to grow on the structure. It draws on the principles of electrolysis, where the electric current causes a chemical reaction to occur which wouldn't have otherwise.

Source: BBC Futures
Impact Level: Local

Your Notes
.....
.....
.....



No. 4

Energy from oxidation in human bodies

In this novel smart-cells exist which supply themselves with energy from a oxidation-process via ATP-molecules (Adenosintriphosphat).

Source: Der unsichtbare Killer (Science Fiction Novel)
Impact Level: Local

Your Notes
.....
.....
.....



No. 5

3D printed emergency shelter

This novel describes an igloo-like emergency shelter made of hexagonal components through 3D printing.

Source: Der unsichtbare Killer (Science Fiction Novel)
Impact Level: Local

Your Notes
.....
.....
.....



No. 7

Carbon nanofibres made from CO₂ in the air

Scientists in the US have found a way to take carbon dioxide (CO₂) from the air and make carbon nanofibres. The team says it can be "scaled up" and could have an impact on CO₂ emissions, but other researchers are unsure. The basic idea of "harvesting" materials from the air has also been brought forward in science fiction.

Source: Motherboard
Impact Level: Mid Range

Your Notes
.....
.....
.....





No. 8

Quantum computing challenges cryptography

The US National Security Agency announced it would be abandoning the cryptography algorithms it has used since 2005 for fear of the coming quantum computing revolution. "Our ultimate goal is to provide cost effective security against a potential quantum computer," the agency wrote on its website.

Source: Motherboard
Impact Level: Widespread

Your Notes
.....
.....
.....



2016



No. 9

Extraordinary advances in facial recognition cause huge privacy issues

Extraordinary advances in facial recognition raise severe privacy concerns. Privacy activists mass-quit U.S. government committee on facial recognition privacy.

Source: The Intercept Blog Unofficial Sources
Impact Level: Widespread

Your Notes
.....
.....
.....



2016



No. 10

Fast HIV detection

Current methods for detecting the antibodies that indicate HIV infection are agonizingly slow and cumbersome. However a new DNA nanomachine developed by an international team of researchers (and funded, in part, by the Bill & Melinda Gates Foundation) could shorten the process to a matter of minutes.

The machine is designed and synthesized to recognize and bind with a specific target antibody, even within biologically-dense and complex samples like blood. When these "machines" do bind with the target antibody, the joining causes a structural change that generates a little burst of light. A test that used to require hours of careful, complex and expensive prep-work could now take as little as five minutes. What's more, these nanomachines can easily be customized to detect a wide variety of antibodies.

Source: Wired
Impact Level: Local

Your Notes
.....
.....
.....



2016



No. 11

Enhanced bloodtest functionality

Several tweets captured in the webimining addressed the growing use of bloodtests with fast DNA sequencing for disease detection (Liquid Biopsy). Specifically for the detection of cancer and brain diseases breakthroughs were reported.

Source: Several
Impact Level: Local

Your Notes
.....
.....
.....



2016



No. 12

Privacy preserving technologies

There may be a huge emerging demand for products such as the Indie Phone that are explicitly designed to preserve privacy. Key concepts are homomorphic encryption and differential privacy.

Source: The Economist Technology Quarterly
Impact Level: Widespread

Your Notes

.....

.....

.....



2016



No. 13

Personal Heating

One way to keep warm is to heat people rather than expending energy heating the empty buildings. Several systems are possible.

Source: The Economist Technology Quarterly
Impact Level: Local

Your Notes

.....

.....

.....



2016



No. 14

Optical implants

Ideas about optical implants emerge in science-fiction. Nervecell-prosthetics which translate a digital optical input in biological data or implants which replaces organs are thinkable. Furthermore there could be laser-implants transmitting additive information direct to the visual nerve via a laser-stimulus.

Source: Die eiserne Karawane, Replay (Books)
Impact Level: Mid Range

Your Notes

.....

.....

.....



2016



No. 15

Unconventional energy sources

A lot of new unconventional technologies and ideas to extract and produce energy emerge: Wind-turbines under bridges, geothermal energy (eg from volcanoes), shock-absorber, biomechanical-energy, underwater wind farms, energy from temperature differences in water or from salt content (blue energy), a lamp that gets its energy from a gravity mechanism, tidal energy, wave energy, energy from algae, energy from waste/ sewage (through graphene seebeck effect), ocean thermal energy conversion, energy from spores, energy from dry ice/sublimation heat engine, energy from vakuum, energy from space, energy kites, energy from electromagnetic waves (through metamaterials), copying energy strategies from animals (dark eaters), nuclear fusion (new designs), energy from surface tension.

Source: Several
Impact Level: Widespread

Your Notes

.....

.....

.....



2016



No. 1

Emerging research front: Analysis of dynamic and static behavior of functionally graded material

Functionally graded material is a new type of non-uniform composite material. In this type of material, the abrupt interfaces of traditional composite materials are replaced by a continuous gradient of a changing material component. Studies in this emerging research front develop analytical and numerical methods to investigate static and dynamic behavior of these materials.

Source: Research Fronts 2014
Impact Level: Mid Range

Your Notes

.....



2016



No. 2

Synthetic DNA

After decades of research, organic chemists succeeded in synthesizing artificially enhanced DNA with two synthetic nucleotides called P and Z. The new nucleotides even outperform their natural counterparts. When challenged to evolve a segment that selectively binds to cancer cells, sequences using P and Z did better than those without. Biotechnology company Synthorx has taken the next step towards creating truly synthetic life. A team of scientists successfully incorporated two synthetic nucleotide bases into the DNA sequence of a strain of E.coli bacteria.

Source: Wired
Impact Level: Widespread

Your Notes

.....



2016



No. 3

Quantum squeezing

As described in a paper in Science, researchers at the California Institute of Technology have come up with a way of observing and even controlling quantum motion by cooling a small (but not quantum-small) device to a temperature of almost absolute zero (or as absolute zero as it gets), the point at which the only remaining forces come from quantum fluctuations.

Source: Motherboard
Impact Level: Local

Your Notes

.....



2016



No. 4

Molecular communication

Use of molecules for communication has been successfully applied by scientists in a very basic setting using a battery-powered liquid sprayer. This could be useful for cases where electronic transmission fails (eg communication between robots in disaster recovery or in-body communication).

Source: The Economist Technology Quarterly
Impact Level: Local

Your Notes

.....



2016



No. 5

Physicists set a new fiber-optic quantum teleportation record

Researchers at the National Institute of Standards and Technology (NIST) have bested the previous quantum teleportation fiber-optic distance record four times over, achieving a span of 100 kilometers. While physicists have teleported over farther distances in free space—via open-air laser beams, that is—the ability to transmit information across vast spans using fiber-optic cabling offers a new degree of practicality to quantum-based networking eg for distributing keys in future quantum encryption schemes. The accomplishment is described in the current issue of Optica.

Source: Motherboard
Impact Level: Local

Your Notes

.....
.....
.....
.....
.....



2016



No. 6

Timekeeping mechanism of human brain uncovered

A group of neuroscientists from MIT and Columbia University may have the beginning of an answer on how the human brain keeps time. In a paper published this week in Current Biology, they describe how the lateral intraparietal cortex (LIP) region of the brain helps it to both interpret and reproduce time intervals, e.g. keep the beat, as it were.

Source: Motherboard/Current Biology
Impact Level: Local

Your Notes

.....
.....
.....
.....
.....



2016



No. 7

Microbiomes

Microbiomes have become the focus of intense study and public interest. The trillions of microbes that live inside the human body play important roles in health, from fighting diseases to maintaining a balanced immune system. The White House is considering increasing ist support of research into the workings of these microbial communities.

Source: The New York Times
Impact Level: Mid Range

Your Notes

.....
.....
.....
.....
.....



2016



No. 8

Emerging research front: CRISPR/CAS Genome-editing technology

The CRISPR/CAS Genome-editing technology is considered to have great potential due to its many advantages to previous methods. It has been successfully applied to many studies of plant and animal behavior. Since 2013 this field has become extermely active very fast.

Source: Research Fronts 2014
Impact Level: Widespread

Your Notes

.....
.....
.....
.....
.....



2016



No. 13

Emerging research front: Synthesis of functional gold nanorods

Gold nanorods have received much attention due to their unique optical and electronic properties which are dependent on their shape, size, and aspect ratio. Studies in this emerging research front of materials science look at the synthesis of these materials.

Source: Research Fronts 2014
Impact Level: Mid Range

Your Notes

.....

.....

.....

.....

.....

.....



2016



No. 14

Emerging research front: Metal organic materials with optimal adsorption thermodynamics and kinetics for CO₂ separation

The energy costs associated with the separation and purification of industrial commodities, such as gases, fine chemicals and fresh water, currently represent around 15 per cent of global energy production, and the demand for such commodities is projected to triple by 2050. The challenge of developing effective separation and purification technologies that have much smaller energy footprints is greater for carbon dioxide (CO₂) than for other gases; Papers in this emerging research front investigate the optimization of metal organic materials for this purpose.

Source: Research Fronts 2014
Impact Level: Mid Range

Your Notes

.....

.....

.....

.....

.....

.....



2016



No. 15

Emerging research front: Synthesis of copolymers by direct arylation polycondensation

Copolymers are promising as basis for organic semiconductors with favourable characteristics e.g. for solar cells light-emitting diodes and transistors, sensors, and displays. Direct arylation represents an economically attractive and ecologically benign alternative to the traditional methodologies for synthesizing these polymers.

Source: Research Fronts 2014
Impact Level: Mid Range

Your Notes

.....

.....

.....

.....

.....

.....



2016



No. 16

Emerging research front: Magnetically retrievable nanocatalysts

The concept of "Green Chemistry" has emerged as one of the guiding principles of environmentally benign synthesis. The preparation and the use of nanoparticles (NPs) in organic synthesis has become a subject of intense investigation, in particular, magnetic nanoparticles (MNPs) which offer advantages in clean and sustainable chemistry as they can be non-toxic, readily accessible, and retrievable. Additionally, the activity and selectivity of magnetic nano-catalysts can be manipulated by their surface modification.

Source: Research Fronts 2014
Impact Level: Mid Range

Your Notes

.....

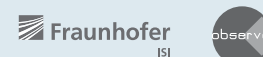
.....

.....

.....

.....

.....



2016



No. 17

Emerging research front: Photoinitiated polymerization and Photoinitiators

Much progress has been made in the past 10 years in the preparation of complex and nano-structured macromolecules by using photo-initiated polymerizations. A number of applications emerge in the field of biomaterials, surface modification, preparation of block and graft copolymers, and nanocomposites.

Source: Research Fronts 2014
Impact Level: Mid Range

Your Notes

.....



2016



No. 18

Bioinformatics

Bioinformatics is an interdisciplinary field that develops methods and software tools for understanding biological data, especially in genetics and genomics. Common uses of bioinformatics include the identification of candidate genes and nucleotides which aims at a better understanding of the genetic basis of disease, unique adaptations, desirable properties (esp. in agricultural species), or differences between populations. Bioinformatics contributes to advances in synthetic biology biomimetics, supramolecular chemistry and other subfields. As such, researchers expect bioinformatics to provide major tools and methods to solve basic questions of biology and genetics. Using bioinformatics for prediction of protein structure and nucleosome positioning is emerging as a research front in the biological sciences.

Source: Several
Impact Level: Widespread

Your Notes

.....



2016



No. 19

Brain understanding

The webmining revealed a number of research insights on the way the brain works emerging in 2015. A particular focus was on memory but also on spatial mapping, timing, vision, decision making, emotional experience assignment, social prediction, hearing, tinnitus, pattern recognition and aging.

Source: Several
Impact Level: Widespread

Your Notes

.....



2016



No. 20

Nanolattices

Strong, lightweight, and recoverable three-dimensional ceramic nanolattices are being developed at the University of Cambridge. Some expect that these materials could revolutionise a wide number of applications from battery electrodes to growing bones. The bottleneck is the large scale production of the material.

Source: MIT EmTech 2015
Impact Level: Mid Range

Your Notes

.....



2016



No. 21

Research front: Synthesis and application of graphene quantum dots

Graphene quantum dots (GQDs) represent single-layer to tens of layers of graphene of a size less than 30 nm. Due to exceptional properties such as low toxicity, stable photoluminescence, chemical stability and pronounced quantum confinement effect, GQDs are considered as a novel material for biological, opto-electronics, energy and environmental applications (Wikipedia). GQD synthesis and application has received strong attention in materials science and chemistry.

Source: Research Fronts 2014
Impact Level: Mid Range

Your Notes

.....
.....
.....
.....
.....



2016



No. 1

Cycling Futures

The bicycle is emerging as a central component of urban and avantgarde lifestyles. Several of the most advanced concepts in city planning and mobility are centering on the bicycle. Highly interdisciplinary research is exploring ways to establish cycling centred city transport systems.

Source: Monocle
Impact Level: Mid Range

Your Notes

.....
.....
.....
.....
.....



2016



No. 2

Time as money

Artist Gustavo Romano carried out a series of actions in public spaces utilizing a monetary system based on units of time (Spot#1. Lost time refunded, Spot#4 Buying time, Time Notes). Offices and other performances have been set up in many cities of Europe, America and Asia. The actions refer to different local and global issues: the exchange systems, the over-employment and unemployment, the increasing virtualization of the economy, and the existential relationship of the human being with his own lifetime.

Source: Exhibition: A brief history of the future
Impact Level: Future of Civilisation

Your Notes

.....
.....
.....
.....
.....



2016



No. 3

From design inspired by nature towards nature inspired by design

Designer and architect Neri Oxman (MIT Media Lab) is leading the search for ways in which digital fabrication technologies can interact with the biological world. Working at the intersection of computational design, additive manufacturing, materials engineering and synthetic biology, her lab is pioneering a new age of symbiosis between microorganisms, our bodies, our products and even our buildings.

In one of her recent works a pavillion of several meters extension was created by 6500 silkworms. The silkworms were stimulated to spin biological silk on a predesigned silk-structure produced by robots. The boundaries between design inspired by nature and nature inspired by design are blurring when biological processes are exploited to produce a designed nature.

Source: TED
Impact Level: Mid Range

Your Notes

.....
.....
.....
.....
.....



2016



No. 4

Compressed conversation

Some researchers expect that digital communication will change the nature of our language so eg the use of irony and sarcasm is on the rise as people try to get across more meaning in less words (eg in twitter). Emojis are increasingly used in digital conversations.

Source: Several
Impact Level: Local

Your Notes
.....
.....
.....



No. 5

Scientists share their embarrassing #fieldworkfail stories

When scientists step out of the lab, things don't always go to plan. Researchers share their most embarrassing #fieldworkfail stories on Twitter.

Source: The Guardian
Impact Level: Local

Your Notes
.....
.....
.....



No. 6

Cognitive overburden through perpetual evaluation

Much of today's software casts the user in a role of perpetual evaluation from which it's relatively easy to escape (with one or two clicks) but impossible to reject all together. This may be a taste of what seems likely to become a potentially overwhelming routine feature of daily life in the near future. Each individual act of evaluation is trivial but the aggregative cognitive burden likely isn't.

Source: The Sociological Imagination
Impact Level: Widespread

Your Notes
.....
.....
.....



No. 1

Bugs not drugs

Increased understanding of the microbiome-the community of microorganisms in our bodies-is challenging our long-running obsession with antibacterial measures. New approaches to staying healthy will be based on balancing the ecologies of microorganisms: think "bugs, not drugs." Indiegogo-funded uBiome is already helping people better understand their germs by sequencing the bacteria in their bodies.

Source: Institute For The Future IFTF
Impact Level: Widespread

Your Notes
.....
.....
.....





No. 2

Treating phantom pain with a mirror

Mirror therapy helps to cure phantom pain of amputees. It works by providing visual feedback to the brain about a functional arm rather than a missing limb, and this changes the central maladaptive reorganisation back to normal. In neuroscience the phenomenon is little understood.

Source: BBC Futures
Impact Level: Local

No. 3

Freakthinking

The books Freakonomics and SuperFreakonomics have been worldwide sensations, selling tens of millions of copies. They have come to stand for challenging conventional wisdom using data rather than emotion. Questions they examine are typically: Which is more dangerous, a gun or a swimming pool? How much do parents really matter? Why is chemotherapy prescribed so often if it's so ineffective? (authors, Steven D. Levitt and Stephen J. Dubner)

Source: Intelligencesquared
Impact Level: Widespread

Your Notes
.....
.....
.....



2016

Your Notes
.....
.....
.....



2016



No. 1

Wooden material on the rise

Wood as a renewable resource becomes a more and more popular eco-friendly material to build things and houses. Cross-laminated timber is increasingly used also for taller buildings thus reducing the use of concrete with its high share in greenhouse-gas emissions.

Source: Several
Impact Level: Local

No. 2

Modeling the human

Technical abilities increasingly allow artificial imitation of the human body or behavior. These imitations are used for testing human related artefacts. Developments include: Artificial/3D printed skin, chips that mimic human organs, real looking animated human flesh or artificial nerve cells.

Source: Several
Impact Level: Local

Your Notes
.....
.....
.....



2016

Your Notes
.....
.....
.....



2016



No. 3

DIY printing of circuits

Instructable offers a tutorial that will teach you how to modify your average inkjet printer to be able to print electrically conductive circuits. This technology is fairly new but can provide a faster and safer prototyping option for DIY printed circuit boards. This project also acts as an introduction to the larger field of printed electronics.

Source: Instructables
Impact Level: Mid Range

Your Notes
.....
.....
.....



No. 4

Smart dust

This science fiction novel describes nano-cells on the skin simulating an environment for the body in a haptic way. In addition they can simulate visual and auditive inputs.

Source: Das Cusanus-Spiel (Science Fiction Novel)
Impact Level: Local

Your Notes
.....
.....
.....



No. 5

Implants that store and transfer data

Prosthetics or implants which store, process and transfer data in many ways emerge in science fiction. These implants could be interconnected and also linked with a global net. In this scenario complete surveillance could be permanent.

Source: Accelerando
Impact Level: Local

Your Notes
.....
.....
.....



No. 6

Bio patent conflicts – who owns your body?

A conflict between bio-engineering patent holders and the growing community of independent bio-hackers on "who owns your body" is emerging.

Source: The Awl
Impact Level: Local

Your Notes
.....
.....
.....





No. 1

Local energy production will power the smart grid

As the smart grid begins to take shape, a big push is emerging for more localized energy production. The idea is to deploy cheaper and more climate-friendly solar, wind, and fuel cell technology at the neighborhood scale, with smart routing and storage. Watch for widespread decentralization of energy grids as digital intelligence and renewable energy technologies drive power production to the edges of our networks.

Source: Institute For The Future IFTF
Impact Level: Widespread

Your Notes

.....
.....
.....
.....



No. 2

Moss walls for air cleaning

To clean and filter the air from nitric oxide and fine dust within cities, moss walls are tested in Oslo (Norway). The so called "city trees" transform the pollution to biomass.

Source: Trends der Zukunft
Impact Level: Local

Your Notes

.....
.....
.....
.....



No. 3

Cleaner-fish keeps salmon healthy by eating lice

Scotland's salmon farming industry has begun farming a new type of fish, specifically to keep salmon clean from parasites. The Scottish Aquaculture Innovation Centre, is working with University of Stirling scientists and seafood company Marine Harvest to breed cleaner wrasse. These are fish that feed on a common and pervasive salmon parasite called sea lice.

Source: BBC Futures
Impact Level: Local

Your Notes

.....
.....
.....
.....



No. 4

Long term preservation of knowledge

The Long Now foundation is creating a library readable for 10,000 years. Rosetta is a physical archive—a 3.5-inch disc made of nickel, with 13,000 pages micro etched onto its surface. The disc does not depend on hardware or software to be read, only magnification, thus obviating the need to keep up with rapidly changing technology or the looming "digital dark age."

Source: American Libraries Magazine
Impact Level: Future of Civilisation

Your Notes

.....
.....
.....
.....





No. 5

Long-term timekeeping

The Long Now initiative is establishing a clock that would still be readable for 10,000 years. The clock is an icon for long-term thinking, envisioned as a way to get people to think in very long terms about the consequences of their choices.

Source: American Libraries Magazine
Impact Level: Fundamental

No. 6

Bee highway

The city of Oslo is in the process of developing a "bee highway" for the pollinating insects, offering them a safe route through the city complete with food sources, resting spots, and places to live.

Source: The Verge
Impact Level: Local

Your Notes
.....
.....
.....



Your Notes
.....
.....
.....



No. 1

Virtual Personal Assistant Bots

Deep machine learning gives rise to a spectrum of smart machine implementations — including robots, autonomous vehicles, virtual personal assistants (VPAs) and smart advisors — that act in an autonomous (or at least semiautonomous) manner. Apps as virtual assistant such as Microsofts Cortana, Google Now or Apples Siri will get better in recognizing situations and derive individual user needs.

Source: Gartner
Impact Level: Widespread

No. 2

Rise of the drones

Science fiction novels envision a world where drones of all shapes and sizes will take over a vast diversity of functions such as monitoring, scanning, surveying, transport and spying. Smarter and smaller drones with more functions are one of the most popular areas on Kickstarter.

Source: Drohneland (Science Fiction Novel)
Impact Level: Widespread

Your Notes
.....
.....
.....



Your Notes
.....
.....
.....





No. 11

Automated indoor farming

A company in Japan is building an indoor lettuce farm that will be completely tended by robots and computers. The company expects the factory to open in 2017, and the fully automated farming process could make the lettuce cheaper and better for the environment. For now, the Wall Street Journal reports that the company is still working on a machine that can plant the seeds, and their process still requires human eyes to determine whether a seedling has sprouted.

Source: Wall Street Journal
Impact Level: Mid Range

Your Notes

.....
.....
.....
.....



2016



No. 12

Self-Propelled particles

Researchers at the University of British Columbia have created the first self-propelled particles capable of delivering coagulants against the flow of blood to treat severe bleeding, a potentially huge advancement in trauma care.

Source: Futuristech Info
Impact Level: Local

Your Notes

.....
.....
.....
.....



2016



No. 13

New sensors to measure ocean acidification

Ocean acidification describes the decrease in the pH of the Earth's oceans due to the uptake of carbon dioxide (CO2) from the atmosphere which is a "silent threat" to humanity. Currently we are not able to accurately measure pH under extreme conditions, such as the cold temperatures and crushing pressures of the deep sea. XPRIZE has awarded a large sum for development of sensors for acidification in deep sea.

Source: Scientific American
Impact Level: Local

Your Notes

.....
.....
.....
.....



2016



No. 14

Terahertz communication enables a new range of wireless applications in the future

In May 2012, a team of researchers from the Tokyo Institute of Technology set a new record for wireless data transmission by using Terahertz-rays and proposed they be used as bandwidth for data transmission in the future. The new devices will use a so called resonant tunneling diode (RTD) in which the voltage is decreased as the current increased, causing the diode produce waves in the terahertz band which enable data transfer rates of 3 Gigabits per second. The demonstration was twenty times faster than the current Wi-Fi standard. Research still has to be done, especially in the fields of adaptive antennas, frequency comb to unleash the potential of the invention.

Source: FET Proposals
Impact Level: Mid Range

Your Notes

.....
.....
.....
.....



2016



No. 15

Photonic crystals

A photonic crystal is a periodic optical nanostructure that affects the motion of photons in much the same way that ionic lattices affect electrons in solids. Photonic crystals occur in nature in the form of structural coloration – and, in different forms, promise to be useful in a range of applications. Photonic crystals can, in principle, find uses wherever light must be manipulated. Existing applications include thin-film optics with coatings for lenses. Two-dimensional photonic-crystal fibers are used in nonlinear devices and to guide exotic wavelengths. Three-dimensional crystals may one day be used in optical computers with superior performance. The related research field are silicon photonics, spectroscopy, optoelectronics, GaN, integrated optics, optomechanics, and photonic integrated circuits.

Source: FET Proposals
Impact Level: Mid Range

Your Notes
.....
.....
.....
.....



No. 16

New kinds of sensors (biosensors, lab-on-a-chip, smart textiles, etc.) and their smart connection will give us a new level of control over our surroundings.

The reason why the Internet of Things still seems to be distant promise today is that there is not enough smart and connected data available. Thus, research needs to be encouraged in the area of sensing devices and technologies to analyze and exploit the data collected in the various fields. This research includes new kinds of biosensors, lab-on-a-chip technologies, wireless sensor networks, remote sensing, environmental monitoring, smart textiles and RFID.

Source: FET Proposals
Impact Level: Mid Range

Your Notes
.....
.....
.....
.....



No. 17

Fully autonomous production organism

If industry 4.0 becomes bigger and more connected, this could mean the end for industrial production as we know it. In science fiction it is envisaged that all production is accomplished by an artificial organism, that works fully autonomously.

Source: Herr aller Dinge
Impact Level: Future of Civilisation

Your Notes
.....
.....
.....
.....



No. 18

Brain interfaces and implants

There is a lot of current R&D effort at the intersection of neuroscience, biotechnology, and computer science directed at developing interfaces to the brain. The topic was one of the most prevalent in the webmining. Examples for research activities on interfaces are memory chips to improve the memory performance, brain controlled bionic devices and a brain reading technology that helps violinists to play again after a heavy accident. For implants new developments in 2015 included soft devices to deliver drugs in the brain and syringe-injectable electronics.

Source: Several
Impact Level: Local

Your Notes
.....
.....
.....
.....





No. 19

Advances in robotics will be achieved by combining biology, material science and computer technology

To build robots is an interdisciplinary venture by nature. In the future, efficient and broadly applicable robots will be available because research has successfully combined insights from biology (robots inspired by plants, octopus or insects, swarms of robots with emergent behaviors) and material science (evolving and shape-changing robots) has successfully mapped those advances into information systems.

Source: FET Projects
Impact Level: Mid Range

Your Notes
.....
.....
.....



No. 20

Neuromorph computing

Several sources from webmining and manual scouting point towards novel developments in neuromorph computing in particular circuits formed after the human brain such as memristors. Some expect that these will allow designers to create devices with memory systems that function more like a brain. A third development is in the use of optical fibres for mimicking the human brain in neural networks. Some researchers point out ethical issues in dealing with future "digital brains".

Source: Several
Impact Level: Local

Your Notes
.....
.....
.....



No. 21

Bacteria-robot model systems

In a recent paper a Virginia Tech scientist used a mathematical model to demonstrate that bacteria can control the behaviour of an inanimate device like a robot. In agriculture, bacteria-robot model systems could enable robust studies that explore the interactions between soil bacteria and livestock.

Source: DEEPSTUFF.ORG
Impact Level: Local

Your Notes
.....
.....
.....



No. 22

New materials for robot parts

New materials for robot parts enhance robot capabilities: Autonomous and soft materials enable changing of shape, artificial skin and muscles and thus allow for more flexible movement and functions.

Source: XPRIZE
Impact Level: Local

Your Notes
.....
.....
.....





No. 23

Robot to robot collaborations

Communication and collaboration between robots without human interference is possible now. E.g. researchers at Carnegie Mellon University have enabled two types of robots with very different capabilities to collaborate in order to fulfill people's requests. In science fiction self governing robot swarms have long been imagined.

Source: Several
Impact Level: Mid Range

Your Notes
.....
.....
.....



No. 24

Robot learning

One of the most discussed topics in the field of robotics in 2015 was new ways of deep robot learning including learning from watching, reading and playing and storing through "thought vectors".

Source: Several
Impact Level: Mid Range

Your Notes
.....
.....
.....



No. 25

Robots will become more human-like as their vocabulary comes closer to that of real humans

Currently, computational intelligence is restricted to lexical descriptions found in dictionaries. But with current results from brain research from clinical studies and neuroimaging, a complete inventory of words, their emotional valence and perceptual properties will become available. However, it takes a combined effort of neuroscientists, cognitive scientists, lexicographers and computer scientists to harness this new source.

Source: FET Projects
Impact Level: Local

Your Notes
.....
.....
.....



No. 26

Spintronics: New principles for new, ultra-high capacity storage devices.

Spintronics is a research field of nano electronics and deals with the study of the intrinsic spin of the electron and its associated magnetic moment. Spintronics differ from older magnetoelectronics, in that spins are also manipulated by magnetic fields and not by electrical fields alone. One promise of this research field, which is at the same time basic research and applied research, is that with the help of the special principles, storage devices with much higher capacities may be developed in the future.

Source: FET Proposals
Impact Level: Mid Range

Your Notes
.....
.....
.....





No. 27

Insights from cognition research and biology may enable better Ambient Intelligence (Aml) systems

Context awareness and activity recognition are key components of the vision of Ambient Intelligence (Aml). A common problem is that activity recognition can only be achieved in narrowly defined sensor configurations. Bringing together insights from biology, machine learning and control theory will allow new systems which take advantage of sensing modalities that happen to be available, rather than forcing the user to deploy specific, application dependent sensor systems.

Source: FET Projects
Impact Level: Widespread

Your Notes
.....
.....
.....
.....



2016



No. 28

Non-invasive brain influencing

The webmining revealed two new approaches to for influencing brain cells without physical interfaces one is through ultrasound waves and another through magnetic stimulation of heat dissipating magnetic nanoparticles within the brain.

Source: The Guardian, BBC
Impact Level: Local

Your Notes
.....
.....
.....
.....



2016



No. 29

The combination of scientific advances in nanotechnology, optics and spintronics with conventional electronics will lead to new computing and switching devices with superior performance.

Advances in nano-electronics, nanoscale integration, optical signal processing and spintronics are currently being combined with existing electronics (chipdesign, switching technology, storage technologies) in order to increase performance or to build all new devices based on new principles. In the future, the incremental improvements from these combinations and inventions may turn into disruptive changes in computing and high-speed applications.

Source: FET Projects
Impact Level: Local

Your Notes
.....
.....
.....
.....



2016



No. 30

Quantum technology will move from basic research to applications

Quantum technology today is in an early stage of its development and research is often characterized by theoretical reflections. However, the promises concerning future applications are manifold and are not limited to the quantum computer. Instead, the expected applications range from secure communications, highly sensitive sensors to other breakthroughs in the context of data processing. For some researchers it is clear that the 21. Century will be the century of quantum technology.

Source: FET Projects
Impact Level: Widespread

Your Notes
.....
.....
.....
.....



2016



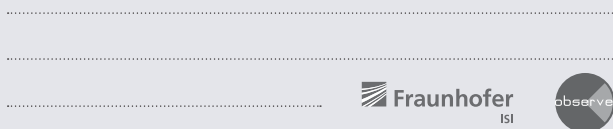
No. 31

Cancer-detection in real-time

New insights in hyper-spectrography, advanced mathematical methods and the combination of available data on more than 200 kinds of cancer make it possible to discriminate between healthy and malignant tissues in real-time. This information may be used by medical doctors during surgical procedures.

Source: FET Projects
Impact Level: Local

Your Notes



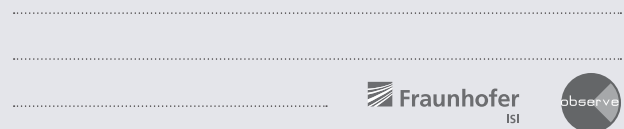
No. 32

Use recently discovered graphene characteristics to produce better switches, lasers, chips, etc.

Graphene has many many extraordinary properties which are being studied worldwide, and especially in the FET Flagship on Graphene in Europe. Currently there are many applications being developed and tested and in the future, graphene may trigger a new generation of better electromagnetic switches, lasers, broad-band chips and so on.

Source: FET Projects
Impact Level: Mid Range

Your Notes



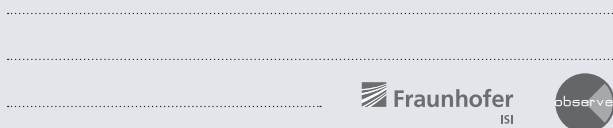
No. 33

Quantum Computing: Combining advances in quantum technology and photonics to realize a quantum computer

Instead of binary digits that are used in conventional digital computers, quantum computers use quantum bits (qubits), which can be in superpositions of states. Quantum computers are still in an early stage of development but if realized, they may be able to efficiently solve problems that no classical computer would be able to solve within a reasonable amount of time. One approach to advance the development is to combine quantum technology and photonics.

Source: FET Projects
Impact Level: Local

Your Notes



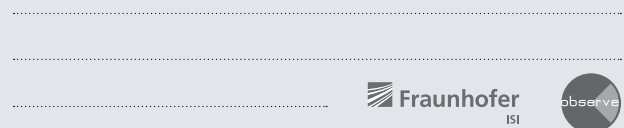
No. 34

Smart materials will be used to provide shape-changing mobile devices and other interfaces

Smart materials are designed materials that have properties that can be changed in a controlled fashion by external stimuli, such as temperature, skin contact, voice, moisture, electric or magnetic fields. In the future, mobile devices may change their appearance for example when a call or a message is being received. Also, other Human-Computer-Interfaces can change their shape, appearance and functionalities according to outer circumstances.

Source: FET Projects
Impact Level: Local

Your Notes





No. 35

Faster computers and newly available massive data hold the key for problems deemed too difficult to solve in the past

Many scientific undertakings like formalizing tacit knowledge, simulating complex organ functions or mapping evolutionary developments in biology were once considered too complex either because there was not enough data available or the computing capacity was not sufficient to run the necessary programs. With increasing computation power and the availability of new mass data which is often made automatically available by new devices many old problems can now be solved.

Source: FET Projects
Impact Level: Widespread

No. 36

Micromotors will be built into nano-scale micro-electro-mechanical systems (MEMS) and enable new lab-on-a-chip systems to biomedical implants.

Researchers from different disciplines (physics, biology, medicine) have teamed up to integrate micromotors into MEMS. Once successful, this combination will allow a wide range of applications such as new lab-on-a-chip systems, pumps for micro-fluids and tuneable filters, tuneable lenses or filtering substrates for biotechnology, tissue engineering and regenerative medicine.

Source: FET Projects
Impact Level: Local

Your Notes
.....
.....
.....



Your Notes
.....
.....
.....

