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WEAK SIGNALS & EMERGING TECHNOLOGICAL TRENDS 2022

The efficiency of production systems in the service of growth has been the dominant paradigm for decades. However, the global health crisis known as COVID-19 revealed that a globalized system operating with just-in-time processes (minimizing stock levels as much as possible, optimizing production costs, offshoring, etc.) has inherent vulnerabilities. For this reason, the resilience of systems has made a strong comeback since 2020. In this report, it is particularly illustrated by themes such as circularity, swarm robustness, and smart dust.

Another clear consequence of the COVID-19 crisis has been the phenomenal acceleration of the digital transition, exemplified by the explosion of online sales, home meal delivery, and the widespread adoption of remote work. In this report, these increased digital uses are confirmed through emerging technologies like the metaverse, autonomous farming, and hybrid artificial intelligence. However, the pervasive use of digital technology currently raises many questions, particularly regarding energy and environmental impacts. Although ongoing efforts are made to reduce energy consumption and achieve sobriety in new technologies, rebound effects are often observed due to the multiplication of uses. This is illustrated by Jevons' paradox, which states that as technological improvements increase the efficiency with which a resource is used, the total consumption of that resource can increase instead of decreasing: energy consumption of computer servers, road or maritime transport...

In a context of multiple crises, foremost among them being climate disruption, it is observed that some technologies are ambivalent and can be used both for greater efficiency and for greater resilience. For instance, autonomous farming (§.5) enhances productivity while allowing cultivation under greater water stress conditions. Others, however, fall within a paradigm of continued resource exploitation, such as space for all (§.4) or geoengineering (§.7).

In the coming years, technological development will oscillate between these two paradigms : **efficiency versus resilience.**

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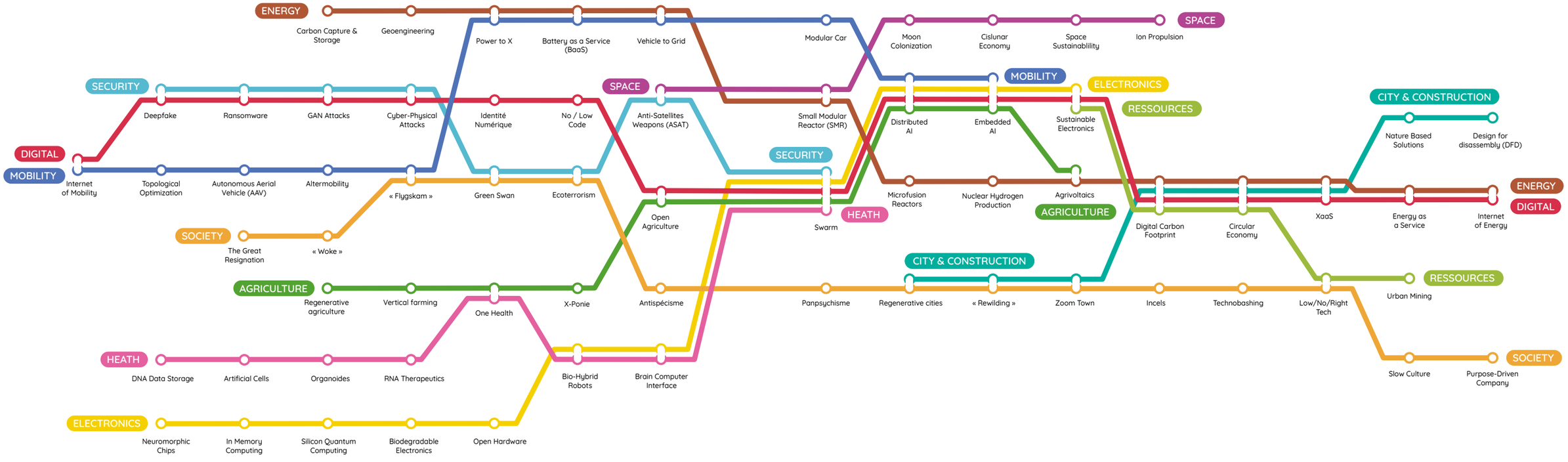

YSPOT

Agrivoltaics

Agrivoltaics or agrophotovoltaics is the simultaneous use of land for both photovoltaic solar energy production and agriculture through open field structures.

Alternative Mobility

Alternative mobility encompasses all travel behaviors that serve as alternatives to the exclusive use of private cars.

Anti-Satellite Weapons

Anti-satellite weapons have been tested for several years by major powers (USA, China, Russia, etc.) and come in three main forms: directed-energy (laser, microwaves, etc.), missiles, or suicide nanosatellites.

Antispeciesism

Antispeciesism is a school of thought that challenges the idea that humans are at the top of the animal kingdom.

Artificial Cells

The discovery of essential genes has led to the creation of a minimal mycoplasma bacterial genome, JCVI-syn3A. This bacterium, composed of 492 genes, divides like a normal cell and helps model the essential building blocks of life. Other developments allow the creation of microcapsules capable of collecting, transporting, and then releasing a payload at the right moment.

Autonomous Aerial Vehicule (AAV)

From Ehang 184 to SureFly, including UberAir, Vahana (by Airbus), Joby, and Volocopter, autonomous drone taxi projects are currently generating much enthusiasm, with over a dozen projects worldwide.

Battery as a service (BBAS)

The Battery-as-a-Service model allows customers to rent batteries as a separate component from cars.

Bio-hybrids robots

Bio-inspired hybrid robots that combine living and synthetic components are an emerging field in the development of advanced actuators and other robotic platforms (e.g., swimming, crawling, walking robots, etc.).

Biodegradable electronics

In recent years, flexible electronic circuits (batteries, sensors, photovoltaics, etc.) made from biodegradable materials derived from plant extracts have been developed.

Brain computer interface

A direct communication interface between a brain and an external device (a computer, an electronic system, etc.) aimed at studying the brain, assisting, enhancing, or repairing human cognitive or action functions that are deficient.

Carbon capture & storage

In recent years, many projects have focused on direct air capture (DAC), which removes CO2 from the air using selective filtration systems.

Circular Economy

The circular economy aims to produce goods and services sustainably by limiting resource consumption and waste production.

Cislunar economy

«Cislunar» is a term commonly used in space jargon to refer to the region near the Moon, sometimes called EON (Earth Orbital Neighborhood). The increasing number of space missions to explore the Moon or Mars will require the exploitation of this region of space to serve as an intermediate space base for space travel or the exploitation of near-Earth asteroids.

Cyber-physical attacks

Cyber-physical attacks target essential infrastructures and services to disrupt or shut them down. The example of the Colonial Pipeline attack in May 2021, which blocked the oil supply, left a lasting impression in the USA.

Deep fake

Deepfake refers to a synthetic image technique, derived from artificial intelligence, that allows the modification of images or videos by superimposing and combining new images in a way that appears authentic (e.g., changing a person's face in a video).

Design for disassembley

Design of buildings to facilitate their dismantling (in part or in whole).

Digital carbon footprint

The carbon footprint of digital technologies is increasingly analyzed as they are responsible for 4% of greenhouse gas (GHG) emissions, and their energy consumption increases by 9% per year.

Digital Identity

The European Commission proposed a digital identity project last June, which will be a dematerialized version of the information found on an identity card or passport.

Distributed AI

The architecture of artificial intelligence systems is becoming hybrid, moving beyond embedded vs. cloud or private cloud vs. public cloud, to a multi-form AI architecture that adapts to situations.

DNA data storage

To cope with the data deluge and the resulting energy consumption, information storage solutions on DNA strands are making significant progress. It is estimated that 215 petabytes of data could be stored in one gram of DNA.

Ecoterrorism

Rising violence within ecological movements in the UK and America, characterized by sabotage or destruction of premises, public equipment such as 5G relays, or railway lines.

Embedded AI

Embedded artificial intelligence (AI) aims to move computations as close to the data source as possible, reducing latency and saving energy by limiting the transfer of large amounts of data to the cloud.

Energy as a service

Unlike the traditional energy model of simply billing customers based on the number of kWh of electricity used, EaaS business models can include services ranging from energy management to the installation of energy equipment.

Flygskam

Flygskam, a movement that originated in Sweden and is motivated by ecological concerns, refers to the shame associated with flying due to the pollution generated by this mode of transport.

GAN Attacks

Generative Adversarial Networks (GANs) are algorithmic architectures that use two neural networks opposing each other («adversarial») to generate new synthetic data instances that can pass for real data.s.

Geoengineering

Capturing atmospheric CO2 to bury it underground or manipulating solar radiation. Geoengineering differs from mitigation strategies that aim to limit greenhouse gas emissions.

Green Swan

Inspired by the «Black Swan» concept theorized by Nicholas Taleb, which refers to rare events with significant societal impacts that are predictable in hindsight (e.g., subprime crises), «Green Swans» are similar phenomena related to climate.

In-Memory computing

The use of resistive memory that allows operations to be performed without transferring data to external memory for processing.

INCELS

A contraction of the expression «involuntary celibate.» This group, mainly composed of heterosexual men aged 18 to 35, claims their single status and blames women for it.

Internet of energy

Also called Enernet, the Internet of Energy involves real-time dynamic management between producers and consumers. China aims to create a global supergrid, called the «World of Energy Interconnection» (WEI).

Internet of mobility (IOM)

IoM means that any vehicle (public, private, or shared) can be dynamically connected to a global network of interoperable mobility services via a series of APIs. When a vehicle is connected to the IoM, it will be detectable by any user of any application connected to the network.

Ion Propulsion

Miniature ion thrusters, no larger than a coin, are opening new perspectives for space travel with costs 100 times lower than current systems and with higher speeds.

Low tech / no tech/ right tech

The concept of Low Tech is based on providing the same service with simpler and less complex technologies (e.g., frugal innovation).

Microfusion reactors

Concepts of mini-reactors for nuclear fusion have been emerging for several years (e.g., the Renaissance project in Grenoble with a stellarator project).

Modular car

A modular vehicle is one where significant components of the vehicle are interchangeable (body elements, trunks, cabins, etc.).

Moon colonization

The return of manned missions to the Moon is planned by the Chinese in 2030 and the Americans in 2025 with NASA's Artemis program.

Nature based solutions (NBS)

Solutions such as restoring vegetation to reduce urban heat islands or bringing rivers to the surface to cool urban areas, etc.

Neuromorphic chips

Neuromorphic processors operate by mimicking the physics of the human brain and nervous system by establishing what are called «spike» neural networks.

Nuclear hydrogen production

According to the International Atomic Energy Agency (IAEA), nuclear energy will be the most cost-effective way to produce clean hydrogen in the future.

No/low code

Low Code / No Code (LCNC) tools enable the creation of digital applications without mastering all programming steps. This involves automatically generating lines of code, visual programming, and designing applications directly through templates.

One health

The «One Health» concept refers to the awareness of the close links between human health, animal health, and the overall ecological state of the planet.

Open agriculture

Sharing agricultural data (weather, soil chemistry, crop status, etc.) to better understand local micro-climatic variations and optimize crop growth conditions through connected farming communities.

Open hardware

Refers to open source in hardware design, allowing anyone to manufacture hardware according to open designs.

Organoid

An organoid is a miniaturized and simplified version of an organ produced in vitro in three dimensions that shows realistic micro-anatomy. Coupled with 3D bioprinting, increasingly specialized tissues are generated: pancreas, heart, mini-brains, etc.

Panpsychism

The attribution of a form of consciousness (primitive or developed) to every fundamental or organized entity.

Power to X

The conversion of electricity into another energy vector: hydrogen, methane, etc.

Purpose-Driven Company

The term «purpose-driven company» in France refers to new forms of companies that statutorily give themselves a social or environmental purpose in addition to the profit motive.

Ransomware

Ransomware attacks target essential infrastructure and services to disrupt or shut them down. The example of the Colonial Pipeline attack in May 2021, which blocked the oil supply, left a significant impression.

Regenerative agriculture

Regenerative agriculture is an approach to conservation and rehabilitation of food and farming systems that focuses on regenerating topsoil and increasing biodiversity.

Regeneratives cities

Urban development built on a restorative and enhancing relationship with the environment, leveraging natural systems from which the city derives resources for its sustenance.

Rewilding

Rewilding activities are conservation efforts aimed at restoring and protecting natural processes and wilderness areas.

RNA therapeutics

Messenger RNA-based technologies enable the development of vaccines (e.g., for COVID-19, malaria) and gene therapy to treat genetic diseases or cancers.

Silicum quantum computing

Based on silicon atom spins, this approach aims to develop architectures compatible with the existing electronics industry.

Slow culture

The Slow movement originated in the 1980s in response to the perceived acceleration of time, starting with Carlo Petrini, a gastronomic journalist, who created the Slow Food movement in Italy as a counter to fast food. This opposition to a fast-paced society extends to various themes: slow cities, slow money, slow design, etc.

Small modular reactor

Small modular nuclear reactors (SMRs) have a power capacity of up to 300 MW(e) per unit and can be added together incrementally.

Space sustainability

A phenomenon developing in recent years due to the increase in satellite and other space object launches. These launches have led to an increase in space debris in orbit around Earth, hindering the ability of nations to operate in the space environment and increasing the risk of future collisions between space objects.

Sustainable electronics

Sustainable electronics is one of the major emerging trends in recent years, exemplified by the mandatory display of the repairability index for electronic products sold since January 1, 2021.

SWARM

Swarm intelligence refers to the collective behavior of decentralized, self-organized systems (natural or artificial) that can maneuver quickly in a coordinated manner.

Technobashing

Technobashing is the phenomenon of disparaging science and technology by a relativist segment of the population. According to relativists, scientific knowledge is relative to contexts (political, ideological, linguistic, cultural, etc.) and «is no better than witchcraft.» With relativism, science is undermined as it is reduced to just another belief system.

The great resignation

Sometimes called the «Big Quit,» this phenomenon describes a record number of people quitting their jobs following the COVID-19 pandemic.

Topological Optimization

A method for lightening mechanical parts that reduces material consumption while maintaining the desired mechanical strength properties.

Urban mining

Urban mining is the process of recovering and reusing materials from a city (buildings, cars, appliances, computers, etc.).

Vehicle to grid

Describes a system in which rechargeable electric vehicles communicate with the power grid to sell demand response services by returning electricity to the grid or by limiting their charging rate.

Vertical farming

Vertical farming involves growing crops in vertically stacked layers in a controlled environment, aiming to optimize plant growth and using soilless farming techniques such as hydroponics, aquaponics, and aeroponics.

Woke

The «woke» movement, derived from the English verb «wake up,» is a militant movement aimed at defending minorities suffering from racial or sexual injustices through strong actions (protests, social media campaigns, etc.).

XAAS

The acronym stands for Everything as a Service, initially known for SaaS (Software as a Service), which allows client software to be relocated to the cloud or servers. Associated with the functional economy, «as a Service» is expanding into other sectors such as energy (EaaS), agriculture (AaaS), and lighting (LaaS).

X-Phonie

Encompasses all technologies that enable controlled delivery of nutrients to plants in artificial containers or other devices (outside of fields). Examples include aquaponics, hydroponics, aeroponics, ultraponics, and air-dynaponics.

Zoom town

With the massive development of remote work following the COVID-19 crisis (in reference to the «Zoom» application), medium-sized towns on the outskirts of large cities have developed, leading to a rise in real estate prices.