Towards a Resilient Society – Technology 5.0, Risks and Ethics

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Keywords:

Smart Systems, Resilient Society, Sustainable Society, Business Resilience, Autonomous Systems, Industry4.0, Systems of Systems, Cyber-physical systems, Internet of Things (IoT), Artificial Intelligence, Society 5.0, Ethical Aligned Design, Sharing Society, Sharing Economy.

Abstract:

Society 5.0 as "super-smart society" is the key element of the Japanese 5th Science and Technology Basic Plan by the Council for Science, Technology and Innovation 2016. It became a political highlight of the Japanese government and was taken over 2017 and 2018 as a vision for the Japanese economy and society, to take over the lead ahead of the world to make people's life more comfortable and sustainable.

Smart Systems, i.e. largely deployed and interconnected CPS (cyber-physical system and IoT networks) and integrated intelligence and autonomy are considered the drivers of innovation. In all industrial and social areas highly automated or autonomous intelligent systems are taking over tasks and services – and maybe, one day, control of our lives. The keynote will raise questions and discuss impact, risks, ethical issues and challenges such as "Can a technology dependent and technology driven society be resilient and sustainable? Can technology make a society resilient and sustainable? Will the role of humans change in such a society? What are the trade-offs with respect to human rights, self-determination, independence or will "Big Brother" control risks become overwhelming? The keynote will address issues that are already evident now and how resilience, sustainability and ethical issues are now discussed in different context – particularly how can a resilient society manage a crisis like the Climate Crises, and Covid-19 – a situation that has revealed vulnerabilities and will hopefully lead to a rethinking of some economic and societal systemic issues.

1. Introduction and Overview – Smart Systems Everywhere

Our society is facing many challenges now – upcoming crisis in many respects, e.g. the climate crisis, the Covid-19 (Corona) crises, and economic as well as social crisis impacts in the future. In many parts of the world, we have exaggerated usage of our natural resources in a ruthless manner often just for short term profits and benefits of a few. This situation is encompassed by an enormous progress in technology, particularly in electronic systems and materials. Smart systems are already everywhere –but integrated into "super-smart systems-of-systems" with advanced algorithms and artificial intelligence and "big data" in the background. The pretended

purpose of this high degree of connectivity is to serve customers (peoples) needs for their benefit – but the impact is much higher. Challenges are not only on the technical and usability level, they are on the level of increased risks, threats and vulnerabilities of the systems concerning safety, security and privacy. Last but not least are we afraid of the "transparent citizen", the total surveillance ("Big Brother") like shown in a much simpler and less professional manner in the famous book "1984" by George Orwell; less professional because of lack of the technology that is easily available now. Even the attacks on human rights, freedom and independence are now much "smarter", and most of us are often not aware of the degree of surveillance and control, even in our democracies in the so-called "Western World".

This will impact considerably our lives and lifestyle, and, as a consequence, we will have to face the new challenges, opportunities and risks. Not to forget the economic risks – recent crisis like Covid-19 lock-downs have demonstrated our vulnerability because of the dependency on worldwide functioning supply chains.

The technological basis is laid by IoT (human – smart devices interaction and communication) and IIoT (IoT in industrial context, machine-to-machine communication) as infrastructure (connectivity), and CPS (Cyber-physical Systems) as "things" or "devices". But smartness is more – it means intelligence, cognitive systems and technology, machine learning and artificial intelligence, security, big data and cloud connectivity, involving many domains of everyday life and digital transformation of our world.

With respect to safety, cybersecurity, privacy, and data sovereignty, the new "cognitive technologies" are a severe concern for specialists, politicians and citizens, and raise severe ethical and societal concerns, and dependency on these technologies in a networked world is an additional concern now.

For our future it is most important now to strive for a "resilient society" and a "sustainable economy", both relying on each other. Such a strategy will cope with the challenges particularly by the of the crises mentioned before – climate, pandemic and economic risks, stability of society and long-term survival and peace.

2. The Role of Technology: Enabler for a Resilient Society, or Risk?

In all technological and industrial advanced regions of our world, research and innovation in smart, intelligent systems and systems-of-systems are considered essential and a lot of money is invested by governments and industry. On European level, organizations like AIOTI [AIOTI], the Alliance for Internet of Things Innovation, which takes care of the IoT aspects in 13 Working Groups, or the industrial associations ARTEMIS [ARTEMIS] (Advanced Research and Technology on Embedded Intelligent Systems), EPoSS [EPoSS] (European Technology Platform for Smart systems Integration) and AENEAS (Association for European Nano-Electronics Activities), which are the private partners in the ECSEL Joint Undertaking, a European PPP within Horizon 2020 (Public-Private Partnership) with an industry-oriented Research Program, and other PPPs, take care of further development of research, standardization and promotion of these topics, together with the European Commission and national funding authorities. China is already keeping up with Europe, US and Japan, e.g. with its AI initiative and strategy.

The digital transformation of European business and society is a major goal of the EC. EC Growth, the DG (Directorate General) for Internal Market, Industry, Entrepreneurship and SMEs, considers digital transformation as a key element for European growth, because Europe can build on its strength in traditional sectors and can take up the potential and challenges of advanced digital technologies. Technologies considered in this context are IoT, big data,

advanced manufacturing, robotics, 3D printing, blockchain technologies and artificial intelligence (see European Commission, 2018 - 2020).

The initiative "Digitizing European Industry" targets to meet Europe's needs to join forces under a common strategy that takes digitalization of the EU's economy forward in order to unlock the full potential of the 4th industrial revolution. The pillars of this initiative are:

Figure 1: Pillars of the European Initiative "Digitizing European Industry"
(Source: *https://ec.europa.eu/digital-single-market/en/pillars-digitising-european-industry-initiative*)

In the booklet "My agenda for Europe" of Ursula von der Leyen, the new President of the European Commission, is one chapter dedicated to "A Europe fit for the digital age". It focuses on AI, IoT, 5G, and ethical and human implications of these technologies, empowering people through education and skills, and on protecting ourselves with respect to the risks of these technologies.

But it is not only economics and competitiveness of European industry – the recently announced "Green Deal" as basis and justification for the upcoming huge efforts are targeting at "Resilience" and "Sustainability" in all technology-driven areas, like manufacturing, mobility, public and industrial administration, particularly considering also societal and ethical aspects.

Additionally, DG Growth delivers an annual report on standardization, e.g. the "Rolling Plan on ICT Standardization", which includes most of the relevant areas in this paper's context and is a key pillar in Digitalization, and have started a Joint Initiative on Standardization (JIS) http://ec.europa.eu/growth/single-market/europeanstandards/notification-system_en, although they do primarily consider the European SDOs (Standardization Organizations, ESOs) CEN, CENELEC and ETSI. The same is done by the international standardization organizations ISO and IEC, particularly in their Joint Technical Committee JTC1 (Information Technology), which cover all these topics of "Joint interest", particularly IoT (SC41), AI (SC42) and Security (SC27) and Software and Systems engineering (SC7).

The straightforward goal of these efforts is to have advanced technologies in ICT end ECS (Electronic components and systems) the enable a sustainable and resilient society in the economic and human factors and well-being sense. As examples like the movement of "Resilient Cities" and "Sustainable Growth" show, these technologies are a chance to overcome current waste of resources and to optimize resource usage, recycling and reuse sustainable production not only in industry but also in agriculture (smart farming, in large cities even

"vertical farming" in an until now unseen performance making large population agglomerates less vulnerable to supply risks in case of a crisis), mobility, work spaces and living spaces ("smart buildings", "smart homes"). "Business resilience" is also a key objective, e.g. the COVID-19 impact on global service delivery models, as several studies have described (SSON-Study "Reality Bites – Impact of COVID-19 on Global Service Delivery Models""").

On the other hand, human freedom, independence and privacy is for sure endangered, as well as too much dependency on technologies you have not nearby access to concerning maintenance and update.

Examples how AI can influence our job situation is demonstrated by measures of some large companies, and even public organizations, particularly by biased training datasets (taken from newsletters):

- Microsoft replaces journalists by AI systems (for MSN-website News)
- Public unemployment service uses AI algorithms to select clients: elder women skipped out of the search for jobs (without individual check of qualification)
- Racist decisions by AI systems (court, police, gender issues)

Therefore, we have to look not only at system properties like safety, security or privacy, but also on other aspects, how we can "TRUST" these technologies.

3. Crisis as a challenge and chance

In a publication "Why European companies need to complete the digital transformation to remain viable and competitive", this crisis is considered as a "turbo" to advance faster in our digitalization – to become more resilient and sustainable as economy and society.

The Corona-crisis is looked at as a "disruptive force and digitalization turbo" (citation):

"Breakthrough for digitalization", "How the virus makes digitalization move forward" or "Corona makes the Internet a matter of course" – this is how the headlines of articles describing the effects of the coronavirus on the digitalization of various areas of life are currently read.

- *Home office: Almost all companies allow flexible working from home; video conferencing is becoming a matter of course.*
- *Digital classroom: As schools, kindergartens and universities are closed for the time being, eLearning is becoming a mass phenomenon and is currently being experimented a lot – even if the "digitalization gap" in areas of schools is still blatant.*
- *Online medicine: Information and diagnosis are shifting almost massively to digital channels. New forms of care and support are emerging.*
- *Entertainment & culture: Concerts and events are taking place virtually; online streaming is causing the biggest peak in internet traffic ever measured at the Frankfurt exchange node DE-CIX: 9.1 Terabit/s!*
- *Social life: In times of "social distancing", digital media and the Internet play an immanently important role for private and social networking and social solidarity. Thus, even the problems with "fake news" fade into the background.*
- *Digital town hall: Authorities and public institutions are restricting public access and expanding digital contact points and services.*

The conclusion ends in a recommendation for a future-proof corporate and IT strategy 2030: "Digital resilience and hybrid organisation", which is figured out in Figure 2 (from "Crisp © research by Cloudflight"):
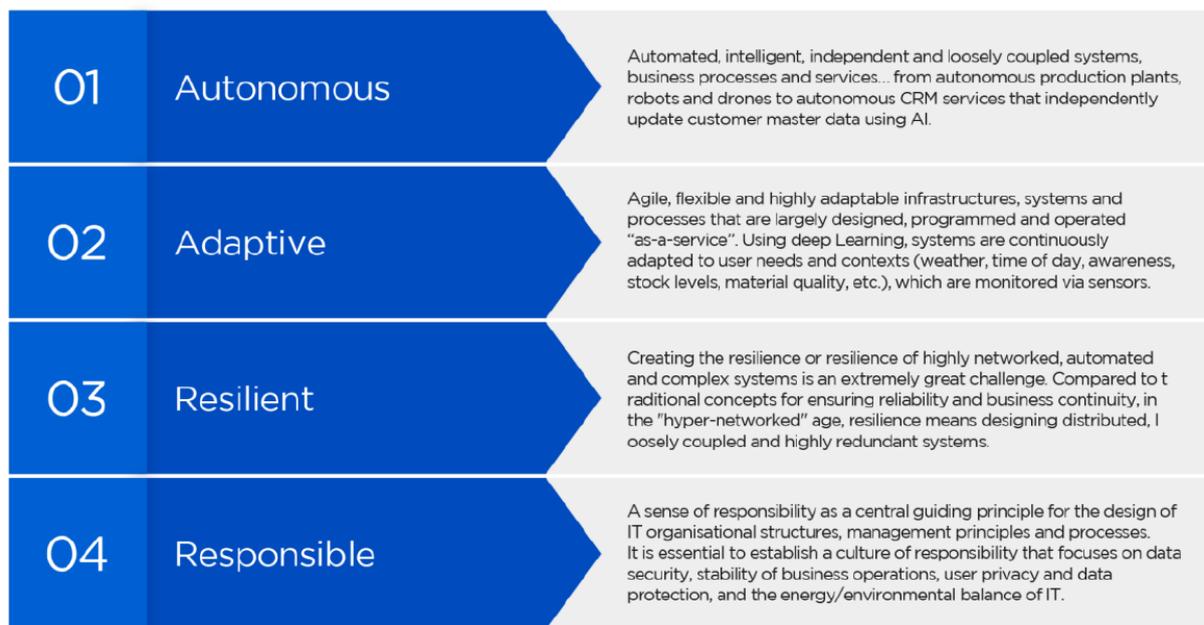
Figure 2: Digital resilience for companies and organizations

4. Trustworthiness of Smart Systems and Systems-of-Systems

With respect to "Resilience" and "Sustainability", SC7, SC41 and SC42 join forces as enablers by creating the adapted system property "Trustworthiness". This is particular of importance if we look at the requirements for a resilient, sustainable society and economy – which goes beyond the classical technical requirements.

"Trustworthiness" as a term was created to include more than the established system properties of dependability (safety, security, reliability, availability, maintainability), but also other stakeholder interests. One of the rather complete definitions we found was:

What is trust?

Trust: degree to which a user or other stakeholder has confidence that a product or system will behave as intended *<ISO/IEC 25010:2011(en) Systems and software engineering — Systems and software Quality Requirements and Evaluation (SQuaRE) — System and software quality models (= reliable and dependable)>*

ISO/IEC JTC1 AG7 Trustworthiness Definition (July 2019, source ISO/IEC JTC1 AG7 presentation by François Coallier):

- **Trustworthiness corresponds to the ability to meet stakeholders' expectations in a verifiable way.**

- Depending on the context or sector, and also on the specific product or service, data, and technology used, different characteristics apply and need verification to ensure stakeholders expectations are met.

- **Characteristics of trustworthiness include, e.g. reliability, availability, resilience, security, privacy, safety, accountability, transparency, integrity, authenticity, quality, usability.**

- Trustworthiness is an attribute that can be applied to services, products, technology, data and information as well as, in the context of governance, to organizations.
- Trustworthiness is ensured and maintained through a sound governance framework and systems engineering practices.
- Trustworthiness can contribute to the building of confidence.

The IIoT Group (Industrial Internet of Things), although traditionally biased by the purely technical and economic aspects, takes already care of these extended requirements (Figure 3) from their Newsletters) and define as a minimum:
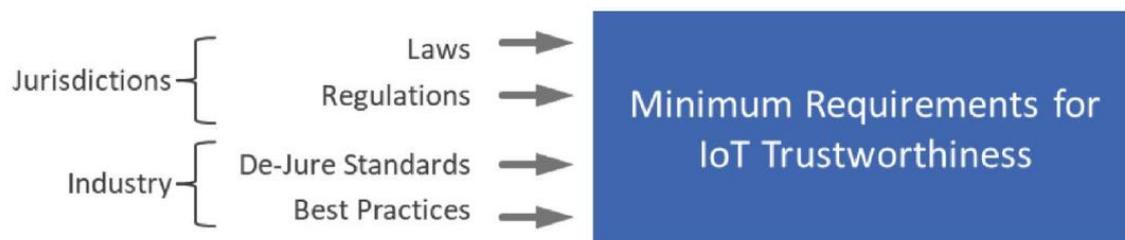
Figure 3: Minimum Requirements as defined by external parties

The societal and political part of resilience and sustainability is defined by the public stakeholders' interests who provide the framework for a resilient and sustainable implementation ("Jurisdiction").

But what about human society? – The Japanese Strategy Society 5.0

5. Society 5.0 – Aiming for a New Human-Centred Society

There are far reaching concepts implemented around us with the "Smart Systems Everywhere". On the other hand, all technologically and economically highly developed countries face chronic social challenges, which add up to the challenges and risks impacted by all the "4.0" revolutions to people and society.

The Japanese strategy "Society 5.0" envisions a so-called "Super-Smart Society". It should create a sustainable, inclusive socio-economic system, powered by the achievements of the fourth industrial revolution and the digital technologies. It leads far beyond Industry 4.0, it aims at benefitting the whole society by utilizing the integration of cyberspace and physical space [UNESCO 2019]. It is fully supported by government and industry to revitalize Japan, an extremely aging society with shrinking work force [Japan Business Federation, 2016, 2017] [Japanese Government, 2017, 2018].

Evolution of Human Society over time:

The documents on their vision say (citation from [Japanese Government, 2017])

"We aim at creating a society where we can resolve various social challenges by incorporating the innovations of the fourth industrial revolution (e.g. IoT, big data, artificial intelligence (AI), robot, and the sharing economy) into every industry and social life. By doing so the society of the future will be one in which new values and services are created continuously, making peoples' lives more conformable and sustainable.

This is Society 5.0, a super-smart society. Japan will take the lead to realize this ahead of the rest of the world."

The concept of "Society 5.0" was drafted in the 5th Science and Technology Basic Plan by the Council for Science, Technology and Innovation 2016.

Key issues of this plan are sustainability and social benefit for all citizen ("inclusion") by utilizing the advanced opportunities of Digital Transformation and Smart Technologies. Social reform (innovation) will achieve a forward-looking society that breaks the existing stagnation in societal and economic stagnation, forming a society of mutual respect, transcending the generations, and a active and enjoyable life for every person. This concept should also face challenges on a global scale, like depletion of natural resources, global warming, growing economic disparity, and even terrorism, by sharing knowledge and information, and cooperation. On the other hand, privacy and human independence is not such a key issue as in Europe, and sensibility is different from our society.

From a moral and ethical point of view, this sounds extremely well. The question that arises if it fits to other kinds of societies and regions in the world, having different social and economic preconditions, and different long-standing cultures and mind sets. From experience in history we know, that the fantastic technologies and opportunities can be misused by some people, criminals or governments against citizens. Therefore, in Europe, which is by far not so homogeneous in culture and mutual influences of neighbours as Japan, and America, institutions of different type have tried to set up ethical guidelines in the field of automated systems, cognitive decision taking (AI), and governance of data and connectivity.

6. Ethics Guidelines

6.1. Ethics Commission for Automated Driving (German Federal Ministry of Transport and Digital Infrastructure)

Automotive is a real mass market, and the trend towards highly automated and autonomous driving is ongoing in research and development. On the one hand, it is rather simple compared to complex AI issues and cognitive decision in achieving transparency in self-learning systems in detail (which is not possible at the moment), but even high-level principles are interesting.

The German document (available in English) [German Federal Ministry, 2017], includes a punctuation of 20 ethical rules for automated and connected vehicular traffic (shortened):

- The **protection of individuals (human life)** takes precedence over all other **considerations** (the systems must be **programmed to accept damage to animals or property** in a conflict).
- Design the vehicles such that they **drive in a defensive and anticipatory manner**, posing as **little risk as possible to vulnerable road users (VRUs).**
- In the event of **unavoidable accident situations**, any distinction based on **personal features (age, gender, physical or mental constitution) is strictly prohibited**. It is also prohibited to **offset victims against one another**.
- **Design** such that the need for an **abrupt handover of control to the driver** is **virtually obviated**. The **systems must adapt** more to human communicative behaviour **rather than requiring humans to adapt.**
- **International standardization of the handover** procedures.

- The **accountability** that was previously the sole preserve of the individual **shifts from the motorist to the manufacturers and operators** and to the **bodies responsible** for taking infrastructure, policy and legal decisions.

6.2. Trustworthy AI (Highly Automated systems in General)

Here is only a short overview on a few AI-related documents on "Trustworthy AI" and Ethical Guidelines for "Smart Systems' Decision Taking" provided:

- The IEEE Global Initiative for Ethical Considerations in Artificial Intelligence and Autonomous Systems (AI/AS) (April 2016)
  - Ethically Aligned Design: A Vision for Prioritizing Human Wellbeing with Artificial Intelligence and Autonomous Systems (EAD V1 released)
  - Identification and recommendation of ideas for Standards Projects focused on prioritizing ethical considerations in AI/AS.
  - IEEE ECAIS "Ethics Certification for Autonomous and Intelligent Systems" (Industry Connections Activity Initiation Sept. 2018!).

- IEC/SMB Ad Hoc Group on autonomous systems and ethics (AHG 79) (ISO/TC299, June 20, 2018!!),

- "When Computers Decide" – European Recommendations on Machine Learned Automated Decision Making (Informatics Europe & EUACM 2018) includes Technical, Ethical, Legal, Economic, Societal and Educational recommendations),

- EC: "Ethics Guidelines for Trustworthy AI" (Final report April 2019, HLEG AI) https://ec.europa.eu/digital-single-market/en/news/ethics-guidelines-trustworthy-ai

7. Conclusions

The technologically oriented funding organizations and the EC have a very positive approach and high expectations concerning the benefits of digitisation of economy, industry and society. The "Green Deal" programme and the human implications of these technologies, empowering people through education and skills, and on protecting ourselves with respect to the risks of these technologies, are targeting resilience and sustainability of society and economy.

The Japanese approach to "Society 5.0" even goes far beyond, and the visionary declarations are of high ethical and moral value. Applications like military, espionage etc. are explicitly excluded in research here. However, we should be aware that many of the achievements could be used against us as well (and some research projects consider this fact already) or lead to wrong decisions because of badly trained or biased AI systems. Knowledge and information can build a better society, but also be used against us by criminals or organizations. This requires careful European and international legislation and control to avoid the worst outcomes of these new technologies, and requires high public awareness. Politics sometimes tend to use safety and security threats as argument for more surveillance and control of people, endangering freedom and human rights. A first approach is taken by several authorities and international or governmental organisations to provide guidelines and recommendations for an ethical approach to highly autonomous systems.

The final question is: Will technologies of the fourth/fifth industrial revolution (e.g. IoT, Big Data, Artificial Intelligence, Connectivity, robots) enabling disruptive developments (evolutionary or revolutionary), lead to a resilient, sustainable and sharing society, to "well-being for all", if based on higher ethical values?

Acknowledgements

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