

THE DIGITAL SOCIETY –

A Summary (Version 0.2)

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We need a "Galilean" paradigm shift in thinking, from a component-oriented, individually centered view to an interaction-oriented, systemic view. When combined with the new opportunities created by Information and Communication Technologies, such a paradigm shift will lead us to a self-organizing Digital Society and can help us to overcome (or at least mitigate) many long-standing problems such as financial instabilities, crime, conflict, war, or tragedies of the commons.

The main arguments of my book on the Digital Society can be summarized as follows:

- The world has become extremely connected, interdependent and complex, causing rapid global change, a hardly predictable system dynamics, and uncontrollable situations.
- We have serious difficulties to understand our world at the pace it is progressing.
- The response to this has been a theory-free Big Data approach, where machine learning is believed to identify all relevant patterns and correlations in the data.
- Big Data sets gathered by companies such as *Google, Apple, Amazon, ebay, Facebook*, or *Twitter* exceed the information collected in the biggest library of the world by a factor of more than 100. In a single minute, there are 700,000 *Google* queries and 500,000 *Facebook* posts.
- The Big Data approach became possible by the exponential explosion of computer power and data volumes. Every year, we now produce as much data as in the entire history of humankind, i.e. in all the years before.

- This allows one to build data-driven instruments of exploration ("socioscopes"), which can serve as compasses for decision-makers.
- It is increasingly easy to digitally represent our world in a computer. *Google Earth* is a well-known example, but one can also reconstruct the world in 3D in a crowd-sourced way, using *flicker* photographs.
- A disaggregated real-time measurement of economic productivity, human capital, health, our environment, and social capital (such as trust or reputation) becomes feasible, too.
- It's conceivable to measure "diseases of our society" such as violence, crime, financial crises, and wars, before they break out.
- It's possible to probabilistically predict epidemics or depict the emergence and spreading of new ideas, innovations, and culture.
- We can also map global change and who causes it, resources and who uses them, and crises, to (re-)act more effectively.
- Such applications can benefit society. But beyond this, collecting "all data in the world" and mining them with powerful algorithms seems to have emerged as "gold standard" of evidence-based policy-making.
- Among some keen strategists, this has probably fueled the dream to develop powerful information technologies with almost God-like properties, such as a Crystal Ball to predict the future, and a Magic Wand to control peoples' decisions by means of personalized information as well as new incentive and sanctioning schemes.
- Even if not intended, these technologies imply a non-negligible risk of turning democracies into "democratorships" or totalitarian states without privacy and freedom, where individuals would basically execute commands or otherwise be punished.
- However, too much top-down control is counter-productive, as it will reduce socio-economic diversity, which is needed for innovation, societal resilience, collective intelligence, and the happiness of people.
- A top-down controlled state also lacks sufficient innovation rates to adapt quickly enough to demographic, social, economic, technological and environmental change. On the long run, it will fail.

- Attempts to optimize the world in real-time and govern it like a "wise king" or "benevolent dictator" are destined to fail, as the complexity of the world grows faster than the amount of data, and data volumes faster than processing power. This prevents the optimization of our world in real-time.
- In fact, the Big Data approach hasn't been able to create a better, stable, more predictable world. On the contrary: with the financial and economic crisis, the Arab spring, the conflict in the Ukraine, the confrontation with the Islamic State and other problems, we face a high level of chaos in the world and an increasing loss of control. What's the reason for this?
- Information and Communication Technologies (ICT), as we use them today, have contributed to the problems. They have created a world with too much speed, too much data, and too much connectivity.
- The speed of algorithmic control has surpassed possibilities of human supervision, as recurrent flash crashes at stock markets illustrate.
- Moreover, Big Data is not the universal tool that it was hoped to be. Mining more data might be worse, because Big Data is often not representative. The way Big Data is used may produce over-fitting, spurious correlations, classification errors, and discrimination. Hence, erroneous or otherwise problematic results are likely, which may lead to seriously wrong decisions.
- Furthermore, Big Data analytics often implies a "flashlight effect": certain details are over-emphasized, thereby distracting us from other important developments and trends.
- To inform us well, we need better approaches than mining Big Data, based on tailored measurements and the combination of data-centered methods with models, computer simulations, and experimental approaches.
- The high level of connectivity in our world, linking computers, people, and things, has created what I call a "complexity time bomb": it causes new externalities and increasingly many vulnerabilities to cascade

effects and systemic instabilities, which threaten the controllability of global techno-socio-economic-environmental systems.

- Financial meltdowns, "tragedies of the commons," armed conflicts, and cyber threats are some of the instability-borne, global-scale consequences we are currently facing.
- Such instabilities may lead to fragmentation processes, socio-economic turmoil, and rapid transitions in our economy and society.
- The digital revolution progresses at extreme speed and comes with a quick spreading of automation and probably mass unemployment, which will transform our economy and society. *NSA* surveillance, *Bitcoin* and *Uber* are just some of the irritating symptoms of change.
- The digital revolution will quickly change almost all established institutions in our economy and society. Therefore, the 21st century will most likely be governed according to fundamentally different principles than the 20th century.
- I expect that the current organizational principles of long-term planning, administration, and regulation will increasingly be complemented or replaced by principles such as self-organization, (co-)evolution, and collective intelligence.
- It will take major investments to prepare our society for the digital revolution. We will need to build new infrastructures and institutions for the emerging digital society in the same way as we publicly invest into good conditions for the agricultural, industrial and service sectors.
- To make our societies more resilient, diversity and modular designs with engineered breaking points or shock absorbers are needed.
- On a societal and economic level, this implies the need of distributed ("decentralized") control approaches.¹
- Taxing high connectivity, strong interactions, long-range interdependencies, and other factors that can promote systemic risks would help us to increase systemic resilience and allow us to invest into the required digital institutions and infrastructures.

¹ including informational self-determination

- Our current way of globalization, trying to increase homogeneity while at the same time producing every more non-local interdependencies, undermines many classical mechanisms producing cooperation.
- The related reduction of social capital such as cooperation and trust reduces social stability and order.
- To compensate for this, many governments have invested into mass surveillance and armed police.
- However, a "Big Government" approach is not sustainable on the long run, if too much top-down control is exerted.
- For example, risks of terrorism seem to increase, and there have been US-wide protests against police violence in Ferguson and elsewhere.
- The spreading of reputation systems offers a promising bottom-up alternative to promote cooperation and quality. Reputation systems transfer the success principle behind the social order in a village to a globalized world.
- However, to support socio-economic diversity, innovation, and collective intelligence, it is important to allow for individual quality criteria and multi-dimensional ratings, as well as individually configurable reputation systems.
- Faced with the increasing data tsunami, we will need information filters ("digital sun glasses") to keep an overview of our situation. Allowing people to modify and share the information filters used by them will create a pluralistic and quickly evolving information ecosystem, in which increasingly better information filters emerge.
- In general, Information and Communication Technologies (ICTs) can provide innovative solutions to our 21st century problems, if they are suitably designed and used.
- Today's information and communication systems allow top-down and bottom-up approaches to come together in entirely new ways and to strengthen bottom-up coordination and mutual help.
- In many cases, problems, tacit knowledge, needs and resources are local. With a stronger involvement of customers, citizens and users, it

is possible to produce better fitting solutions "on the bottom" and to free up capacities "on the top." This supports the "subsidiarity principle," according to which it is best to decide only those things on the top that cannot be efficiently solved on the bottom.

- In any case, our society and economy are complex dynamical systems. This requires a new way of systemic thinking, focusing on interactions rather than on system components.
- Attempts to "control complexity", i.e. to force a complex system to behave in a certain way, are often unsuccessful and expensive, and sometimes even counter-productive.
- But complexity science allows us to understand the surprising outcomes resulting from interactions in the system, such as self-organization and emergent properties. This offers new opportunities to manage complexity.
- With the pervasive sensor networks behind the emerging "Internet of Things," we can now perform a real-time measurement of our world. There are already more "things" (e.g. computers, smartphones, or machines) connected to the Internet than humans. In ten years, the Internet of Things will probably include about 150 billion sensors.
- The Internet of Things makes it possible to build a "Planetary Nervous System" offering (1) greater awareness of chances and risks to support everyone's decision-making, (2) possibilities to enable "smart," self-organizing systems, and (3) opportunities to create collective intelligence.
- The Planetary Nervous System can also help us to reveal the forces underlying socio-economic change as well as the principles of success or failure in socio-economic systems.
- In complex systems, self-organization can often outperform top-down management. Guided self-organization is resource-efficient and resilient.
- Many processes and outcomes in our society and economy are based on self-organization processes.

- Given suitable institutional settings and interaction rules, a complex system will self-organize in a bottom-up way and create the desired functionality.
- In the past, we have often been bad at finding and implementing suitable institutions and interaction rules. These may be found, however, by studying the success principles of various cultures, sophisticated computer simulations, or experimental approaches. Experiments may also be performed in Interactive Virtual Worlds, such as serious multi-player online games.
- If the institutional settings and interaction rules are well chosen, it takes only minimally invasive measures to guide the self-organization of a complex dynamical system and manage its complexity.
- A great advantage of self-organization is that it's mostly based on local interactions and, therefore, doesn't require a full view of the entire systemic complexity (which has surpassed everybody's cognitive capacity).
- Decentralized approaches are spreading with good education; access to reliable high-quality information, decision support systems and services; emergence of coordination platforms (such as social media); use of reputation systems promoting accountable and responsible behavior, and the consideration of externalities.
- These factors are currently on the rise with the spreading of Open Data, citizen science, recommender systems, moderated Internet communities, the makers movement, the Internet of Things, etc.
- Decentralization (e.g. by means of modular designs or "niches") improves systemic resilience (by decoupling) and allows one to manage and harness the increasing level of complexity and diversity of global systems.
- Diversity is an important precondition for innovation and collective intelligence, happiness and resilience, but it also creates interface problems between local solutions, which may not be mutually fitting.

- Suitable Information and Communication Technologies (ICT), namely "Social Information Technologies" ("socio-cultural guides"), can help us to overcome such interface problems and to support self-organization and coordination.
- For self-organization to work well, other-regarding rules (considering the interests of the affected neighbors) are needed.
- If everyone considers externalities (the impacts on interaction partners and the environment), the principle of the "invisible hand" can work well, i.e. individual and systemic outcomes can simultaneously improve over time.
- The externalities can be measured with the Planetary Nervous System or determined in advance by using Interactive Virtual Worlds.
- The consideration of externalities creates benefits for all (e.g. it can overcome "tragedies of the commons" such as environmental pollution, climate change, or over-fishing).
- Other-regarding decisions (as they are characteristic for the "homo socialis") create "networked minds" and will become more common. This trend is promoted by evolutionary principles and social media.
- I further expect a spreading of multi-dimensional incentive and exchange systems, which will support socio-economic self-organization.
- The need for increased participation in our society and economy follows from the need to move towards a more distributed management and self-organization of complex systems.
- This implies a re-balancing of authority and responsibility in our economy and society, which requires "digital airbags and guardrails."
- To support responsible behavior, suitable institutional settings such as reputation systems or merit-based interaction principles will be crucial.
- The Economy 4.0 is driven by the (fourth) sector of information and knowledge production and will lead to a Participatory Market Society.
- The Economy 4.0 is characterized by automation and fundamental changes in work, ownership and production. One increasingly finds short-term commitments and projects, co-creation, home production

(e.g. with 3D printers), sharing, personalized products, and user-centric hyper-variety markets, as well as a modular organization of projects such that they form a network of projects.

- We are entering a less material age. Data and information-based products will be abundant and cheap. While material resources are limited and imply conflicts, for information-based goods it does not have to be like this. In this context, it is crucial how Intellectual Property Rights are regulated.
- It's time to build suitable institutions for the 21st century: global, participatory, trustworthy ICT systems.² Let's build them together!
- Citizens can and should contribute to the creation of the digital society.
- For example, a challenge of the Internet of Things is to build and operate it such that it respects the constitutional right of information self-determination and avoids a dystopian surveillance nightmare.
- One should, therefore, build and manage the Internet of Things as a Citizen Web. Moreover, a Personal Data Store should empower individuals to control who can use what kinds of personal data for what kinds of purposes.
- The Nervousnet community (nervousnet@ethz.ch) has started to work on this. It wants to create an open, transparent, participatory, and user-controlled Planetary Nervous System.
- Nervousnet will offer open real-time data to benefit everyone, based on the principle of give and take. Besides data, the Nervousnet community will share open source codes to measure, process, and visualize data.
- This will allow everyone to offer consultancies, run projects, or create an own business. The economic value of Open Data is estimated to be in the order of thousands of billions of dollars per year.³
- Together, we can create a huge innovation, product, services, and information ecosystem, and a better future!

² See the last chapter and http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2490894 for a discussion of these platforms.

³ See http://www.mckinsey.com/insights/business_technology/open_data_unlocking_innovation_and_performance_with_liquid_information