

The FuturICT Knowledge Accelerator to Explore and Manage our Future

Globalization, societal and technological developments have changed our world at an astounding pace, much quicker than our understanding of it could progress. As financial markets demonstrate, the growing level of regional and systemic interdependencies has created exciting new opportunities, but also serious systemic risks. In fact, man-made structures that are created to enable new functions may also provide new pathways for the spreading of disasters.

The systems created by humans are now characterized by a degree of complexity previously unheard of. This often implies counterintuitive behavior, feedback and cascading effects, and it causes self-organization, emergent phenomena, and unexpected regime shifts. Attempts to improve one part of the system often have unwanted side effects in other parts of the system. At the same time, previous experience is insufficient to prepare us for the future, as the financial crisis has shown.

Therefore, we need to invent and craft new methods and tools to support our imagination and tackle upcoming opportunities and challenges. Today, massive computer power and the collection and mining of "big data" are used to design and test everything from cars to planes to electrical devices and medical drugs. So far, however, we are lacking something like a "flight simulator" (or "policy wind tunnel") to explore techno-socio-economic-environmental systems, in order to give decision-makers a better, integrated picture and multiple perspectives on the hard problems we are facing.

Understanding socially interactive systems - society and future technological systems alike - is one of the greatest and most urgent questions to address in the 21st century. We quickly need to learn how to design and manage techno-socio-economic-environmental systems in a resilient and sustainable way, to minimize serious instabilities, uncontrollable systemic shifts, conflict, crime and war. This is what the FuturICT Knowledge Accelerator is about.

The FuturICT project is a response to the European Flagship call, which has been initiated by the Future and Emerging Technologies (FET) section in the area of Information and Communication Technologies (ICT). According to this call, flagship projects need to demonstrate a "man-on-the-moon" scale vision, a scientific revolution, the creation of a paradigm shift, scientific coherence and critical mass. In a first competition, 21 flagship candidates were narrowed down to six flagship pilots, and these will have to submit their detailed proposals by about April 2012, describing the scientific roadmap, financial plan, organizational and legal structure. FuturICT is the only flagship pilot directly addressing techno-socio-economic challenges of the future. Only one or two of the six flagship pilots will be selected for full-fledged flagships and supported by up to 1 billion EUR each over a time period of 10 years - a tenth (or less) of what is invested into other Big Science: the CERN elementary particle accelerator, the ITER fusion reactor, the Galileo satellite program, the Human Genome project, etc.

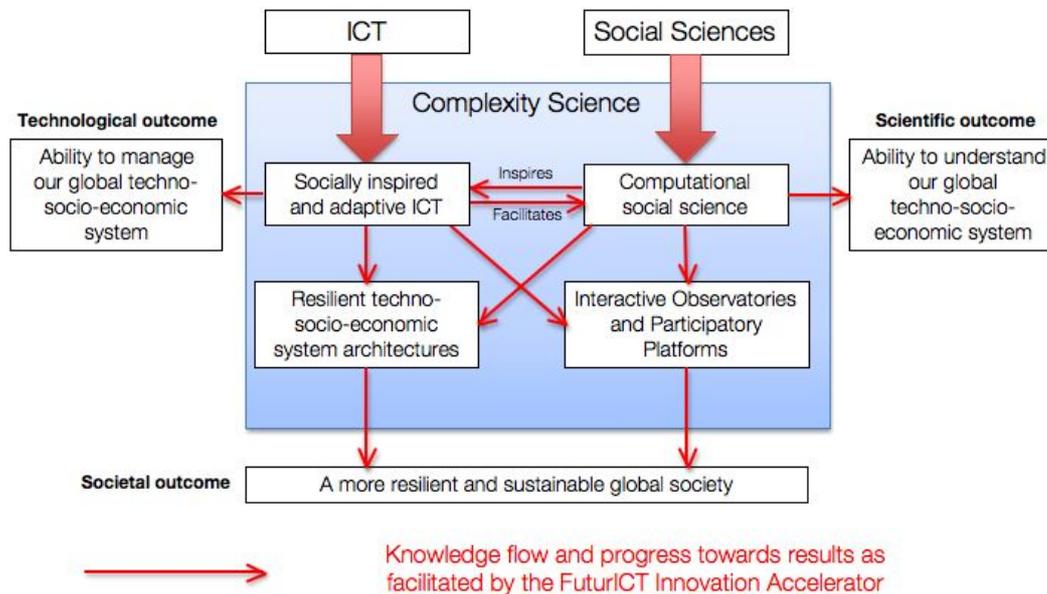
The European Commission will not provide the full budget required for the flagships. A

substantial fraction of the funding will have to be mobilized by the project partners themselves from national budgets and funding agencies, from business and industry, or from donations (and half of that amount can probably be contributed in-kind, i.e. by providing lab access, computer power etc.). FuturICT will create value that is multiple times higher than the required investments. Reducing the impact of crises only by 1 percent would save our societies billions of Euros every year. For example, the FuturICT projects will cost much less than one per mille of the financial crisis. And looking at the enormous value of social networking companies illustrates the breath-taking economic potential of *socio-inspired technologies*.

So, what exactly will FuturICT do? Just like the CERN, which studies the forces that keep our physical world together, *the FuturICT Knowledge Accelerator will study the principles that keep a social system together. This will be crucial also for the proper design of future ICT systems, as they are socially interactive systems as well: they are made up of billions of interacting, intelligent, and partially autonomously acting components (such as computers, smartphones, their users, etc.).* Since our society has become largely dependent on ICT systems, their stability and reliability has become absolutely crucial - but is not at all guaranteed in the way they are currently designed. In fact, it is known that increasing the density of networking can destabilize systems requiring cooperative behavior. Systemic breakdowns, cybercrime and cyberwar are problems that have become virulent indeed. At the same time, social features such as self-organization, adaptiveness, emergent cooperation, social norms, cultures and community formation are attractive features for ICT systems. "Trust" is just one example of a hardly understood, but crucial property of social systems - and ICT systems as well.

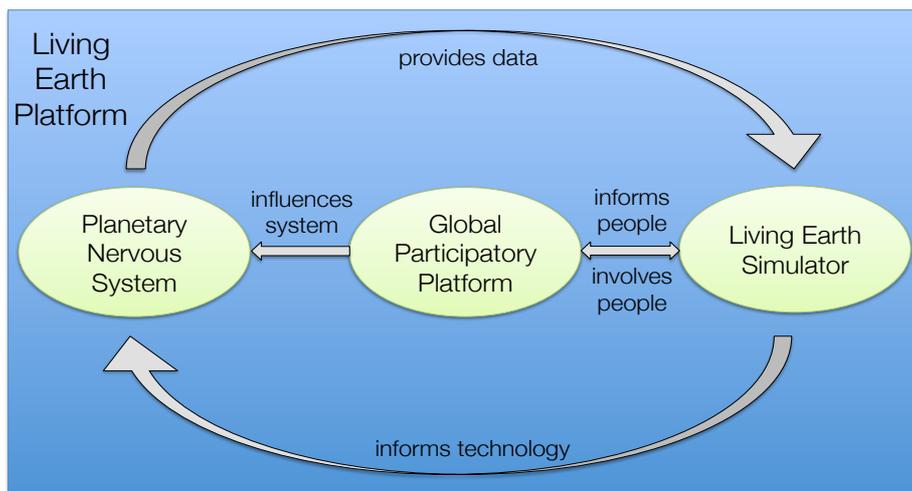
FuturICT will, therefore, create sustainable, *socio-inspired technologies* - ICT systems that *self-organize* and *socially adapt* to users, their respective contexts, and to individual and collective needs. It will create a *Living Earth Platform*, which includes mainly three levels: the techno-socio-economic "flight simulator" (also called "Living Earth Simulator"), a "*Planetary Nervous System*", and a *Global Participatory Platform*. The simulator will require the development of interactive decentralized supercomputing that scales up to global-level systems and allows one to study the impact of different possible decisions, i.e. to *explore various future scenarios* at different degrees of detail, employing a variety of perspectives and methods (such as multi-level and micro-macro models or agent-based simulations, where agents are sophisticated and equipped with cognitive features). This requires us to establish a *World of Modeling* - an open platform comparable to an app-store, where scientists and developers can provide theoretically informed and empirically validated modeling components that map parts of our real world. It also needs a coupling with huge amounts of data, which will become available by integrating various data sources coming from online surveys, web and lab experiments, and from large-scale data mining.

FuturICT: Innovative ICT and science for a resilient and sustainable society



This is, where the *Planetary Nervous System* comes in - and the need for a new data science, a "*social information theory*" that allows us to understand when and how new knowledge is created from existing pieces of information. The Planetary Nervous System can be imagined as a global sensor network, where sensors mean everything that provides data about techno-socio-economic-environmental systems in real-time (including the internet). Such an infrastructure will allow one to do reality mining on a global scale and to measure the socio-economic-environmental footprint of human actions, i.e. to create a greater awareness of the possible implications of human decision-making. This will result in better tools to increase human well-being than the gross national product is today.

The massive amounts of data produced will also enable one to calibrate and validate models of techno-socio-economic systems, and even to extract suitable models in a data-driven way, guided by theoretical knowledge. Note, however, that FuturICT is not interested in tracking individual behavior. It rather wants to understand the macroscopic interdependencies resulting from social interactions. In fact, FuturICT will promote the development of a *trusted web and of privacy-respecting data mining technologies* that give users back control over their data. FuturICT wants to benefit society and not control it. Therefore, FuturICT will also have a strong research focus on ethical issues, and it is committed to informing the public about the use of socio-economic data and to counter-acting misuse of data and ICT.



Furthermore, FuturICT will build a *Global Participatory Platform* that promotes the communication, coordination, cooperation of people, and their social, economic and political participation beyond what eGovernance platforms offer today. In fact, FuturICT will create opportunities to reduce the strict separation between users and providers, customers and producers etc., facilitating a participation in industrial and social value generation chains. Leveraging Wikipedia's success principle, FuturICT will help societies to use the knowledge and creativity of multiple minds much better than we can do it today. The Participatory Platform will also craft populated virtual worlds very much alike our real world, but with the possibility to create variants of them. In other words, through serious multi-player online games, we will be able to explore possible futures - not only different designs of shopping malls, airports, or city centers, but also different financial architectures or voting systems.

FuturICT will combine the best available and future approaches from ICT, the social and complexity sciences to address all these challenges. *Given the involvement of up to 300 teams of scientists in Europe and all over the world, and given its open platform approach, it has the potential to promote not only a favorable co-evolution of ICT and society, but also to create a renaissance of the social sciences, a new data science, and a whole new era of social information and communication technologies as well as a plethora of computational methods for modeling and theory building.* In fact, FuturICT has the potential to spawn a whole new economy and to improve everyone's life, in the same way as the internet has made our life so much richer. There is no doubt that a new information science and new branches of ICT and social science are emerging from the availability of big data and new theory-building and testing tools. Some countries, such as the UK, Ireland or the US, are now opening their data archives in order to identify jointly with their citizens, how public money can be spent more efficiently.

To succeed with its ambitious endeavor, FuturICT is building communities of

excellence integrating ICT, social and complexity sciences in most European countries, the US, Japan, China, and Singapore. It will build the *Living Earth Simulator* by integrating *Interactive Observatories*, which explore certain areas of our global techno-socio-economic-environmental system through a combination of large-scale data mining, computational modeling, supercomputing, and participatory approaches. For example, FuturICT plans to build interconnected Observatories of Financial and Economic Instabilities, of Conflicts and Wars, of Social Well-Being, of Health Risks, of Transportation and Logistics, and of Globalization. These Observatories will be closely connected to overcome disciplinary silo thinking, to gain a systemic picture of risks and opportunities, and to facilitate an integrated risk management. And they will pursue a pluralistic approach, allowing one to study many different perspectives, in order to give us a more differentiated picture of our world and allow us to better manage our way in a rapidly changing world.

In summary, *the FuturICT Knowledge Accelerator wants science to catch up with the speed at which new problems and opportunities are arising in our changing world as consequences of globalization, technological, demographic and environmental change*, and make a contribution to strengthening our societies' adaptiveness, resilience, and sustainability. This definitely needs Big Science, i.e. it cannot be reached without a large-scale, multi-disciplinary, European or even global effort.

FuturICT will produce its scientific and technological breakthroughs by developing new research approaches and combining these with the best established methods in areas like multi-scale computer modeling, social supercomputing, large-scale data mining and participatory platforms (including web experiments and populated virtual worlds). The grand innovations needed on the way will be promoted by "*Hilbert Workshops*", i.e. think tanks that identify through crowd sourcing methods, what the fundamental problems are and how they can be tackled. FuturICT will, in fact, create an *Innovation Accelerator* that will identify innovations early on, discover valuable bits of knowledge in a flood of information, help to find the best experts for projects, and support the distributed generation of new knowledge. In particular, it will support communication and flexible coordination in large-scale projects, co-creation and quality assessment. Hence, the Innovation Accelerator will also form the basis of the innovative management of the FuturICT flagship.

Further Reading:

<http://www.futurict.eu> , see also <http://www.futurict.ethz.ch/Media>

<http://www.futurict.ethz.ch/FurtherInformation> , for example, "Pluralistic Modeling of Complex Systems"

<http://springerlink.metapress.com/content/1951-6355/195/1/>

<http://www.futurict.ethz.ch/RelatedPublications>