



# FuturICT

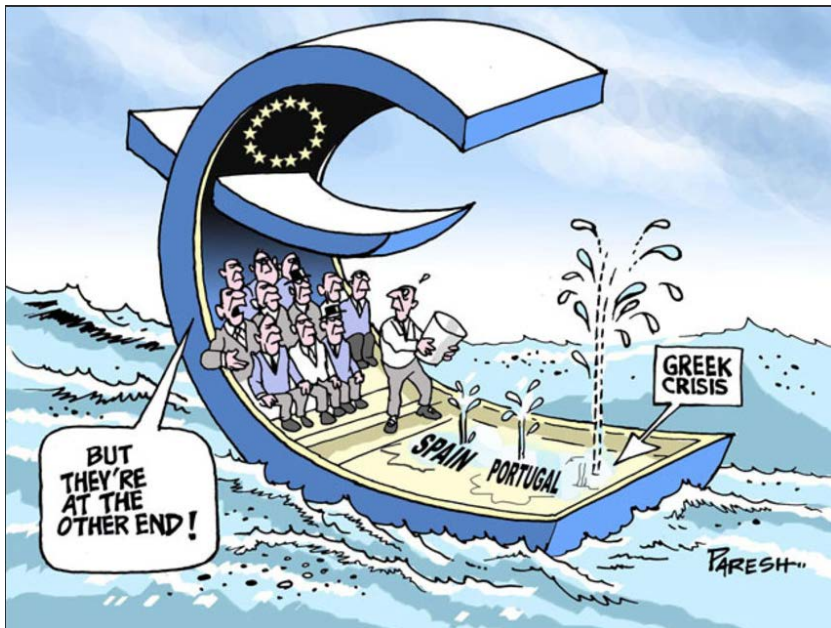
Dirk Helbing - ETH Zurich

Steven Bishop - UCL

[www.futurict.eu](http://www.futurict.eu)

# Our World Has Changed

- Globalization and technological change have created a strongly coupled world
- We have now a global exchange of people, money, goods, information, ideas...



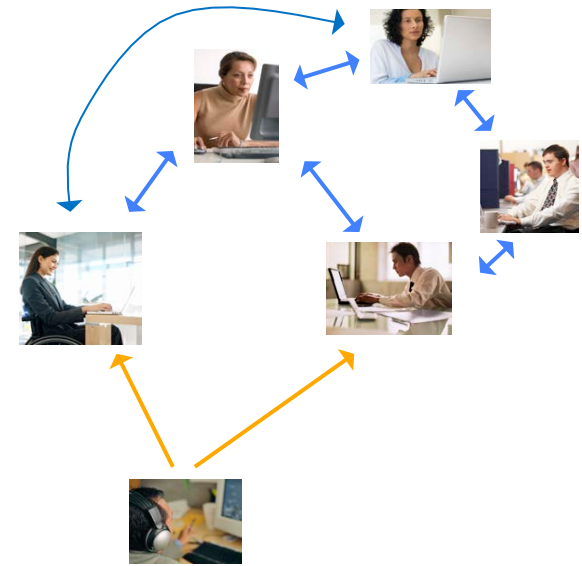
## Problems:

1. World financial and economic crises
2. Global terrorism and international wars
3. Political instabilities, revolutions
4. Global environmental change, extreme weather
5. Organized crime, cybercrime
6. Quick spreading of emerging diseases
7. Global disruptions of supply chains
8. Migration and integration problems

Network infrastructures also create pathways for disaster spreading

# Future ICT Systems Are Artificial Social Systems

- ICT systems are made up of **billions of non-linearly interacting components** (computers, smartphones, software agents, ...).
- More and more of them take **autonomous decisions**, based on an **internal representation** (“subjective” interpretation) **of the surrounding world** and expectations regarding future conditions.
- This effectively makes them **artificial social systems**.
- **Example:** Computer-based **automatic trading strategies** now perform the majority of transactions in our world’s financial system.
- **Most ICT systems are not designed and tested for the collective behavior of their components.**
- A lack of coordination, instabilities, an inefficient use of resources, conflicts of interest, cybercrime and cyberwar are the result.
- Note that **networking can destabilize systems!**
- **An understanding of social systems is needed!**



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# Challenges Humanity is Facing in the 21st Century



Lee C. Bollinger, president of Columbia University, formulated the issue as follows: [“The forces affecting societies around the world ... are powerful and novel. The spread of global market systems ... are ... reshaping our world ..., raising profound questions. These questions call for the kinds of analyses and understandings that academic institutions are uniquely capable of providing. Too many policy failures are fundamentally failures of knowledge.”](#)



# 3 Mega-Events Which May Lead to Global Power Shifts

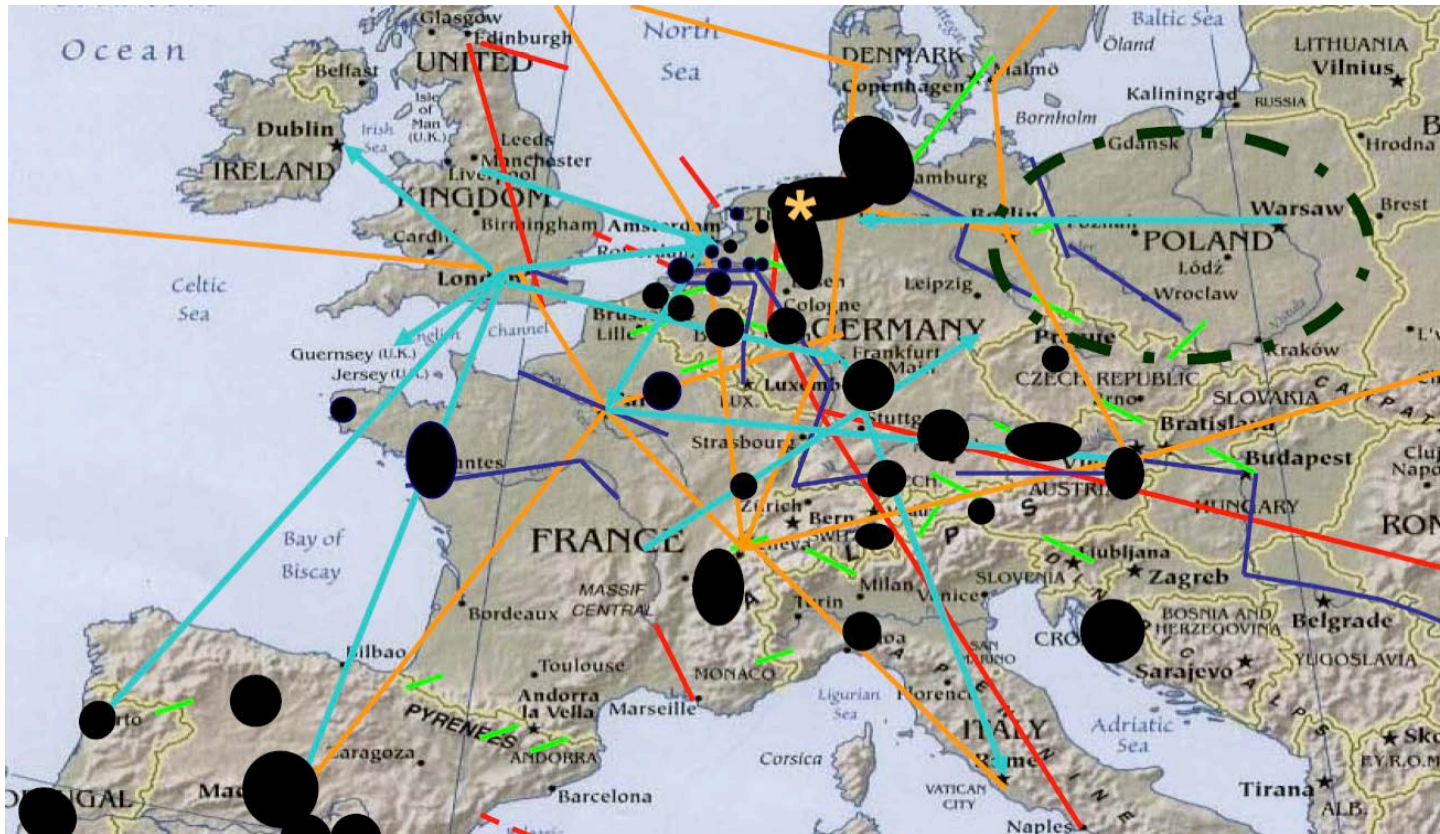
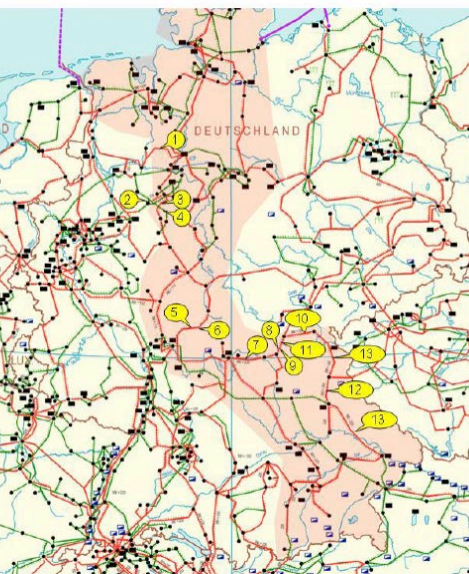
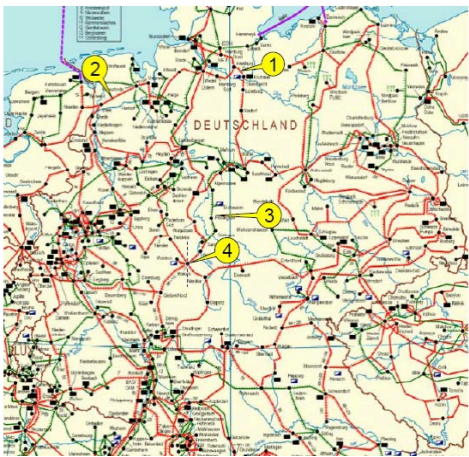


1. Financial Crisis
2. Arab Spring
3. Japanese Earthquake and Nuclear Disaster



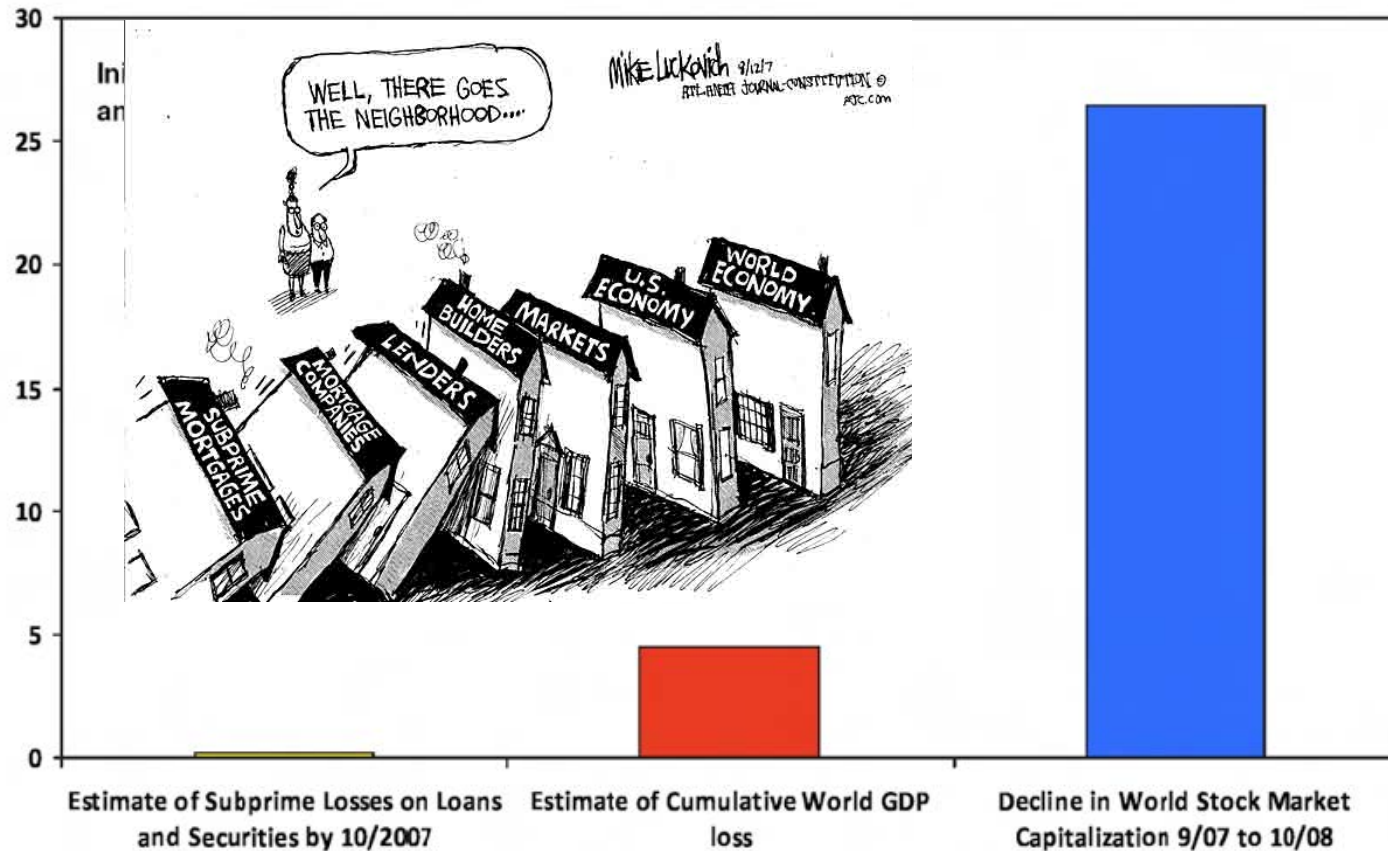
# Cascading Effect and Blackout in the European Power Grid

Failure in the continental European electricity grid on November 4, 2006



EU project IRRIS: E. Liuf (2007) Critical Infrastructure protection, R&D view

# Cascading Effect Were also Triggered by the Subprime Crisis



Source: IMF Global Financial Stability Report; World Economic Outlook November update and estimates; World Federation of Exchanges.

(thanks to Didier Sornette)

# Cascading Effects During Financial Crises



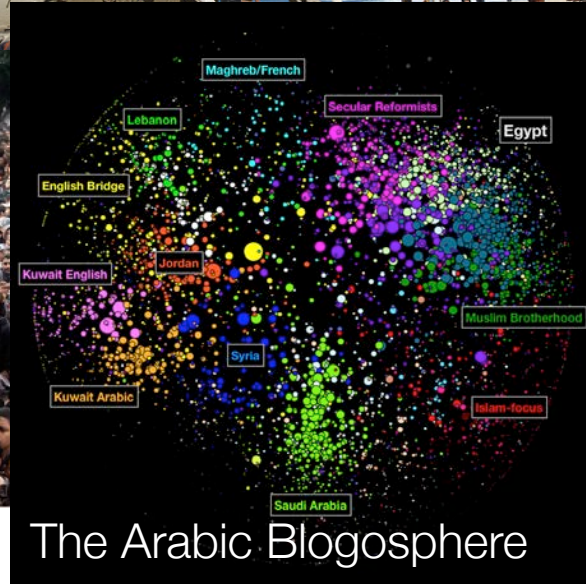
Video by Frank Schweitzer et al.



# Another Cascading Effect: Revolutions as Political Earthquakes

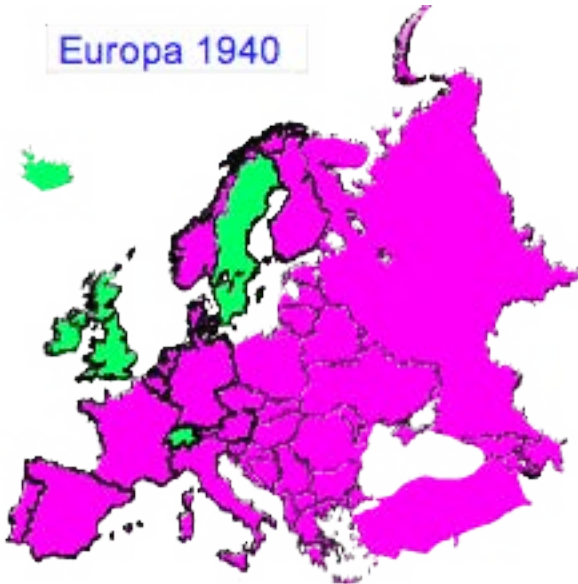


twitter



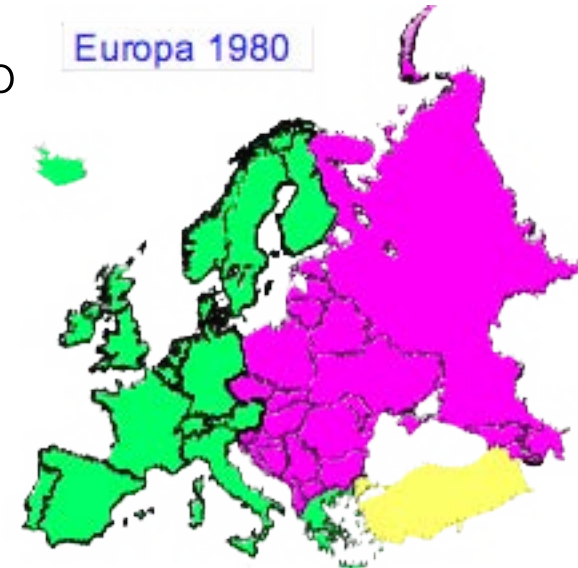
# Political Cascading Effects

Europa 1940



Transition from hierarchies to democracies  
(source: Jürgen Mimkes)

Europa 1980

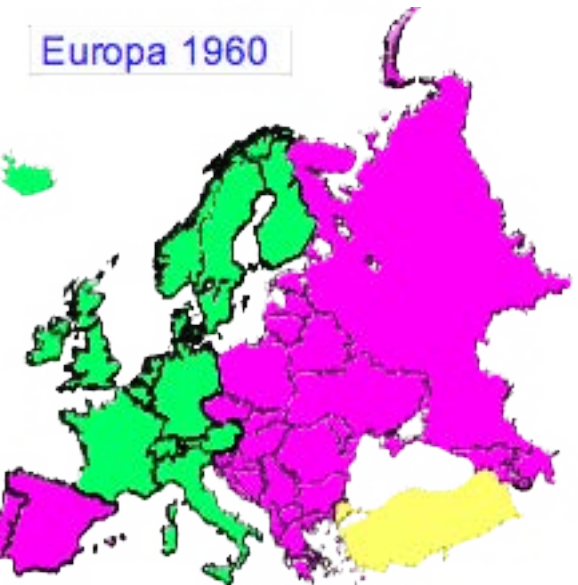


 hierarchy

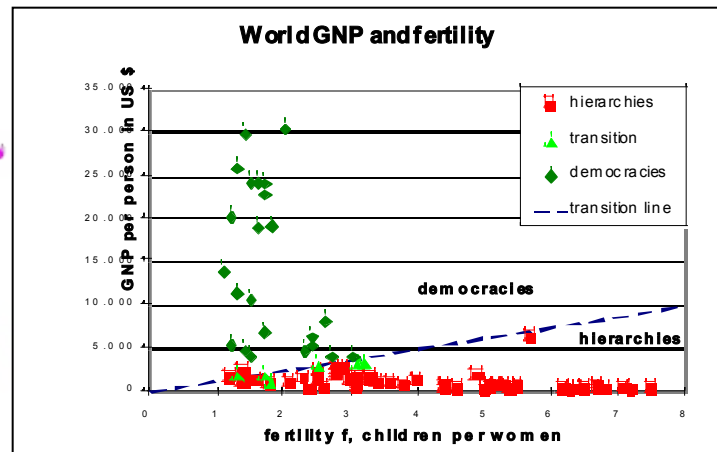
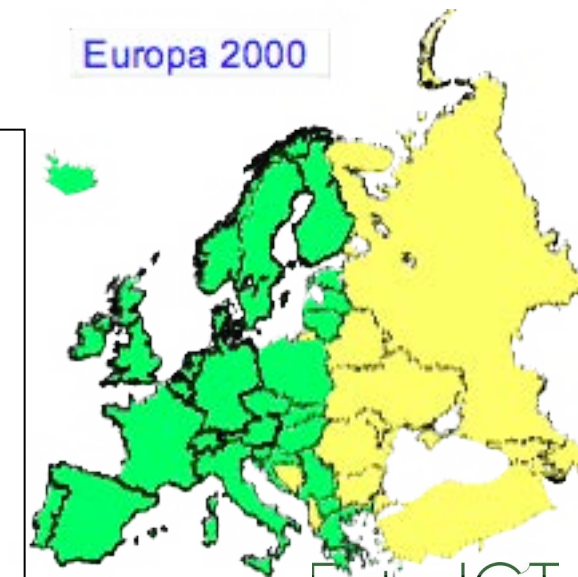
 transition

 democracy

Europa 1960



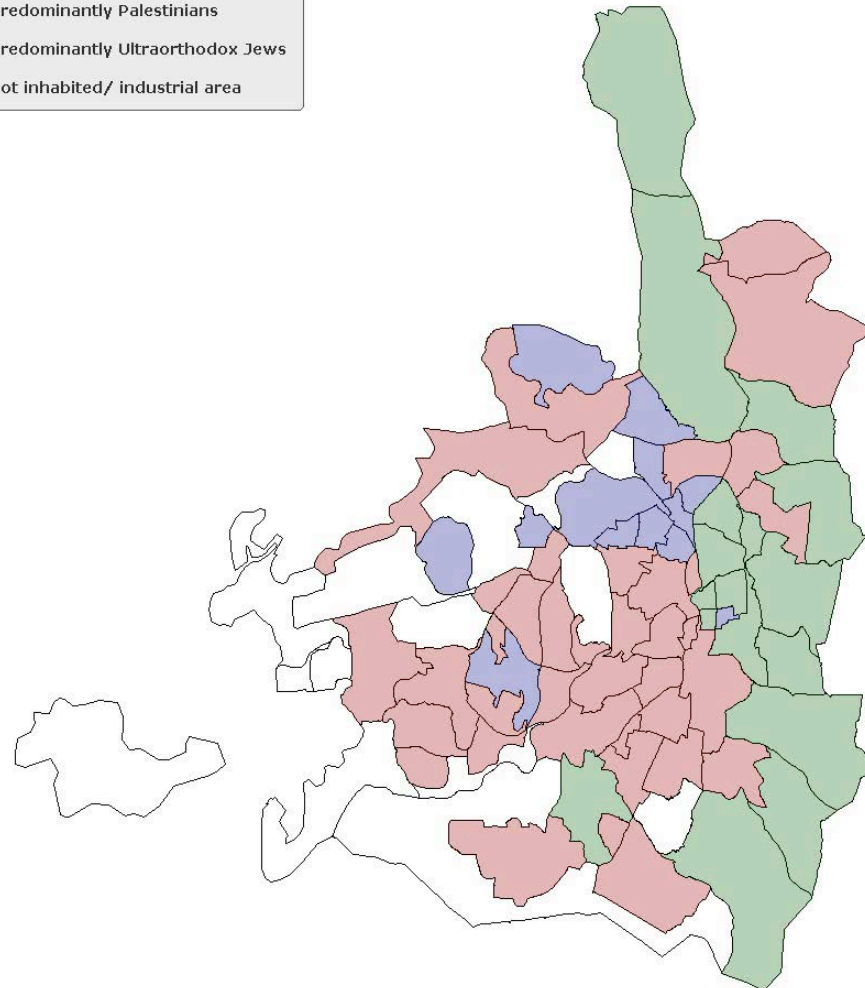
Europa 2000



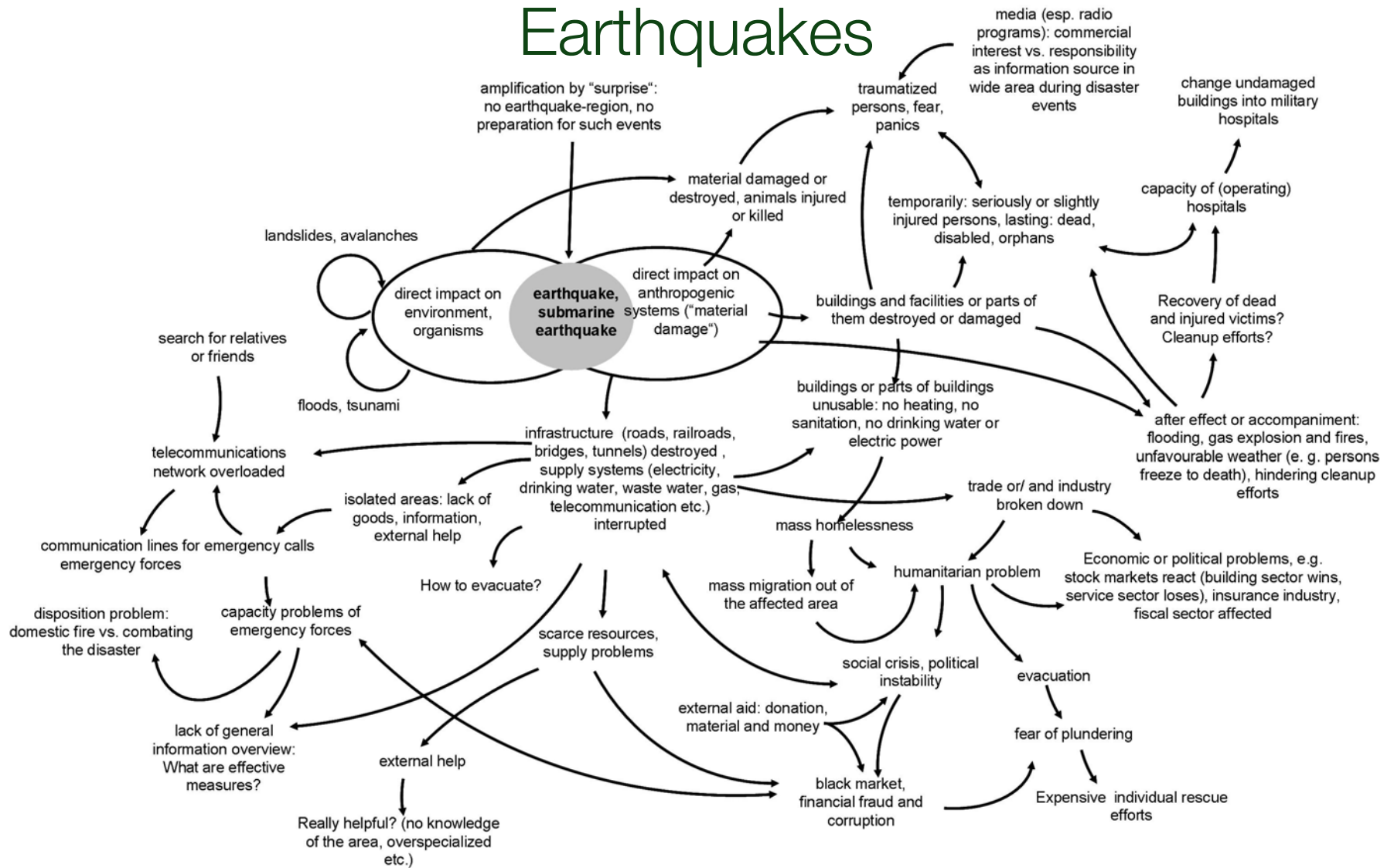
# Conflict in the Middle East



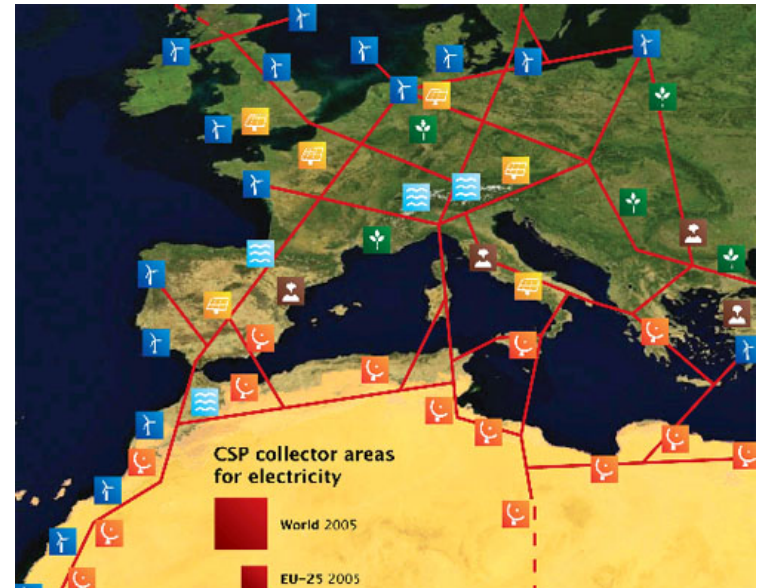
Jan. 2005



# Predicting the Sequence of Possible Impacts of Earthquakes

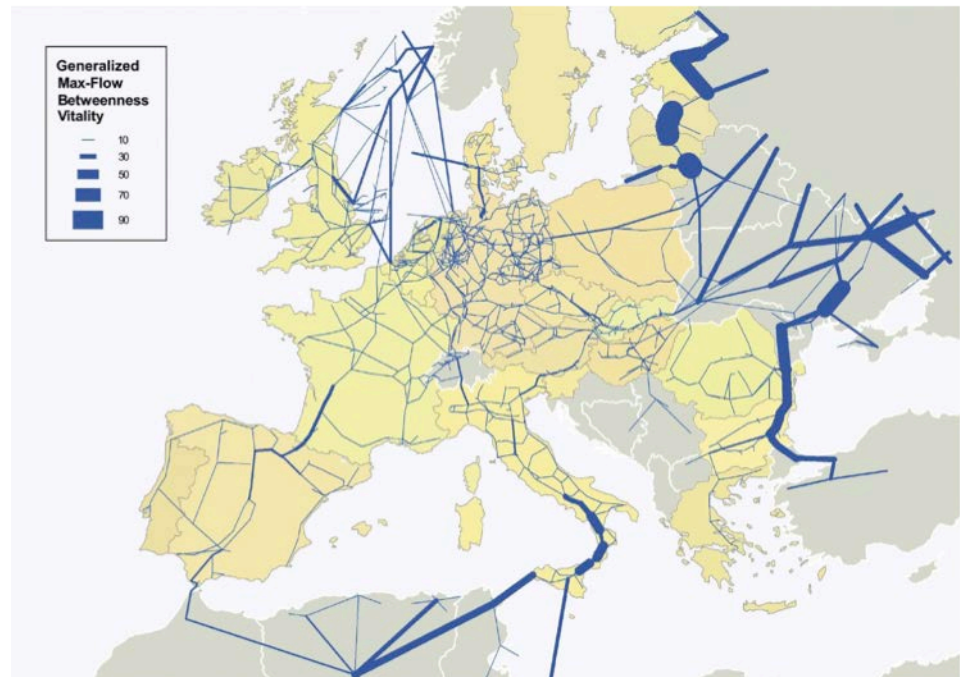
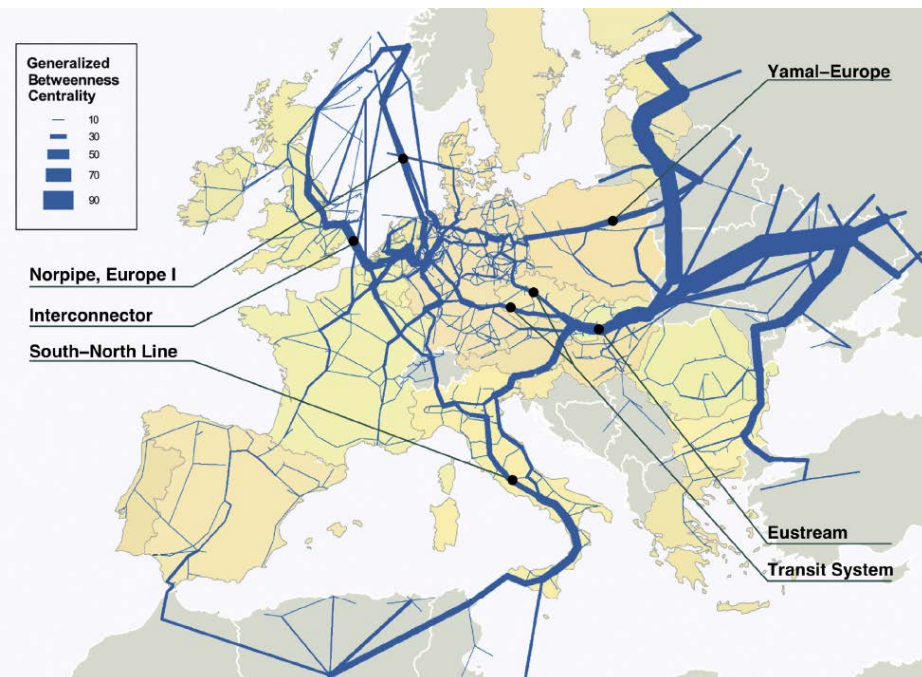


# Interdependencies in Energy Supply



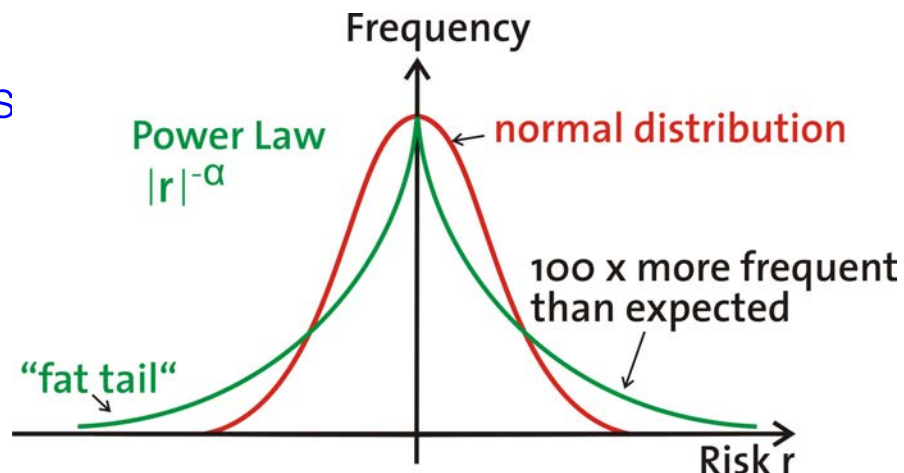
# Resilience and Fairness in the Gas Network

High Traffic (Hot) Backbone + Error Tolerance = Robustness

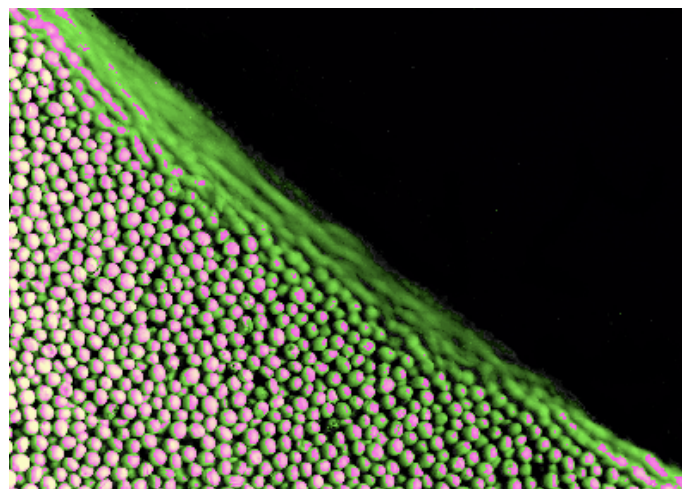


# Characteristic Features of Strongly Connected Systems

- Faster dynamics
- Increased frequency of extreme events
  - can have any size
- Self-organization and strong correlations dominate system dynamics
- Unwanted feedback, cascade and side effects, counterintuitive behavior
- Predictability goes down
- System optimization not possible in real time – even with supercomputers
- Possibilities of external control are limited
- Larger vulnerability to random failures and external shocks
- Loss of trust



Examples: Frequency of floods, storms, earth quakes, wars



Our current world shows all these features!

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# Nuclear Forces: An Example of Strongly Coupled Systems



Have humans inadvertently built a global time bomb?



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# Are Derivatives Financial Weapons of Mass Destruction?

## Buffett warns on investment 'time bomb'

Derivatives are financial weapons of mass destruction

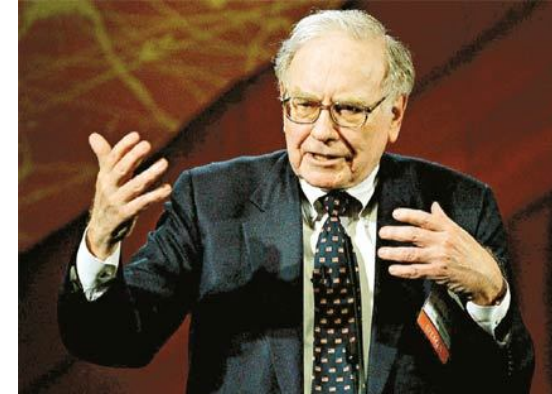
Warren Buffett

**The rapidly growing trade in derivatives poses a "mega-catastrophic risk" for the economy ..., legendary investor Warren Buffett has warned.**

The world's second-richest man made the comments in his famous and plain-spoken "annual letter to shareholders", excerpts of which have been published by Fortune magazine.

The derivatives market has exploded in recent years, with investment banks selling billions of dollars worth of these investments to clients as a way to off-load or manage market risk.

But Mr Buffett argues that such highly complex financial instruments are time bombs and "financial weapons of mass destruction" that could harm not only their buyers and sellers, but the whole economic system. **(BBC, 4 March, 2003)**



Mr. George Soros

Zürich, 17 March 2010

Dear Mr. Soros,

Many leading scientists from various scientific fields, including Nobel Prize winners, have recently expressed their dissatisfaction with the state of economic theory, and it is obvious that new approaches are needed to address the fundamental and practical challenges of our financial, economic and social system. The criticisms of the pillars of classical economics are substantial and suggest that

- markets are not efficient by nature,
- economics can be driven far from equilibrium (as bubbles and crashes illustrate),
- the system behavior is dominated by interactions between the market participants and stakeholders, and hard to regulate,
- network interactions can change the behavior of markets dramatically, and
- science needs to be driven by empirical data, not just by the logic or beauty of theories.

This situation calls for concerted action and a largely multi-disciplinary approach. It has been proposed, for example, that one can gain valuable insights by comparing financial with eco-systems, in which extreme events can be the result of systemic instabilities. This approach relates to the theory of complex dynamical systems, considering randomness and strong interactions as fundamental features.

The financial crisis has not only created huge financial losses. It has damaged the economic system to an extent that several countries are at the verge of bankruptcy, and social systems have become dangerously vulnerable. The problems we have seen may just be the beginning of a larger crisis. The situation may totally get out of control, endangering social peace and cultural achievements.

It may, therefore, interest you that the European Union is currently creating scientific "Flagships" to address the grand challenges of the future. With a budget of 100 million EUR per year, over a period of ten years, they want to foster unprecedented scientific discoveries and radical innovation by transdisciplinary research. FuturICT, one of the initiatives applying for this program, aims at developing a realistic theory of economic systems and society, at creating computer simulations of global-scale systems, and at designing new concepts for a sustainable world. It will involve scientists from a large range of disciplines. Hundreds of experts in social simulation, economics, physics, sociology, mathematics, psychology, ecology, computer science, etc. would be working together to combine the best of human knowledge.

Herewith, we would like to invite you to be a galleon figure of this Flagship. The FuturICT flagship fits perfectly the goals of your **Institute of New Economic Thinking**. Joining forces could largely accelerate the required paradigm shifts and the development of solutions to the challenges humanity is facing.

Sincerely yours,

Dirk Helbing

Economists: Mauro Gallegati, Domenico Delli Gatti, Cars Hommes, Alan Kirman, Thomas Lux  
Econophysicists: Jean-Philippe Bouchaud, Dooyne Farmer, Imre Kondor, Matteo Marsili, Yi-Cheng Zhang**GEORGE SOROS**

March 30, 2010

To Whom It May Concern,

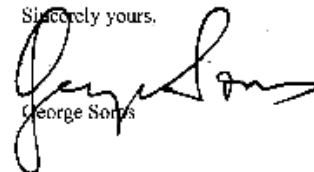
On behalf of the Institute for New Economic Thinking and Central European University I am writing to express strong interest in this scientific endeavor and in collaborating with the candidate flagship FuturICT and the team Professor Helbing is creating.

The Institute for New Economic Thinking (INET) [www.ineteconomics.org](http://www.ineteconomics.org) has been founded to foster and create new interdisciplinary ways to address social and economic problems. Applications of network theories to system evolution, political-economic interactions and psychologically sophisticated approaches to understanding system dynamics are just a few dimensions of exciting new research that our fellows will be working to develop.

Central European University, INET and a number of leading universities are working to establish a network of campus based joint venture institutes around the world to further invigorate our research agenda. The first of which, in conjunction with the Oxford Universities 21<sup>st</sup> Century School will begin to operate shortly. This interdisciplinary network will add further strength and depth of scholarship to the pursuit of new and deeper understanding of a myriad of social issues.

The team of scientists that Dr. Helbing has gathered together can, I believe, make a significant contribution to the understanding of the evolution and change in societies as they meet the formidable issues of governance, climate change, sustainable economic balance that we are all faced with in the coming decades. I look forward to CEU and INET joining with FuturICT to address these daunting challenges in the coming years.

Sincerely yours,

  
George Soros

Lord Robert May of Oxford: "Your letter to Soros puts the case admirably well, and I believe he may well be interested in such an initiative."

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# Our Knowledge of Global Techno-Socio-Economic Systems Today Is Quite Limited



“When the crisis came, the serious limitation of existing economic and financial models immediately became apparent... we felt abandoned by conventional tools.”

Jean-Claude Trichet

FuturICT

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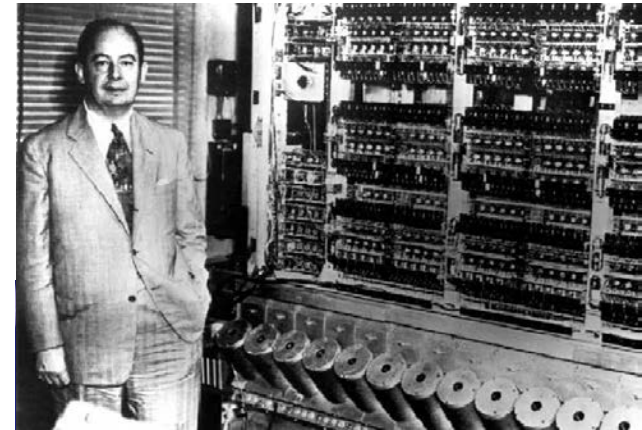
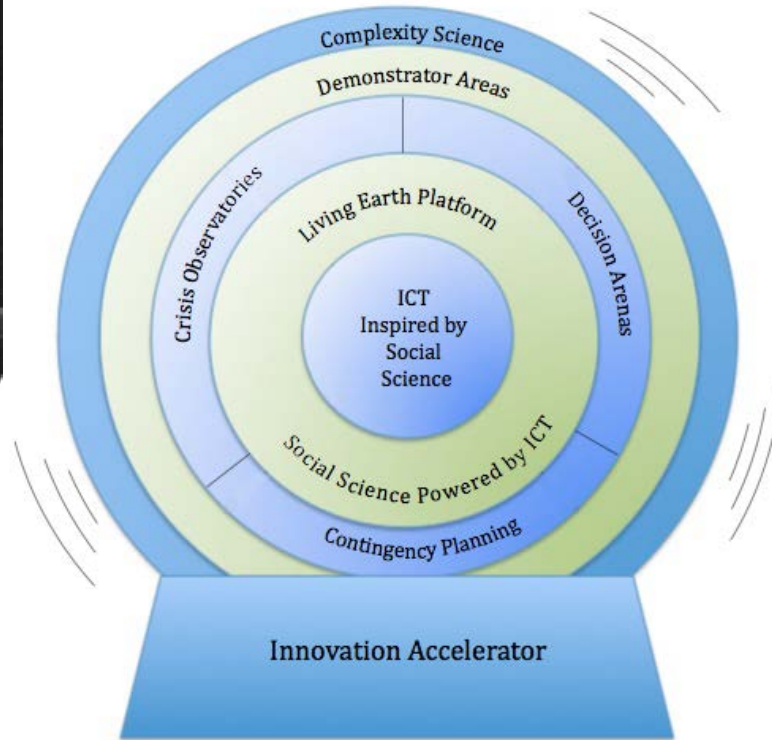
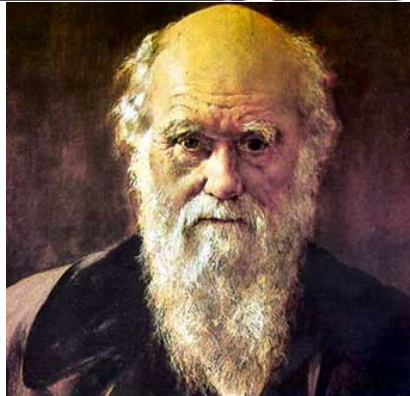
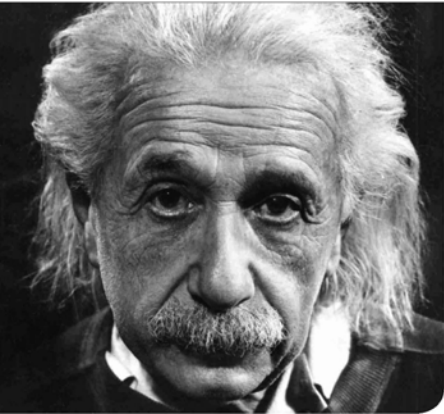
# Alex (,Sandy‘) Pentland of the MIT Media Lab Says:

- Our financial, transportation, health system are broken

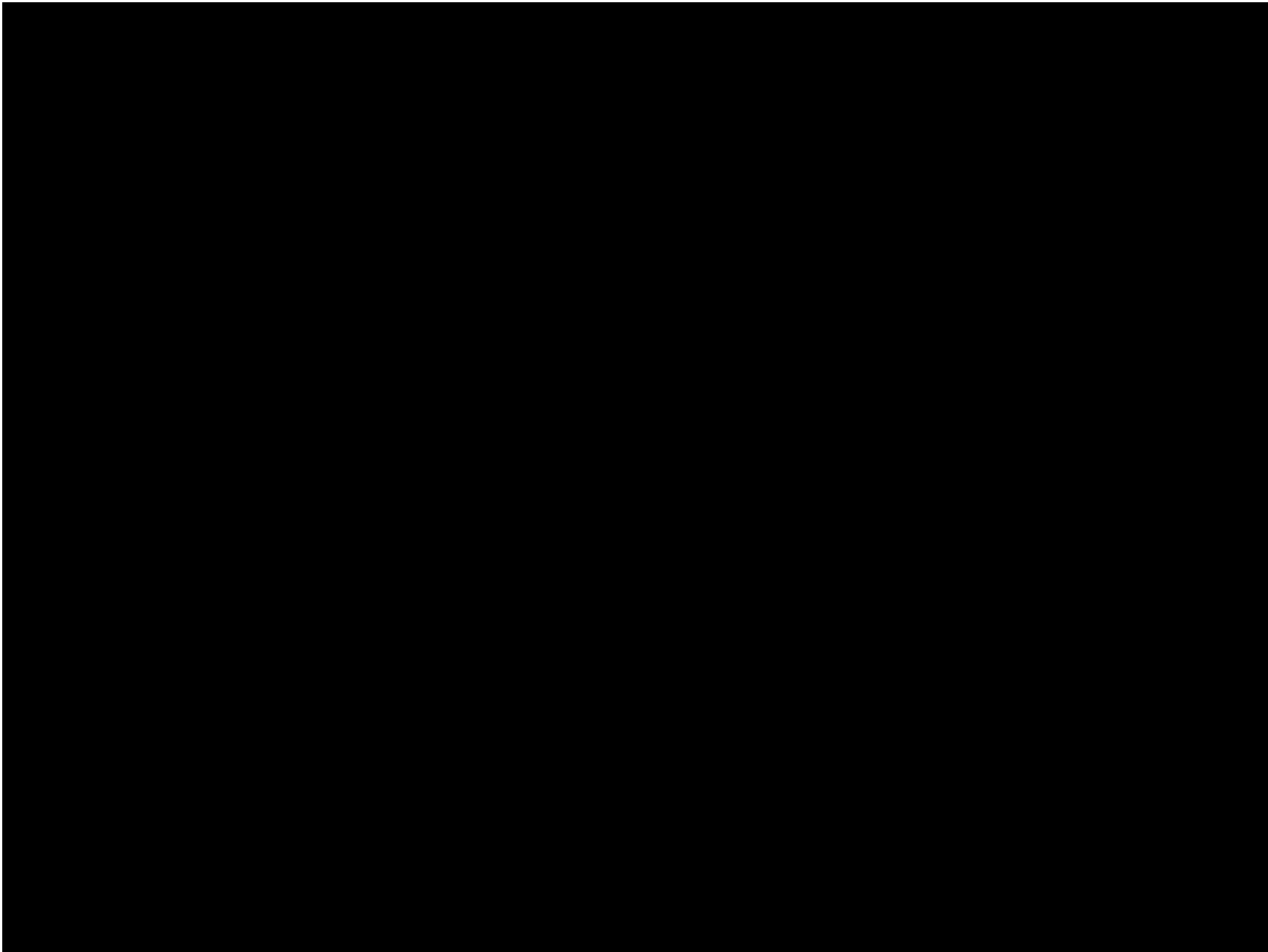


- We need to develop a decentralized adaptive approach
- Managing complexity requires real-time data mining

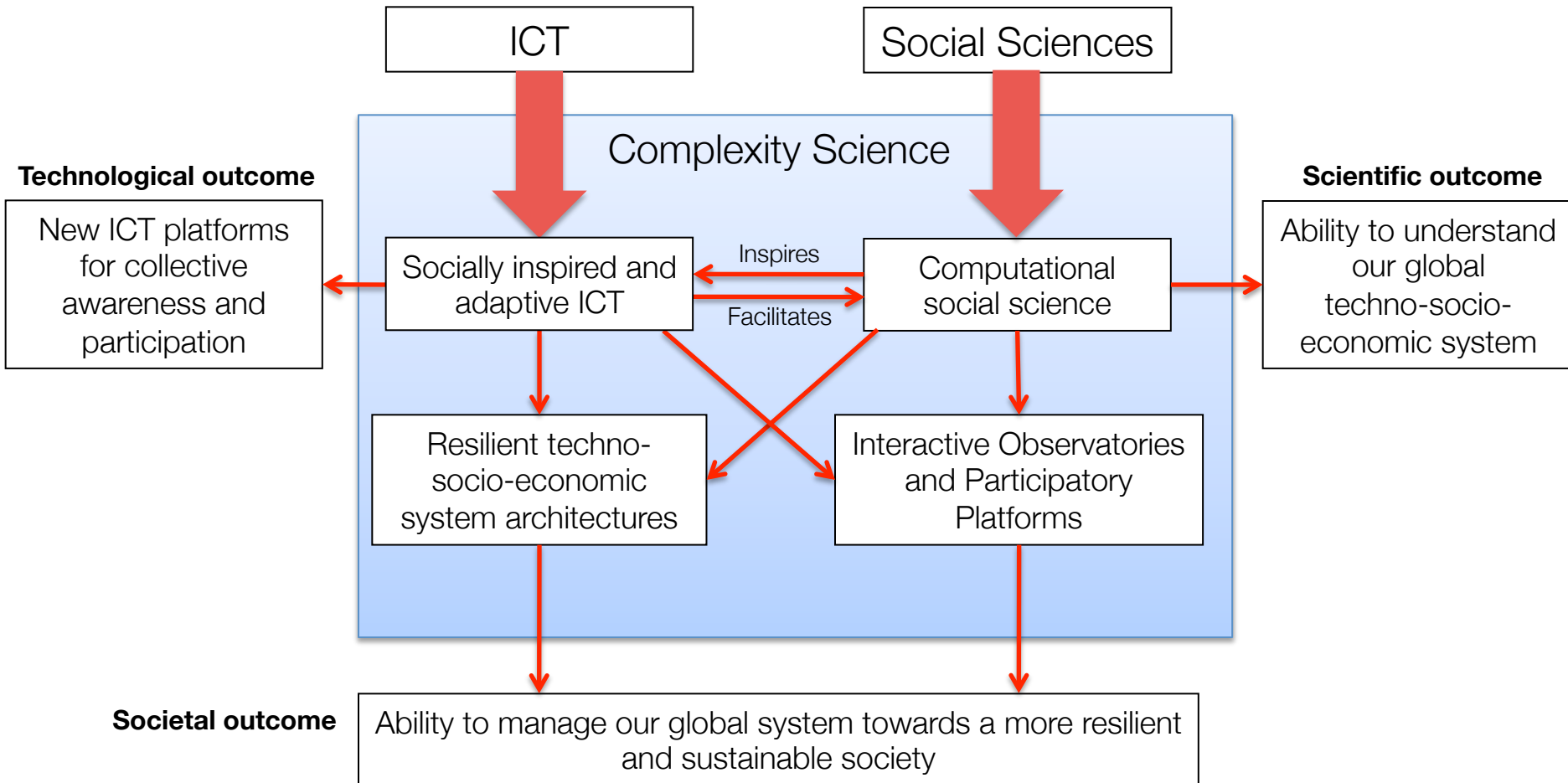
# The Need of A Knowledge Accelerator



We need to create a **techno-socio-economic knowledge accelerator** - a large-scale multi-disciplinary project that uses current and future ICT developments to address the challenges of humanity, involving natural scientists and engineers



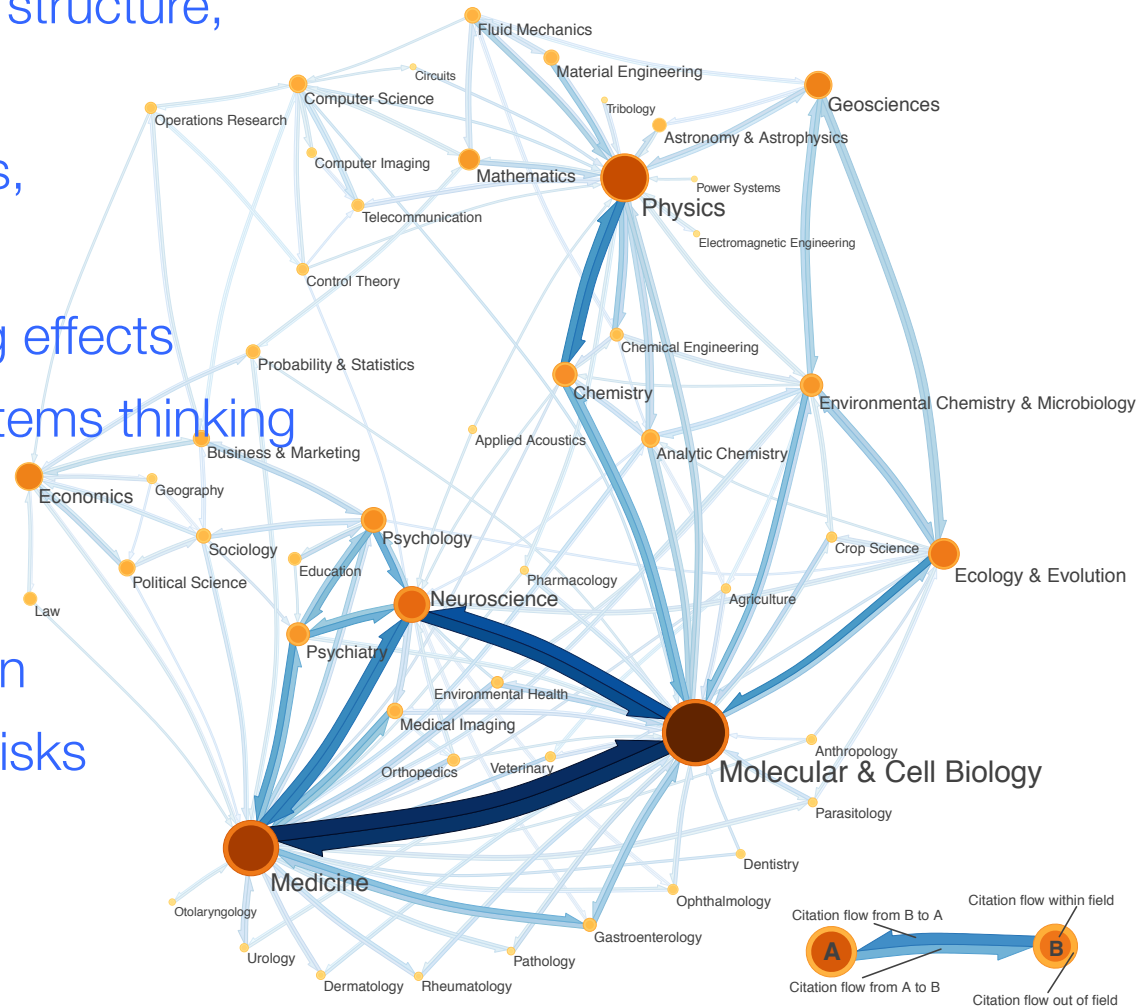
# FuturICT: Innovative ICT and Science for a Resilient, Sustainable Society



→ Knowledge flow and progress towards results as facilitated by the FuturICT Innovation Accelerator

# Some Over-Arching Research Challenges

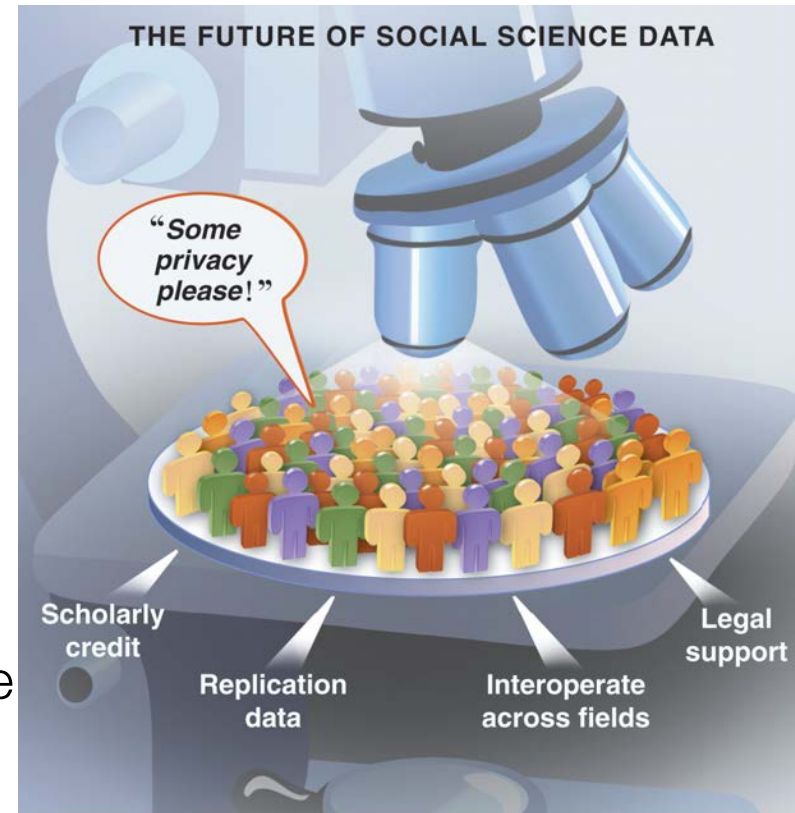
1. Interrelationship between structure, dynamics, and function
2. Strongly coupled systems, interdependent networks
3. Contagion and cascading effects
4. Ecological and social systems thinking
5. Managing complexity
6. Incentives
7. Integrative systems design
8. Resilience and systemic risks
9. Sustainability
10. Trust





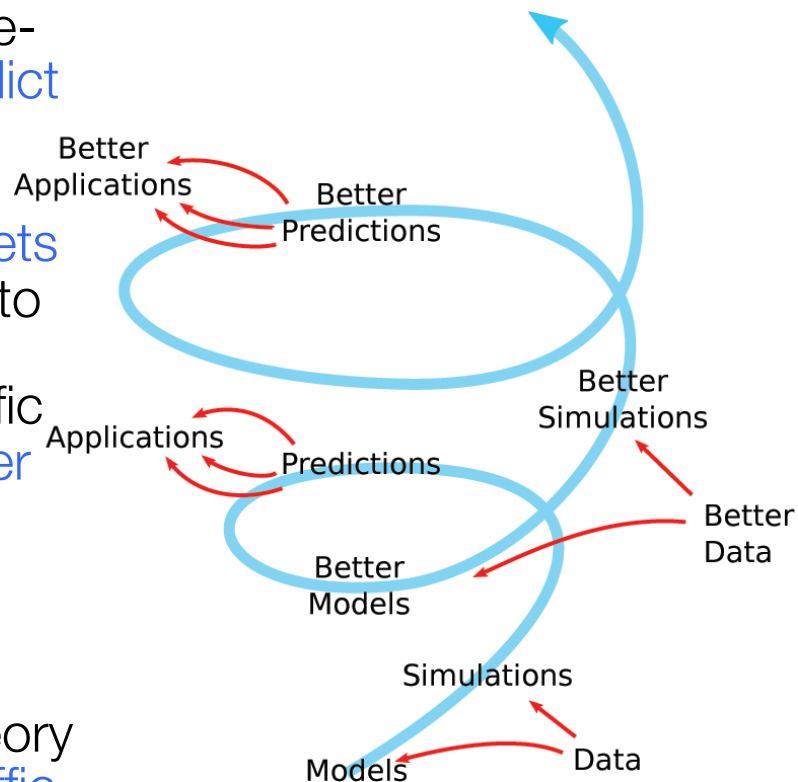
# A New Era of the Social Sciences

- Experiments, Big Data and computer simulations generate many new insights
- Models considering spatial and network interactions, heterogeneity, randomness (which can change the systemic outcome dramatically!)
- Models of the emergence of social cooperation under unexpected conditions (social dilemma situations promoting tragedies of the commons)
- Models for the formation of social norms, although individuals have to make a sacrifice
- Models for the spreading of conflict and violence
- Models of collective behavior (opinion formation, crowd disasters, revolutions)
- Models considering emotions
- Models explaining conditions for other-regarding behavior
- Models with learning and communication
- Models considering cognitive complexity



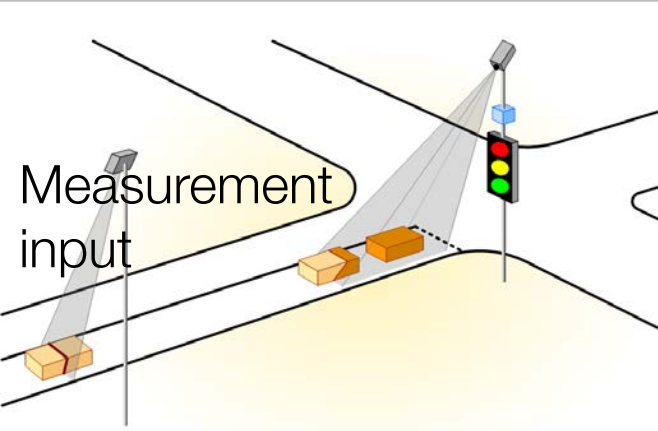
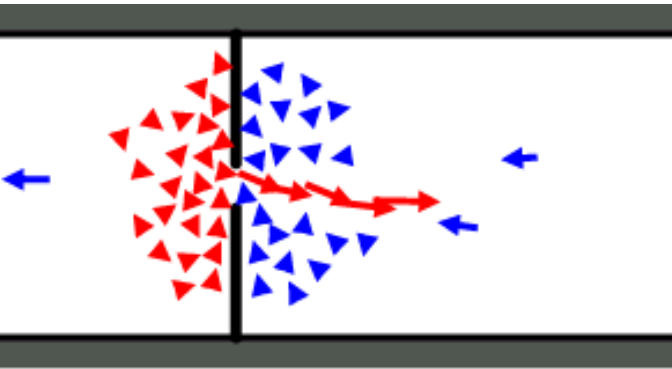
# Relevance of Scientific Progress and Use Cases

1. Models of social self-organization and segregation, [strategies to reduce crime and conflict](#)
2. Models of social cooperation, [recipes to overcome tragedies of the commons](#)
3. Opinion formation models, [prediction markets](#)
4. Models of pedestrian dynamics, measures to anticipate and [avoid crowd disasters](#)
5. Understanding of mobility patterns and traffic breakdowns, [congestion avoidance](#), [smarter cities](#)
6. Models of financial systems to increase the [robustness of stock markets](#)
7. Simulation of supply networks, more stable and [efficient production](#), business cycle theory
8. Models to [reduce war](#), [insurgency](#), [drug traffic](#)
9. Network theory and conditions for [resilience](#), Google's [page rank](#) algorithm, [reputation](#), [trust and recommender systems](#), [semantic web](#)
10. [Real-time measurement and simulation of pandemics](#), scenario-based policy recommendations, [immunization strategies](#)
11. Evolution of social groups and communities, [social networking](#) applications
12. Evolution of language, [communicating robots](#) etc.

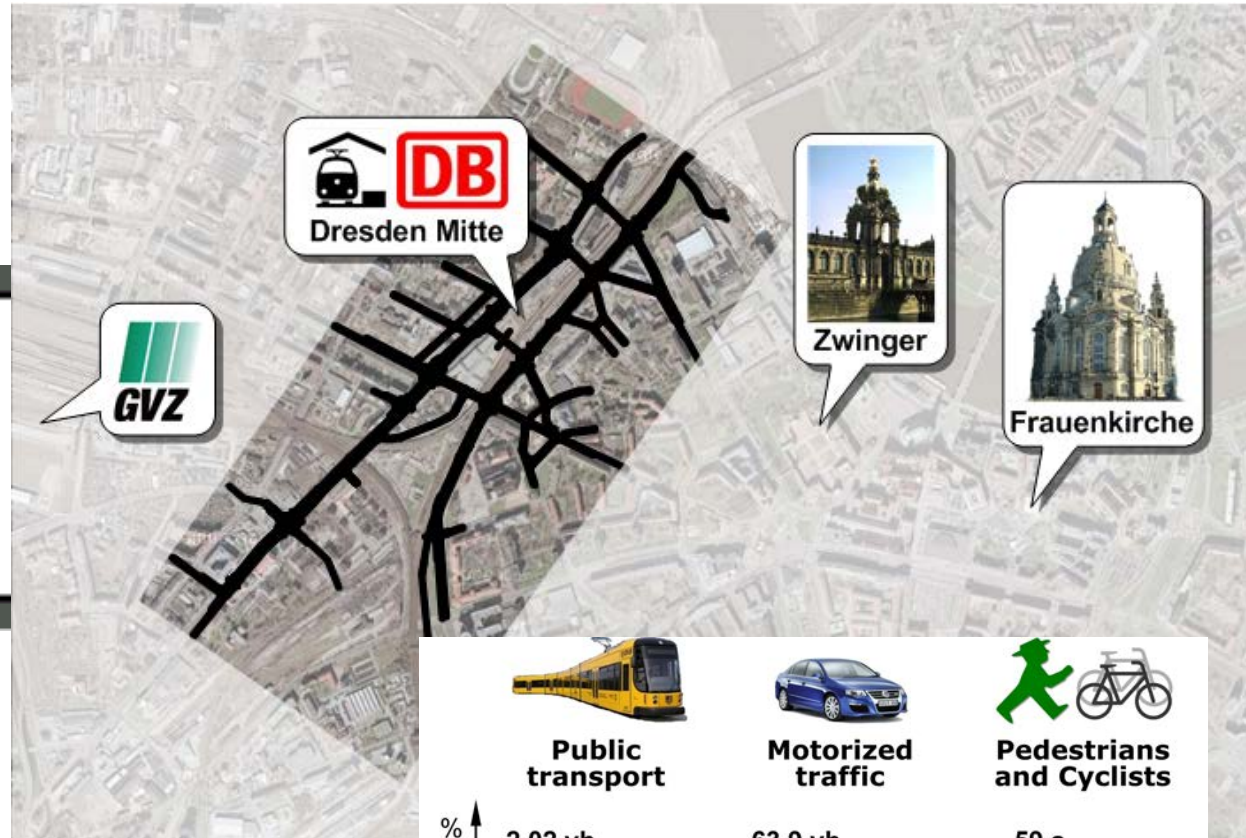


# Self-Control of Traffic Lights: Making More Out of Scarce Resources

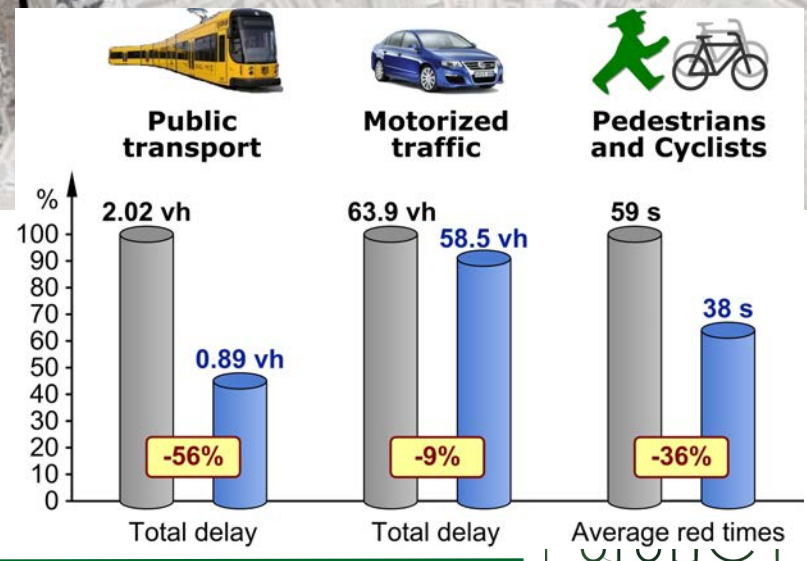
Inspiration: Self-organized oscillations at bottlenecks



Published in *JSTAT* (2008)

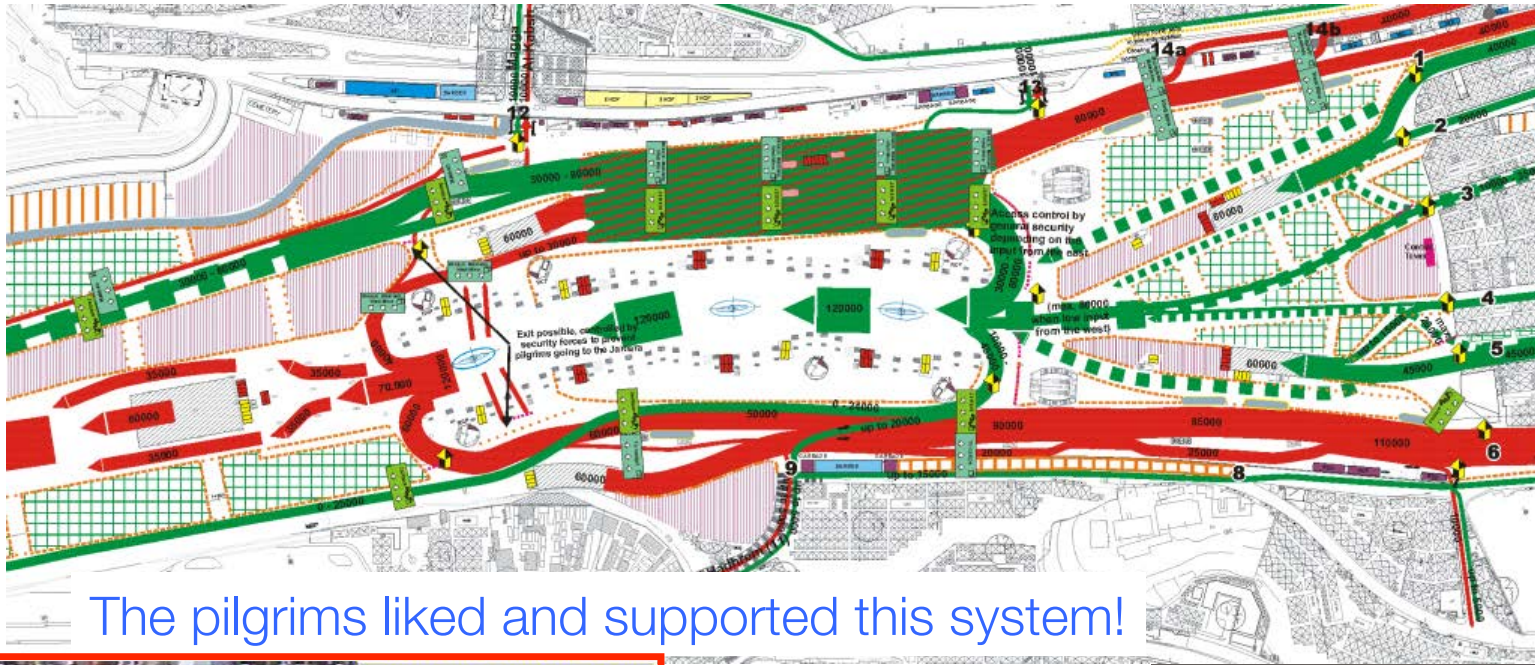


Optimal compromise between coordination and local flexibility



# Avoiding Crowd Disasters: A More Resilient Organization

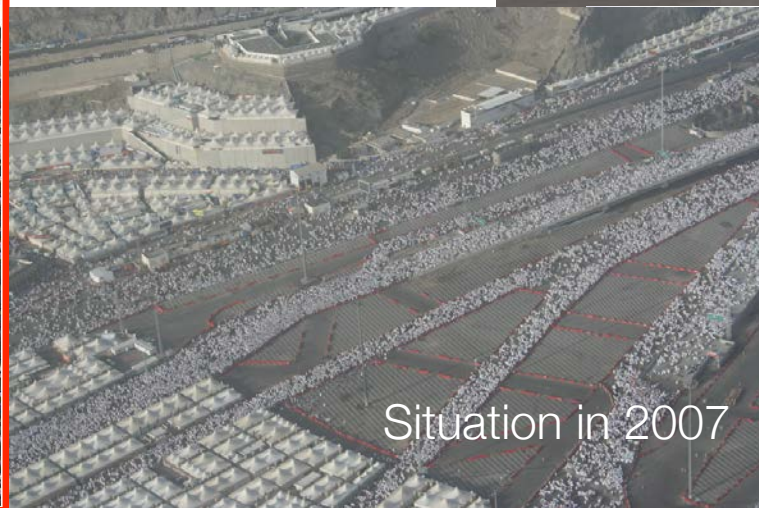
Thanks to:  
D. Serwill,  
IVW Aachen



The pilgrims liked and supported this system!



Situation in 2006



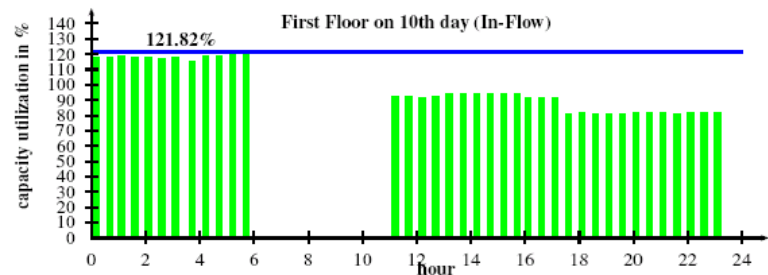
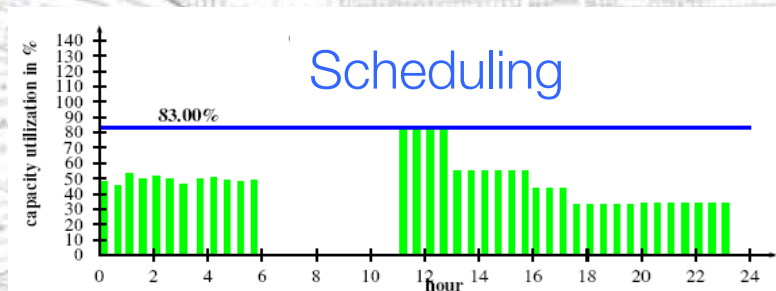
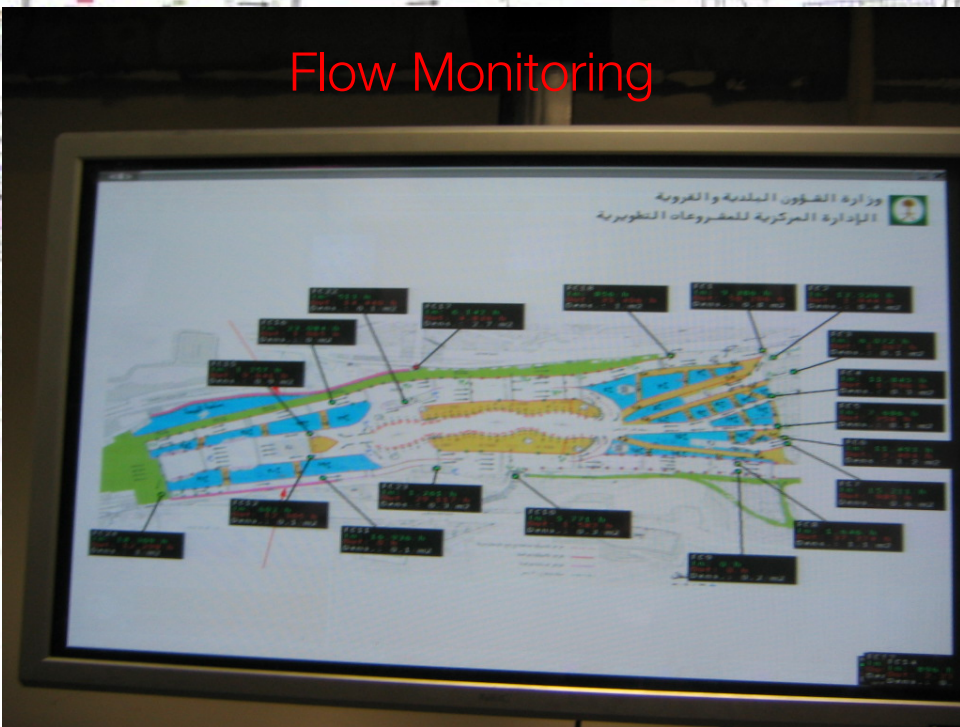
Situation in 2007



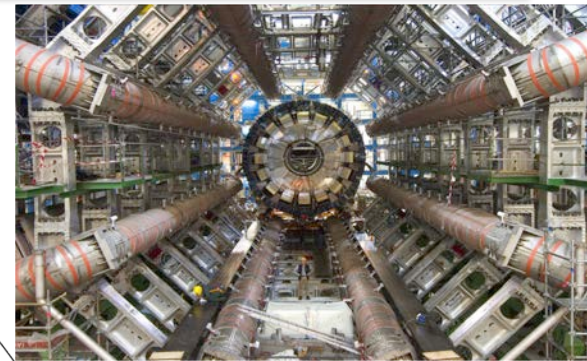
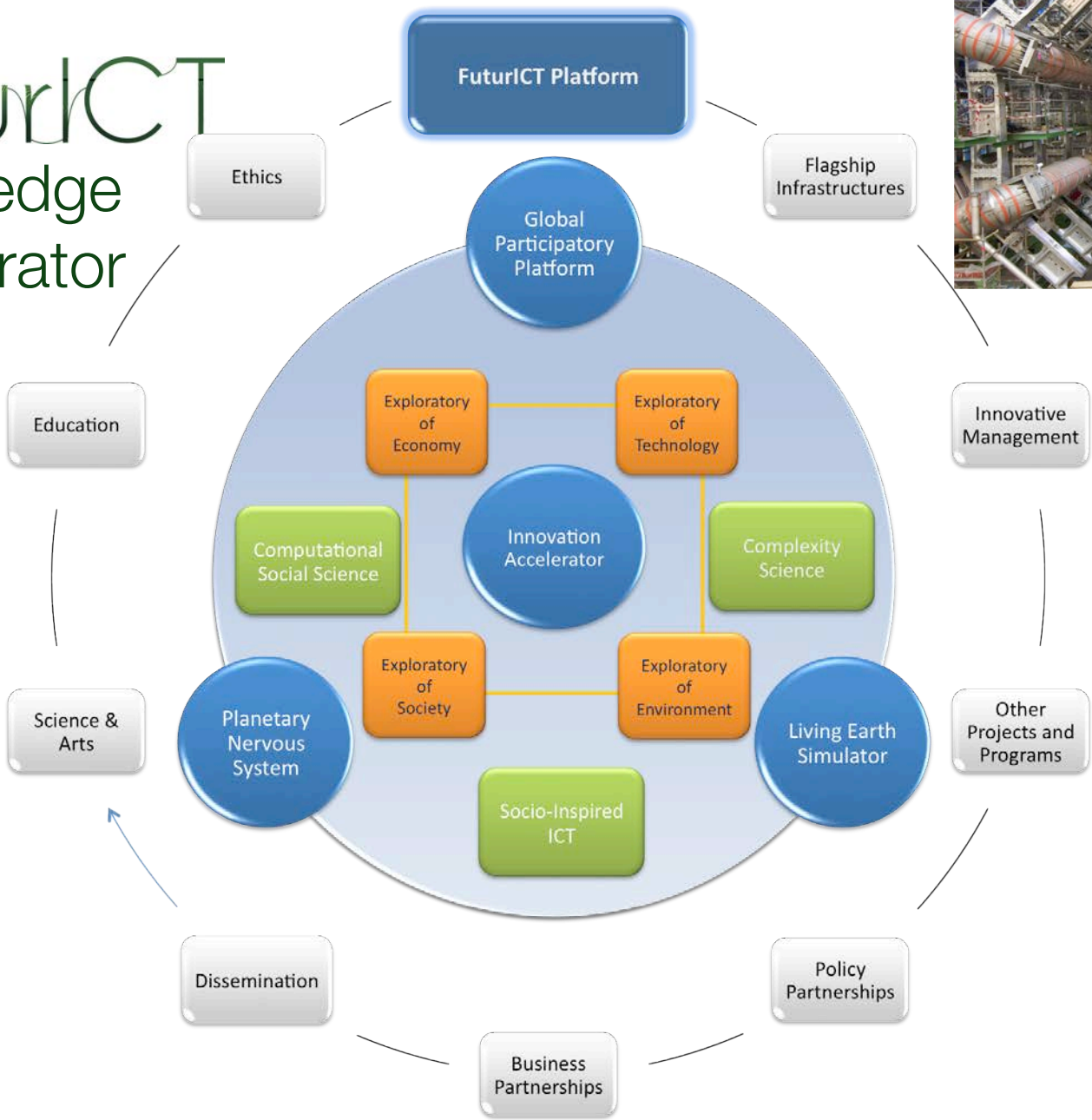
# Scheduling, Flow Monitoring and Adaptive Rerouting



Flow Monitoring



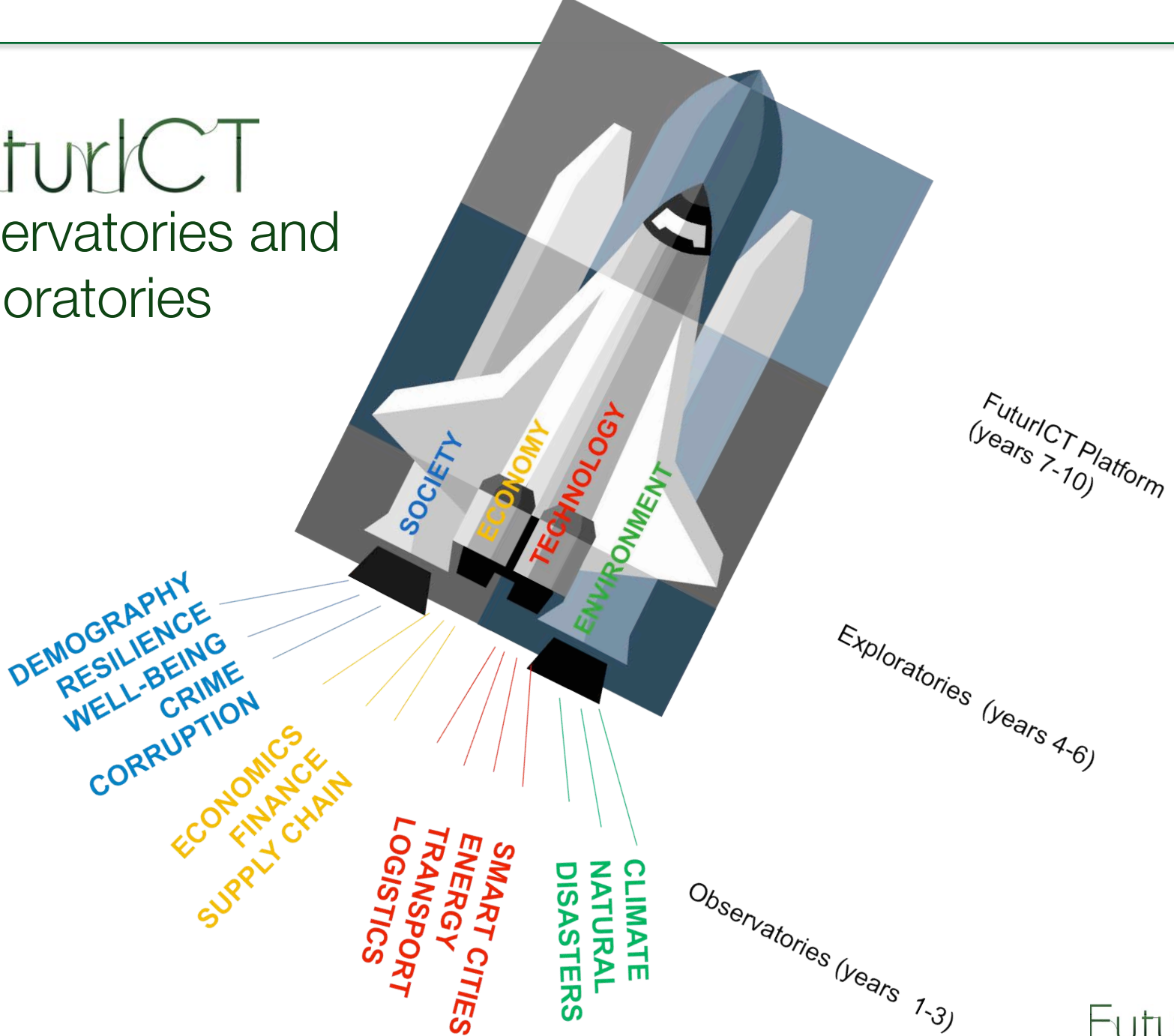
# FuturICT Knowledge Accelerator



ATLAS  
detector  
of CERN

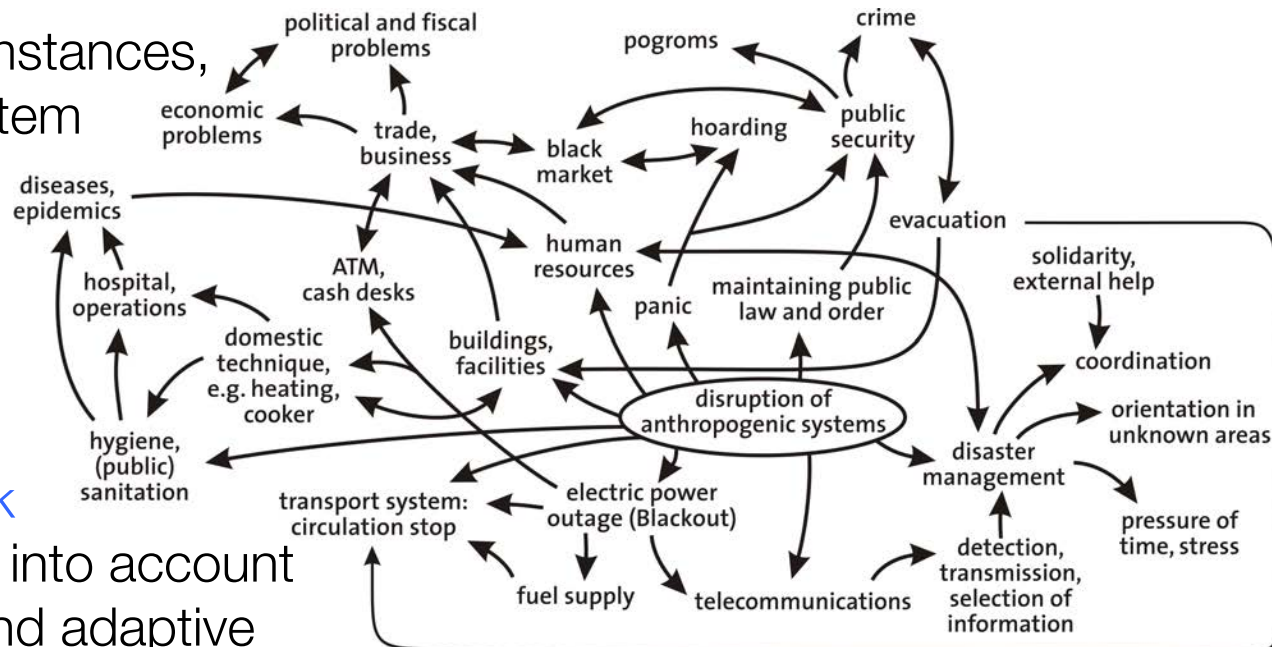
# FuturICT

## Observatories and Exploratories



# Living Earth Simulator: Issues of Predictability

1. **Prediction** (under what conditions something is likely to happen) is not the same as **forecasting** (when something will be happening)
2. Forecasting of the exact timing is usually difficult in social systems, but **likely courses of events can often be predicted** (cascading effects follow from causal relationships)
3. **Short-term anticipation is often enough to reach significant improvements** through adaptive strategies (e.g. principles of self-organization and self-control)
4. It depends on circumstances, whether a social system shows a **self-fulfilling prophecy, or a self-defeating prophecy, or is not influenced by a prediction**
5. **Information feedback** effects can be taken into account by heterogeneous and adaptive recommender systems

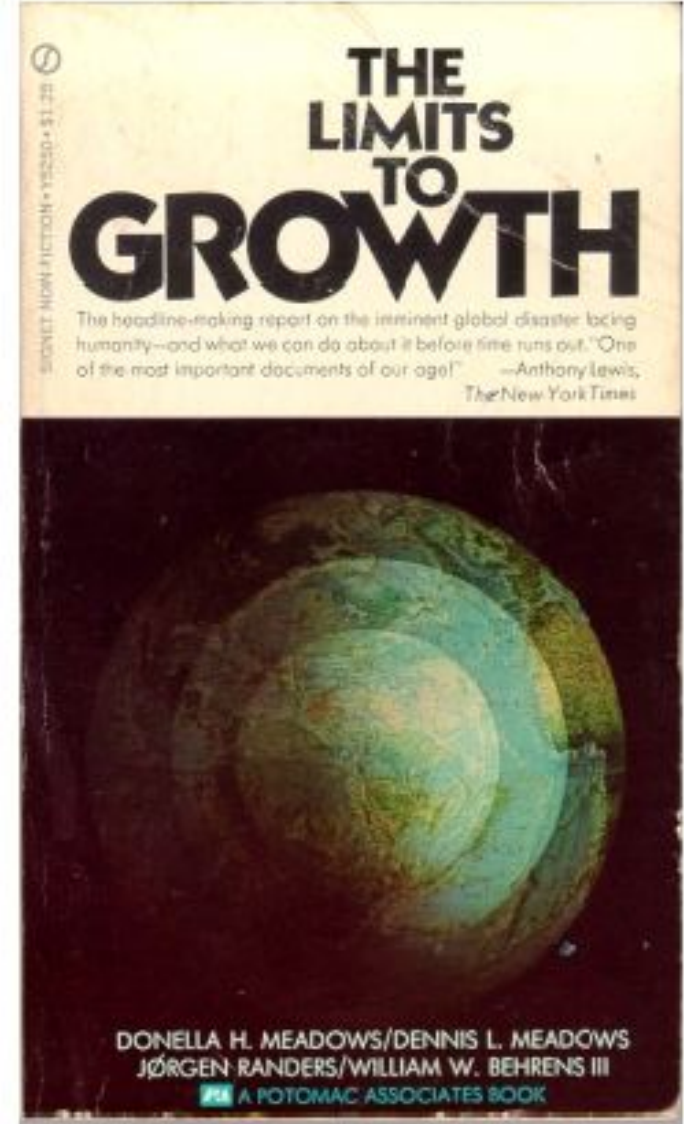




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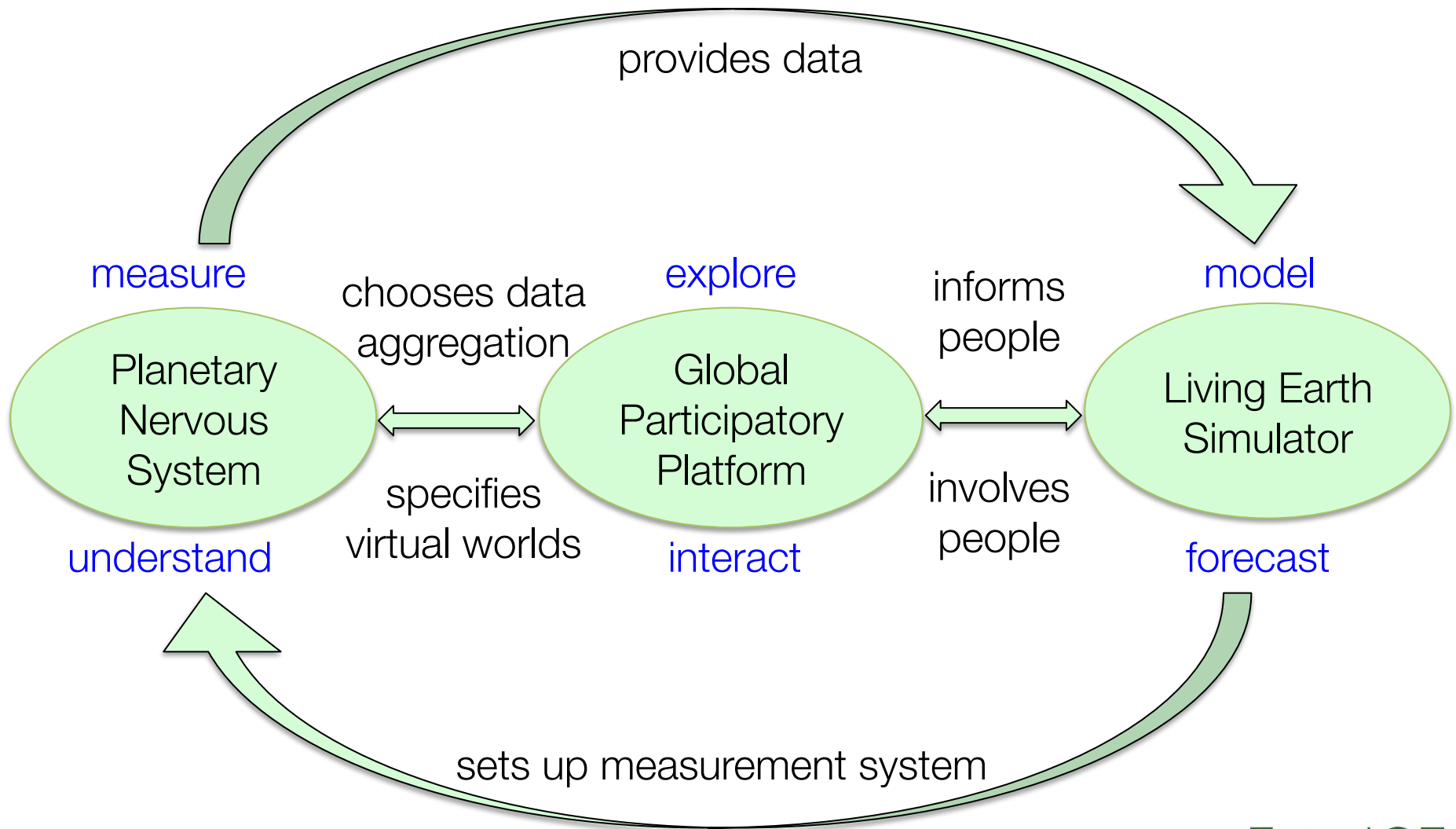
# Some Differences to the „Limits to Growth“ Study

1. No long-term forecasts, addresses current and generic problems
2. Goal is improvement in system performance and the ability to absorb shocks
3. Consideration of spatial and network effects, heterogeneity and randomness
4. Use of network theory, complex systems theory, social science models, multi-agent simulations, multi-level models, experiments, participatory platforms
5. New methods of investigation (Living Earth Simulator, Planetary Nervous System, Global Participatory Platform, Interactive Exploratories)
6. Use of Big Data and reality mining
7. Support by hundreds of scientists and best academic institutions

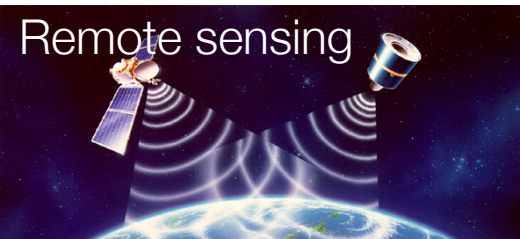


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# New ICT to Explore and Manage Our Complex, Strongly Connected World



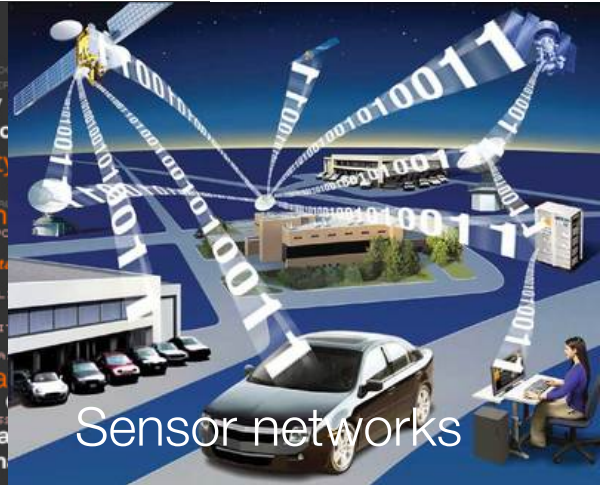
# Reality Mining with the Planetary Nervous System



Remote sensing



Web2.0



Sensor networks



Internet



Satellites



Telecommunication  
Prediction markets



GPS



Second life



Social networks



nature  
BIG DATA  
SCIENCE IN THE PETABYTE ERA

# How to Establish A Planetary Nervous System

1. **Goal:** Measure the state of the world in real time
2. Do real-time data mining (“**reality mining**”)
3. **Use smartphones** to establish a global sensor network (collaboration with Sandy Pentland of the MIT Media Lab)
4. Provide **incentives to voluntarily provide data** (share benefits and profits generated with the provided data)
5. Establish a reward system (people can collect points) and a **micropayment system**
6. Provide users **control over their own data** and the use of their data
7. Develop a **privacy-respecting** data mining approach
8. Anonymize and **aggregate data “on the fly”**
9. **Examples:** Open streetmap, earthquake sensing and warning



GPS



Compass



Bluetooth



Microphone



WLAN



Camera



Gyroscope



Accelerometer



# Towards Collective (Self-)Awareness

- Goal: Promote sustainability, protect the fabric of our society
- Idea: Create collective (self-)awareness
- How? Measure the “social footprint”, i.e. the impact of human decisions and actions on our society
- Aggregate incoming information
- Detect possible threats and opportunities
- Anticipate possible courses of events and likely consequences of decisions through “mental simulation”
- Help resolve conflicts between incompatible demands, motives, requirements, functions, and goals
- Help avoid harmful actions



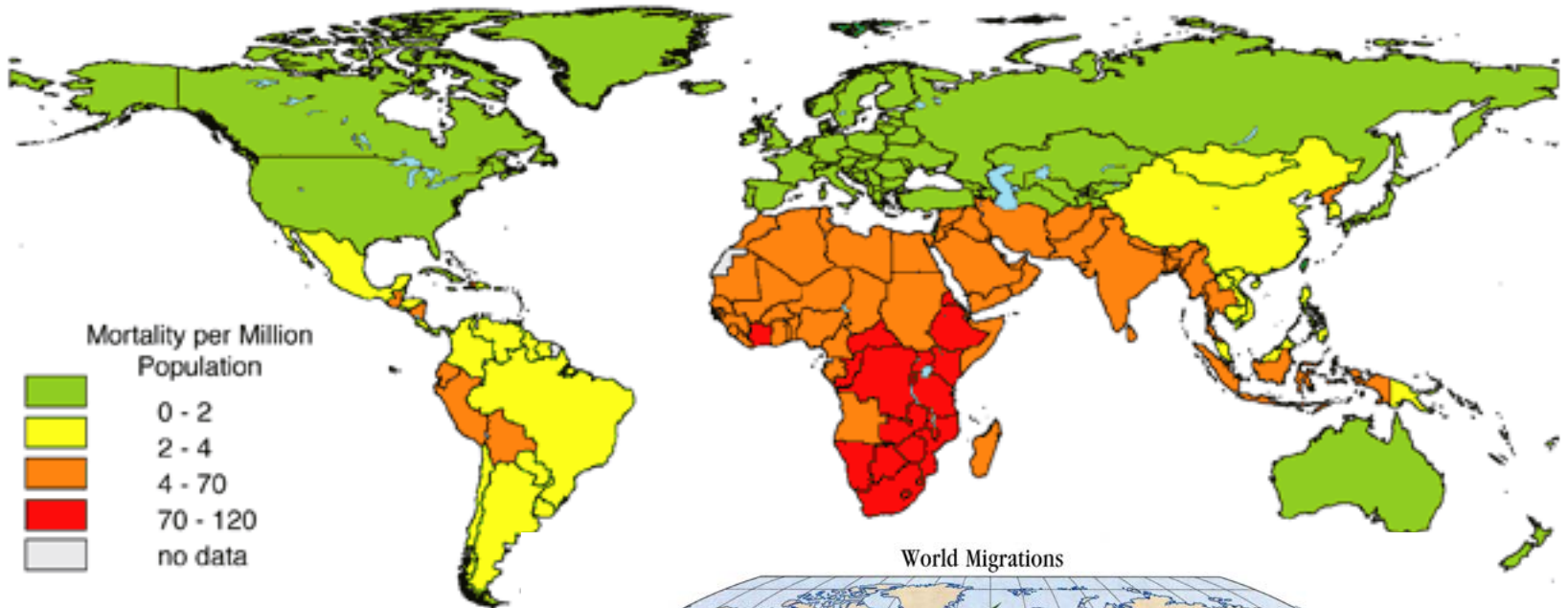
Painting by Maurits Cornelis Escher

Thanks to Andrzej Nowak



# Towards Measuring the Social Footprint

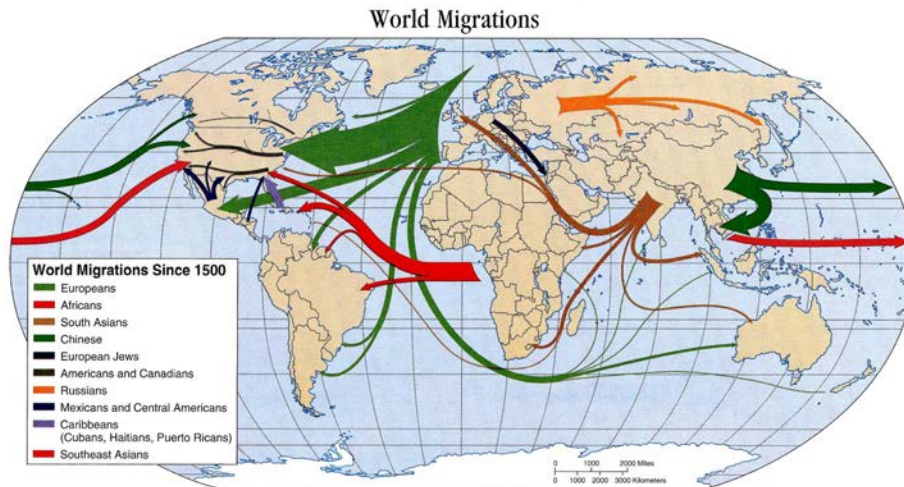
Estimated Deaths Attributed to Climate Change in the Year 2000, by Subregion\*



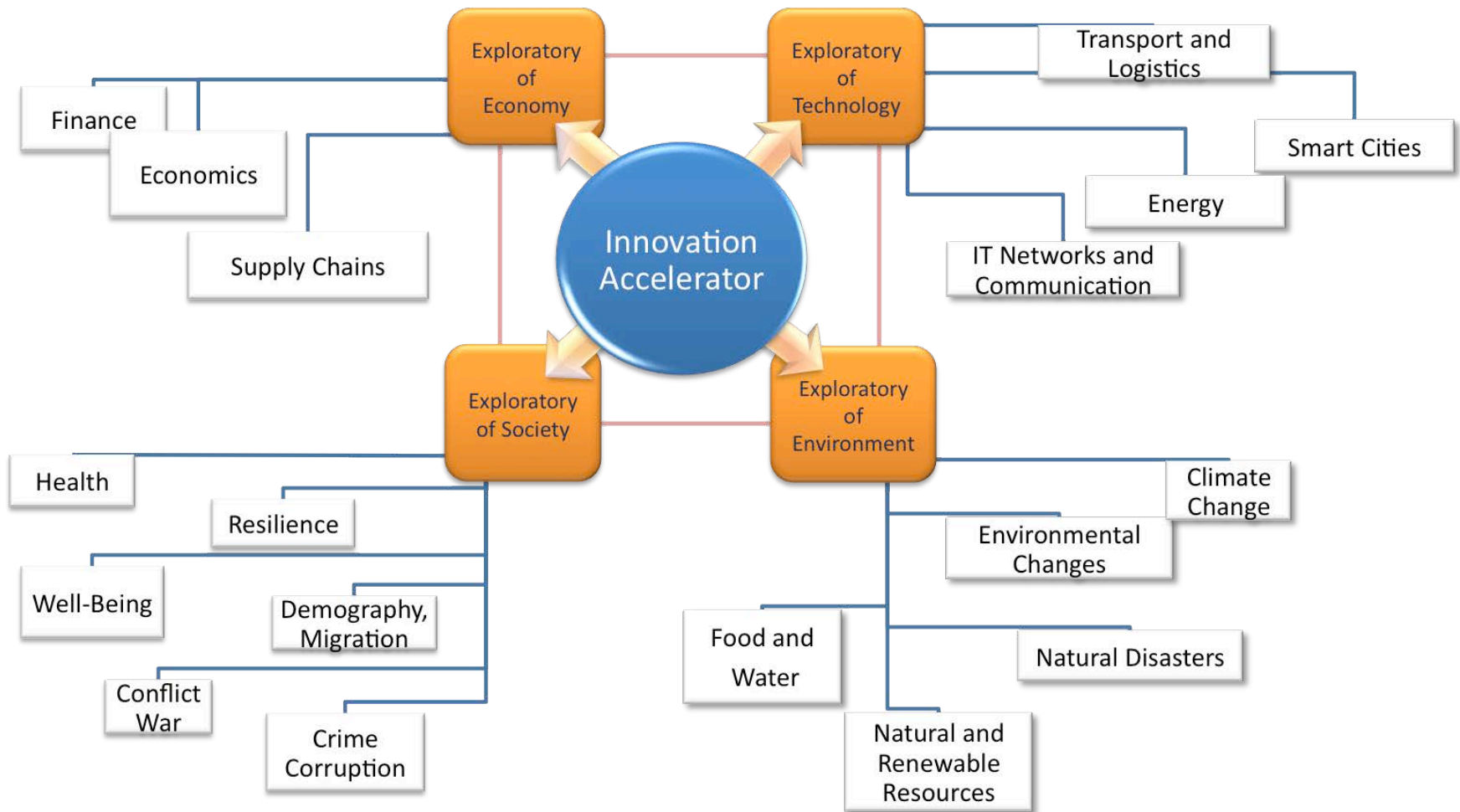
Data Source:  
McMichael, JJ, Campbell-Lendrum D, Kovats RS, et al  
Burden of Disease due to Selected Major Risk Factors



Maps produced by the Center for Global Change Science

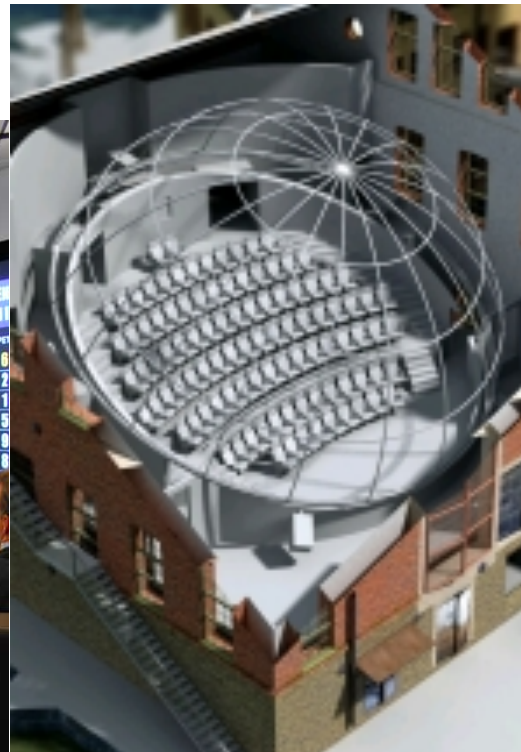


# FuturICT Observatories and Exploratories

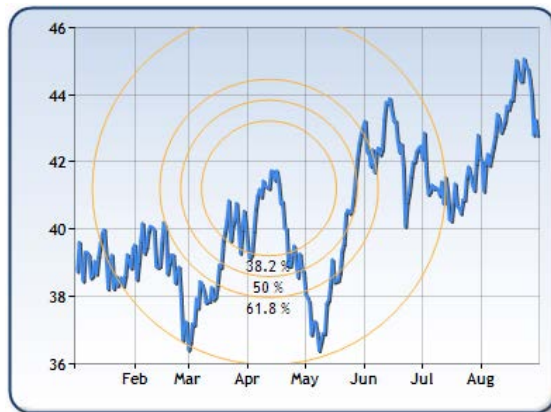




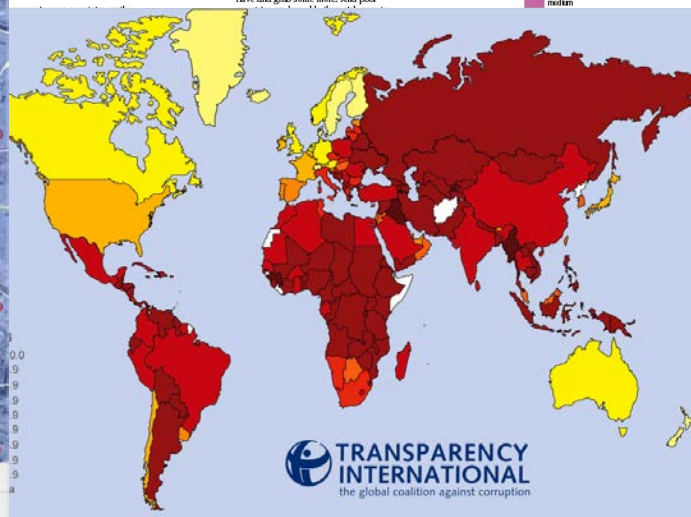
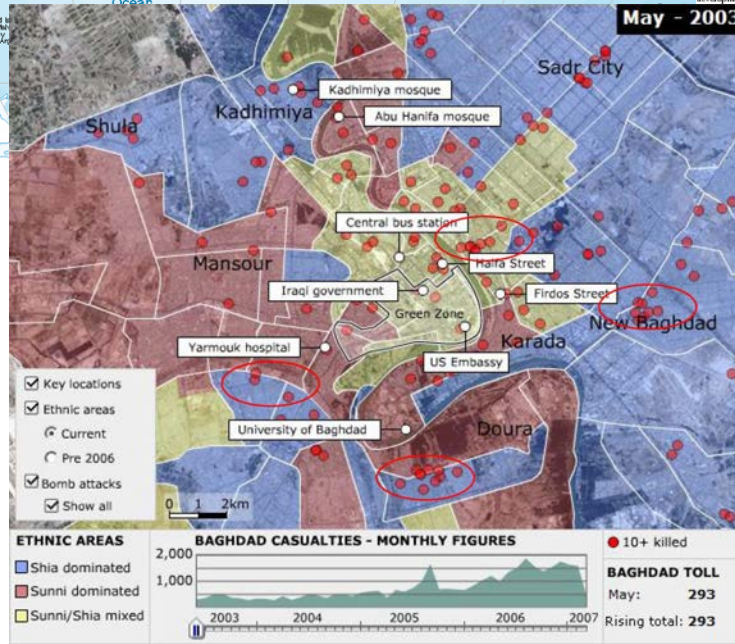
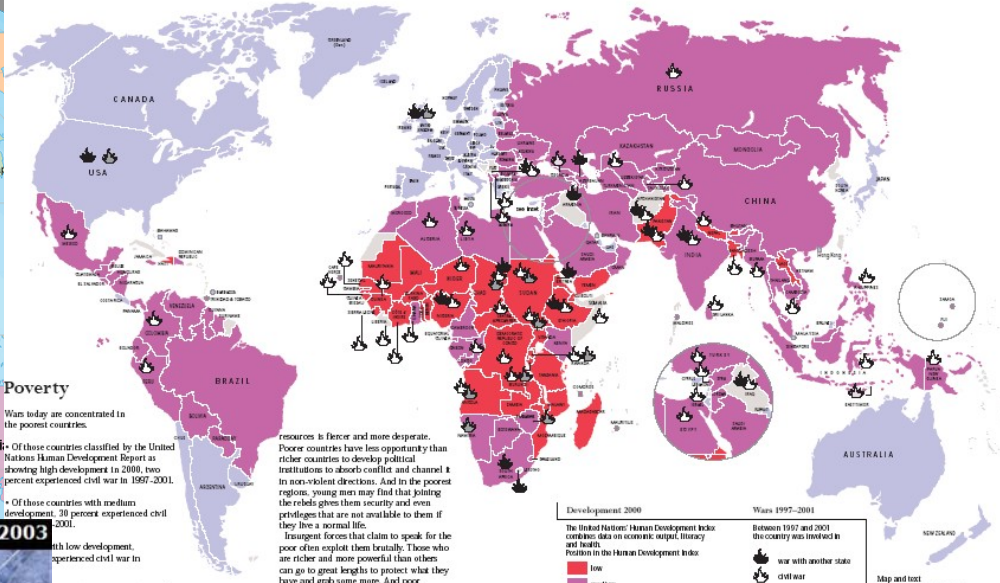
# Simulation and Visualization



# Observatory for Financial Instabilities

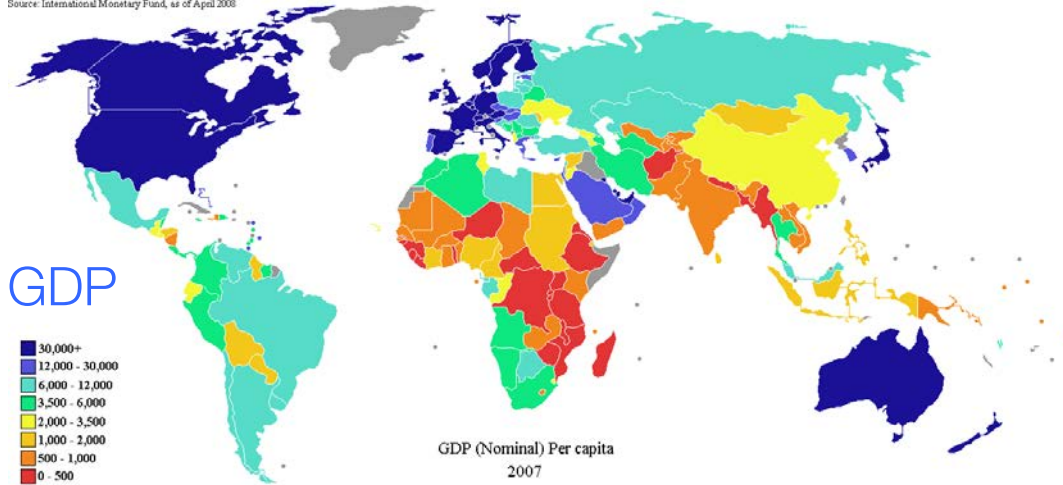


# Observatory for Wars and Conflicts



# Observatory for Social Well-Being, e.g. Measurement of Social Capital

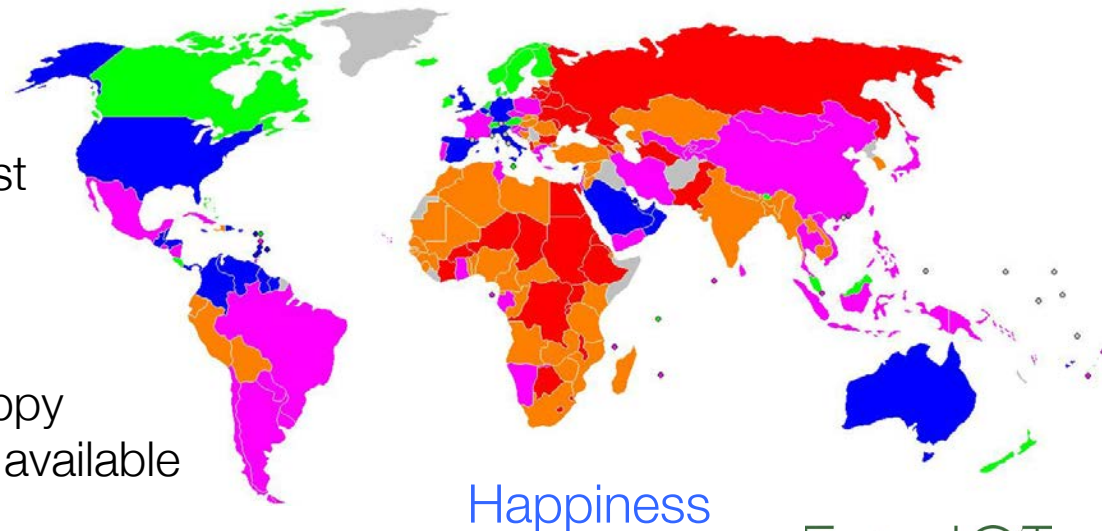
Source: International Monetary Fund, as of April 2008



- Solidarity, cooperativeness,
- compliance,
- reputation, trust,
- attention, curiosity,
- happiness, mental health,
- environmental care...

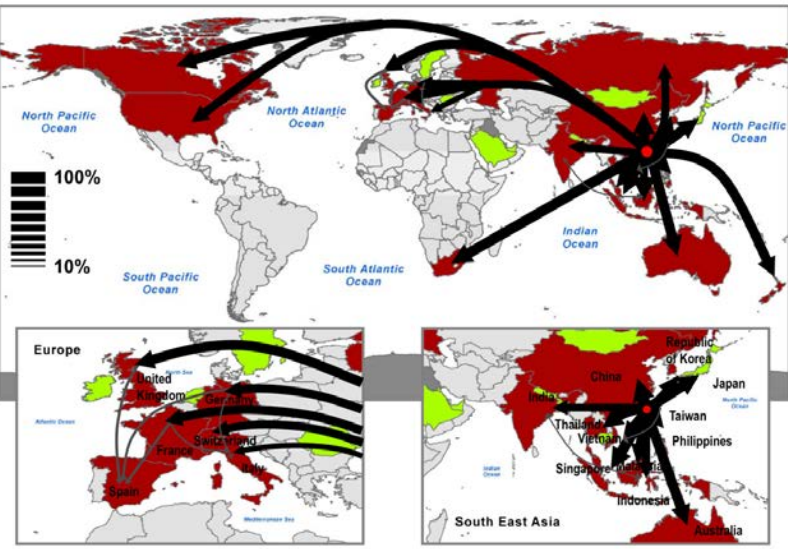
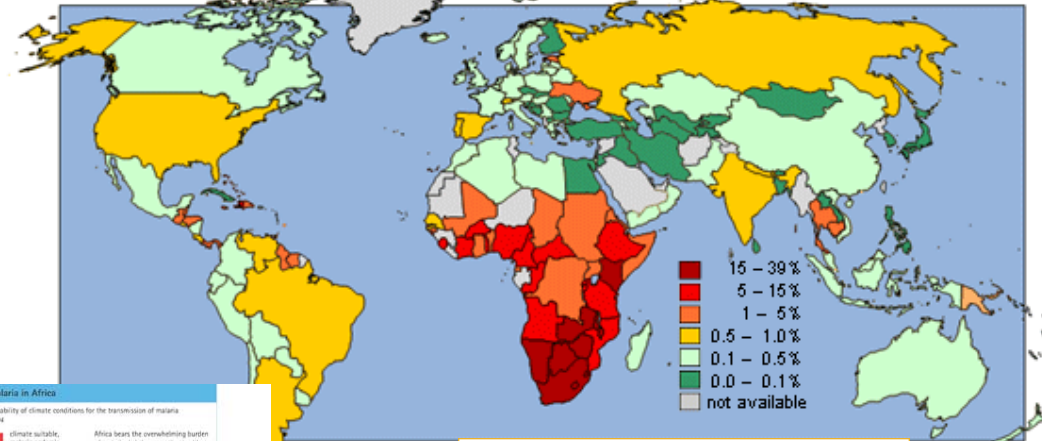
Goal: Creating  
indices better  
than GDP

Green = Happiest  
Blue  
Purple  
Orange  
Red = Least Happy  
Grey = Data not available



# Observatory for Epidemic Spreading and Health Risks

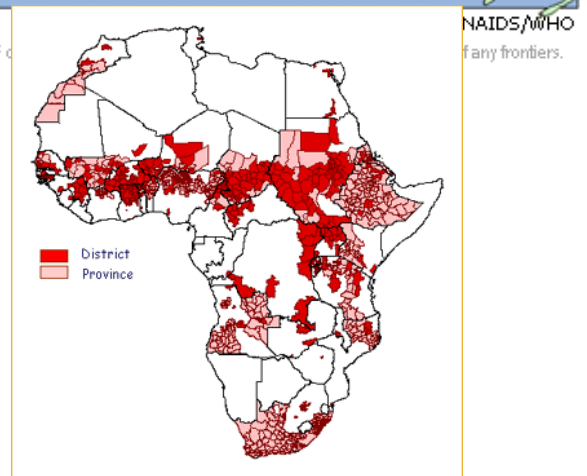
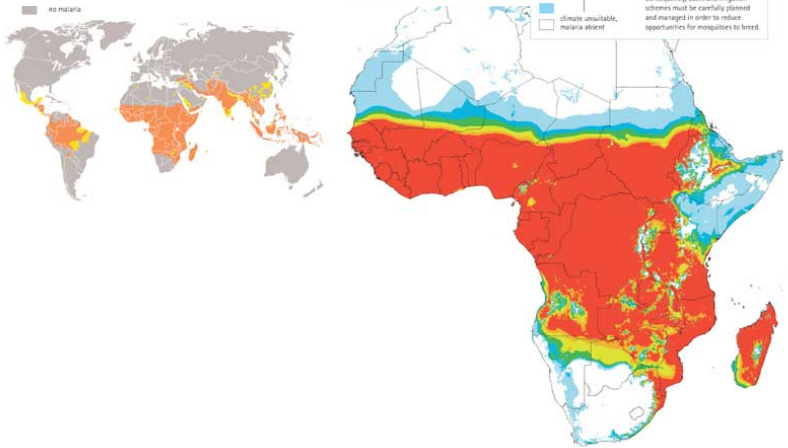
HIV prevalence in adults, end 2001



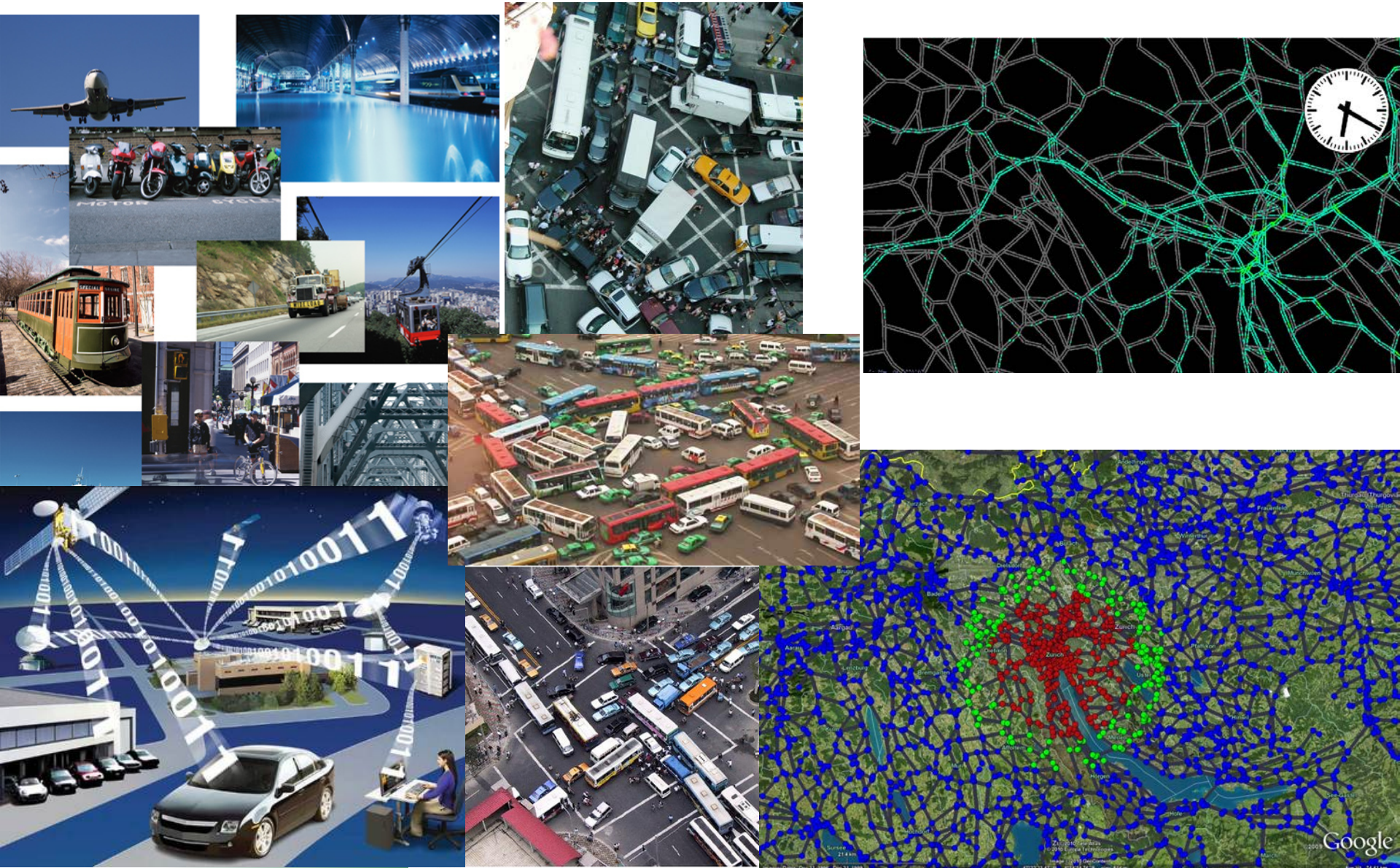
**Malaria in Africa**  
 Suitability of climatic conditions for the transmission of malaria: 2004

- climate suitable, malaria endemic
- climate suitable, malaria not endemic
- climate unsuitable, malaria absent

Africa bears the overwhelming burden of malaria. It is home to the deadliest form of the malaria parasite and to climatic conditions where mosquitoes flourish. Local environmental conditions, such as wetlands and drainage patterns, also influence the abundance of mosquitoes. Consequently, dams and irrigation schemes must be carefully planned and managed in order to reduce opportunities for mosquitoes to breed.

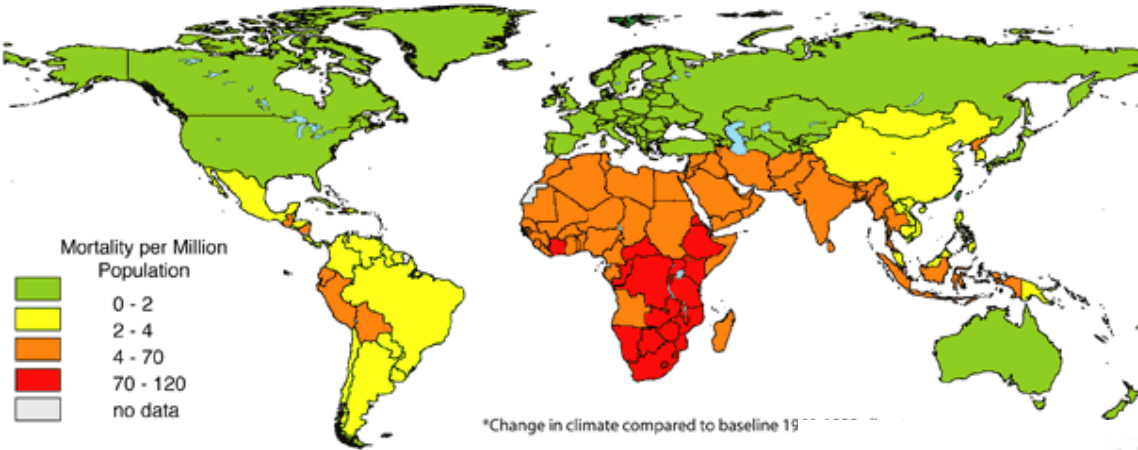


# Transport and Logistics Observatory



# Observatory for Environmental Change

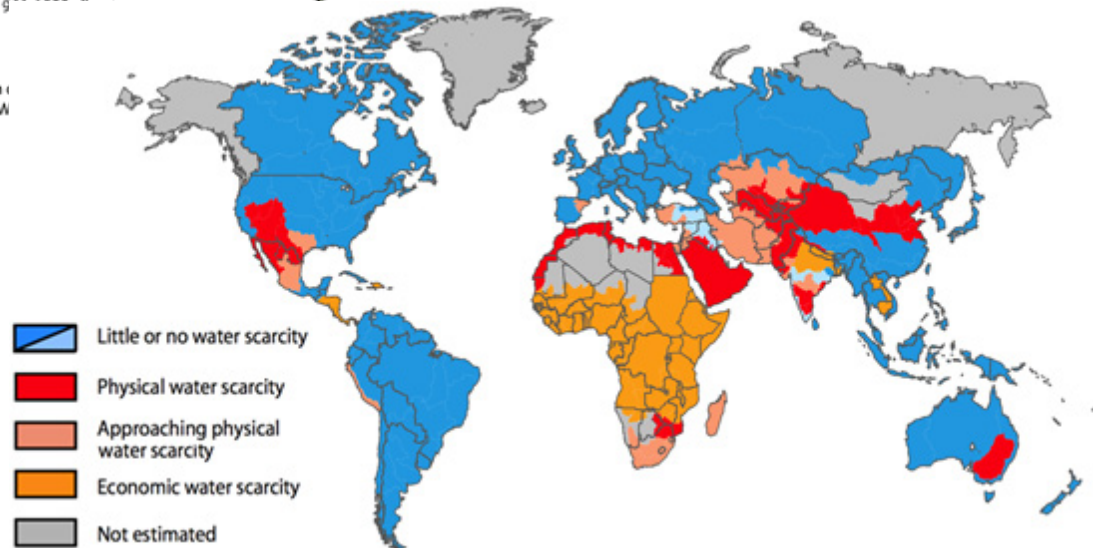
Estimated Deaths Attributed to Climate Change in the Year 2000, by Subregion\*



Data Source:  
McMichael, JJ, Campbell-Lendrum D, Kovats RS, et al. Global Climate Change. In Comparative Quantification of Burden of Disease due to Selected Major Risk Factors. M. Ezzati, Lopez, AD, Rodgers A., Murray CJL. Geneva, W



Maps produced by the Center for Sustainability and the Global Environment (SAGE)



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# An Open, Transparent Platform for Everyone

- **Goal:** Overcome “black holes” for data and data fragmentation
- An open platform for everyone
- **Transparent** data sources and quality, transparent algorithms, transparent results
- Transparent, **responsible use**
- A **new public good**, like our environment, air, and languages
- **Potentials:** New services and jobs, less barriers for social, economic and political participation, an age of creativity
- **Problem:** Mechanisms needed to avoid data pollution, manipulation, misuse, cybercrime





# Towards A Trustable Web

- Require **ownership and control** of users over their data (see WEF document)
- Need **privacy-respecting** information systems, hence pseudo-/anonymity
- How to reach **responsible use**?
- Requires a decentralized, transparent, and manipulation-resistant **reputation system** for information contents and providers
- **Principle:** A self-organizing and **self-regulating system**, something like a socially adaptive and mutually beneficial **information ecosystem**
- For a suitable design principle, we **need to understand social systems**, otherwise instabilities, coordination problems, poor system performance, conflicts, (cyber) crime, and (cyber)wars will result



# Populated Virtual Worlds to Explore Possible Futures



# FuturICT's Living Earth Platform



## Meltdown modelling



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# Further Reasons for the FuturICT Flagship Project

1. FuturICT **builds bridges** between communities
2. A federated **Big Science** approach is needed to catch up with the pace at which the world is changing and new challenges are emerging
3. We pursue an **open platform** approach like the “**International Space Station**”, allowing other countries to participate (e.g. Japan, China, Singapore, Australia, South America, Africa)
4. **Europe can lead this global endeavor**, if the project is supported now (and not in 3 years)
5. The European **academic powerhouses** and 5 **supercomputing centers** support the project, **George Soros** does so, and we also have support by the **JRC** and the **OECD**
6. There is a **moral obligation** to do what we can do to address the 21st century challenges
7. It must be avoided that powerful tools and social innovations end up in the hands of a few stakeholders rather than **benefiting humanity**



# FuturICT Supporters

“FuturICT can, I believe, make a significant contribution to the understanding of the evolution and change in societies, meeting the formidable issues of governance, climate change, sustainable economic balance that we are all faced with in the coming decades.”

George Soros  
(Financial investor and founder of the Institute for New Economic Thinking and Sponsor of Budapest's Central European University)



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# FuturICT in Numbers

**Financial Crisis:** 5,000 - 20,000 billion EUR

**CERN:** about 0.9 billion EUR per year

**ITER:** about 1.5 billion EUR per year

**NASA:** about 19 billion US Dollar in 2010

**ESA:** about 4 billion EUR per year

**Human Genome Project:** 0.9 billion Dollar per year

**Nanotechnology:** 0.6 billion EUR per year

**FuturICT:** just 0.1 billion EUR per year

More than 700 supporters in Europe

Best academic institutions, 5 supercomputer centers, major European countries involved

Value of **Facebook:** 65 billion EUR.

Illustrates the economic perspectives of social ICT.

FuturICT will connect  
*many* brains.

It's ideas that counts!

---

# FuturICT's Benefits Scale with Societal Costs

1. **Financial crisis:** Losses of 2.2 trillion \$
2. **Conflict:** Global military expenditures amount to 1.5 trillion \$ annually.
3. **Terrorism:** 9/11 attacks caused 90 billion \$ lost output of the US economy
4. **Crime and corruption:** 2-5% of GDP, about 2 trillion \$ annually.
5. **Flu:** A true influenza pandemic infecting 1% of world population would cause losses of 1-2 trillion \$ per annum
6. **Congestion:** 7-8 billion £ only in UK
  - Even a 1% improvement would create **benefits many times higher than project investments**
  - **For comparison:** Weather forecasts cost 10CHF per citizen, but create a 5 times higher benefit.
  - **Business opportunities:** Facebook's value, for example, amounts to 60-80 billion \$



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# FuturICT vs. Commercial Projects

1. FuturICT will provide policy and decision makers new tools to improve society, whereas commercial companies have no such capacity.
2. FuturICT will ultimately provide tools to tackle social and natural catastrophes, on a large scale. Individual private companies can not provide such tools.
3. The aim of FuturICT is to understand and quantify social cooperative behavior. Private companies are interested in learning about the behavior of individuals, in order to profit from this behavior.
4. FuturICT will be a synergetic consortium of interdisciplinary scientists across Europe and other partners, whereas private companies are in constant competition. This synergy will promote collaborations on scales larger than any previously conducted.
5. FuturICT will be a major driving force for *all* scientific research in the areas of ICT, social sciences and complexity science. Through different dissemination strategies, FuturICT will publish all main results and methodologies, and promote others to continue and progress the research. Private companies do not act in such a way, and they keep their methodologies and results for themselves.



# Impact on Science, Business, Governance

## Science and Education:

- Innovation accelerator
- Personalized education



## Public Sector:

- Smart, sustainable cities
- Healthcare (e.g. epidemics)
- Crisis observatories, risk management



## Business and Industry:

- Financial sector
- Managing complexity
- Transport, traffic, logistics
- Electrical micro-generation



## Administration and Governance:

- eGovernance
- Institutional design



## Consultancy:

- Customized information services

# Socio-Inspired ICT

Understanding the hidden laws and processes of society

Development a new wave of **robust**, **trustworthy** and **adaptive** information systems based on socially inspired paradigms.

Fundamental transformational effect on ICT and Computer Science



Facebook is by now one of the most valuable companies in the world (65 billion \$)

# FuturICT

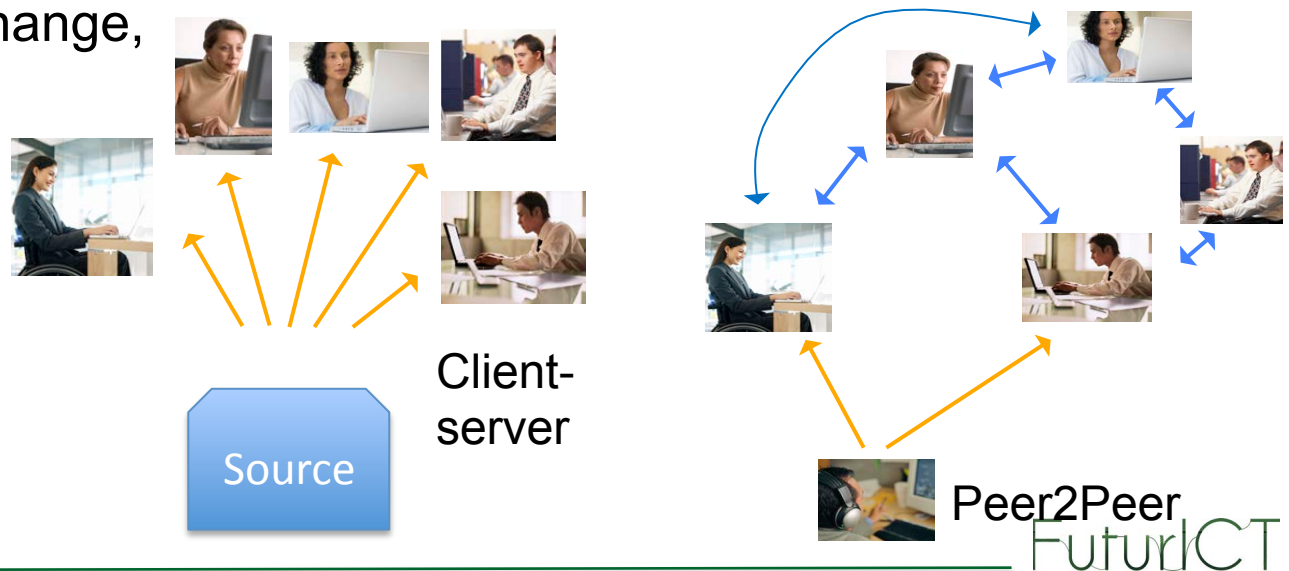
1. Collective awareness

2. Social adaptativeness

3. Socio-inspired, bottom-up self-organization

# Social Features of Techno-Social Networks in the Future

- Coordination,
- cooperation,
- adaptability,
- interaction,
- networking,
- group or community formation,
- collective (aggregate) behavior,
- signalling and exchange,
- integration,
- differentiation,
- conflict resolution,
- stability,
- resilience,
- trust,
- reputation,
- deviance (malicious behavior),
- (cyber)crime,
- (cyber)war,
- innovation, and
- culture

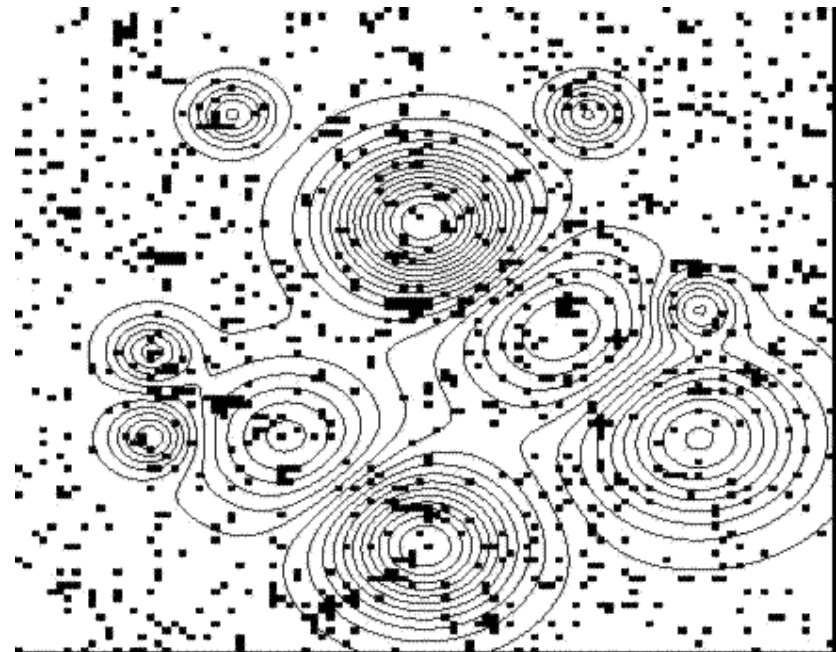
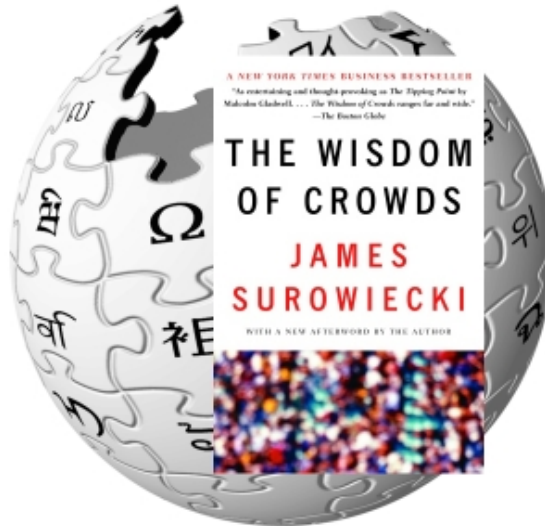


# Swarm Intelligence and Wisdom of Crowds

- Estimation of facts (e.g. the weight of an ox, 1906)
- Quest for lost US submarine (1968)
- Internet search engines (e.g. Google)
- Wikipedia
- Darpa balloon challenge
- Prediction markets (e.g. Wahlstreet)
- Stock markets
- Democracy ...

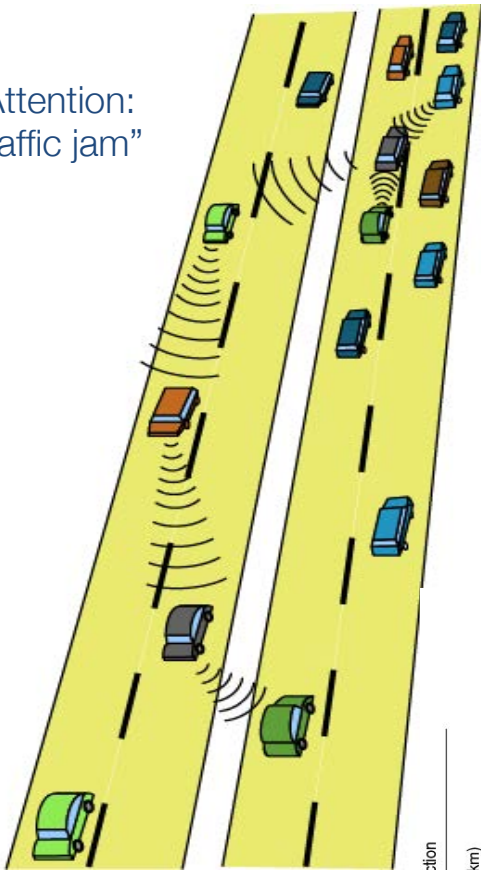


C. Fernandes *et al.* (2005)



# Social Sensing: The Example of Cooperative Driving

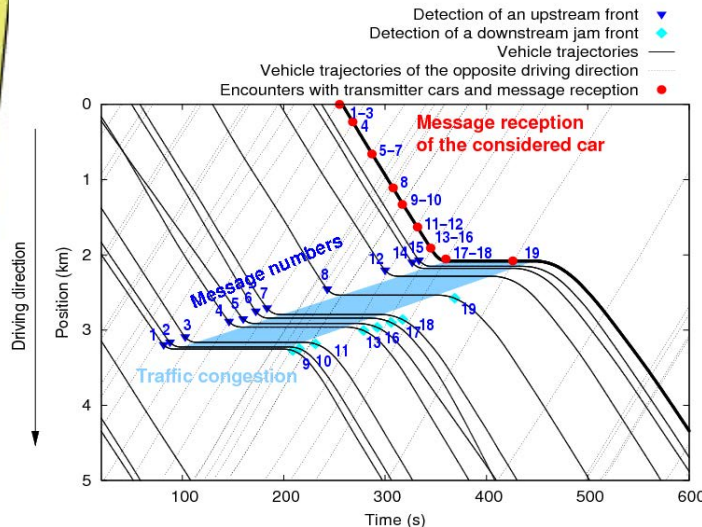
“Attention: Traffic jam”



- On-board data acquisition („perception“)
- Inter-vehicle communication
- Cooperative traffic state determination (“cognition“)
- Adaptive choice of driving strategy (“decision-making“)
- Driver information
- Traffic assistance (higher stability and capacity of traffic flow)



In: *Transportation Research Record* (2007)



# Decentralized Adaptation Mechanisms Can Mitigate Congestion



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# Ethical ICT

- Promote **human well-being**,
- increase the **self-awareness** of society,
- **reduce vulnerability** and risk,
- **increase resilience** (the ability to absorb societal, economic, or environmental shocks),
- **avoid loss of control** (unexpected and disastrous systemic shifts),
- develop **contingency plans**,
- explore **options** for future challenges and **opportunities**,
- increase sustainability,
- support **flexible adaptation**, **cooperation** and **conflict resolution**.
- **Protect privacy** and other human rights, pluralism and socio-bio-diversity,
- promote **fairness**,
- increase **social capital** and the **happiness** of people,
- support **social, economic and political participation**, enable formation of “quality collectives”,
- **balance between central and de-central (global and local) control**,
- support collaborative forms of competition and vice versa (“coopetition”),
- **reveal knowledge gaps, double edge swords, and misuse of power.**

---

# Inter-National Adapter / Cross-Cultural Guide

- Near-perfect **real-time translation** of both written and spoken language
- Automated **interpretation of non-verbal communications** from gestures and body language
- Help to understand **social norms** across human cultures and how to deal with these
- Make **mutual expectations** understandable to each other and **support negotiations**
- Create platforms to connect **multiple devices** in order to support the **coordination, cooperation and co-creation** between many people
- Replace submission of minorities by the possibility of fair deals

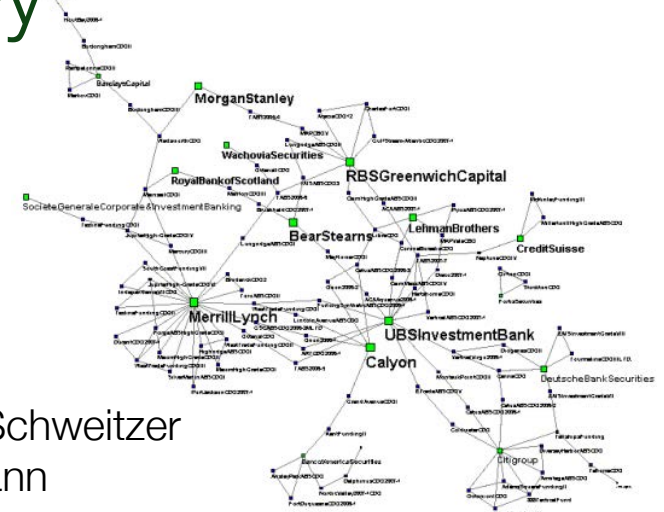




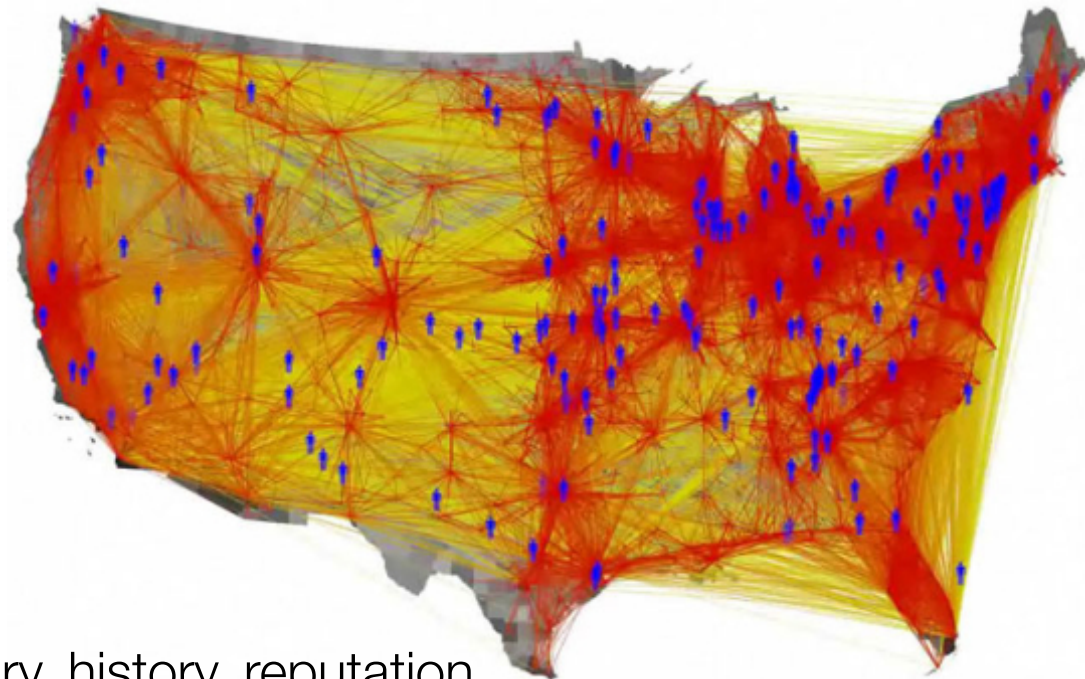
# Social Money



Thanks to Frank Schweitzer  
and Dirk Brockmann

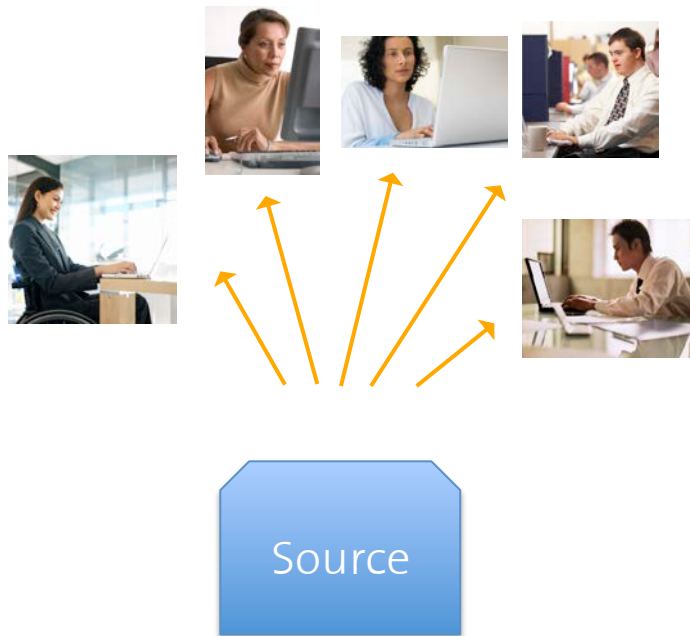


Treat money as nodes  
in a money flow network  
rather than as a one-  
dimensional entity (scalar),  
give it multi-dimensionality, memory, history, reputation.

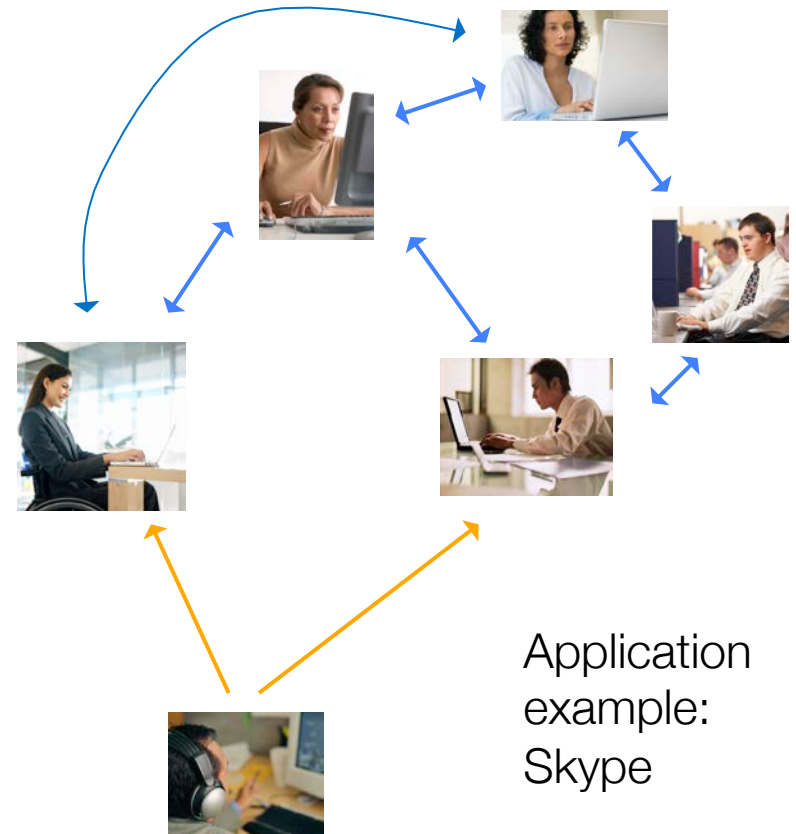


# Client Server Systems vs. Peer to Peer System

Client - Server



BitTorrent



Application  
example:  
Skype

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# BitTorrent as a Public Goods Problem

- Torrent: Group of people downloading and distributing a file
- Torrents depend on cooperation:
  - Users downloading provide bandwidth for each other
  - Users can provide extra capacity (i.e. download speed) once have finished downloading
  - If users do not share after downloading, the torrent can die

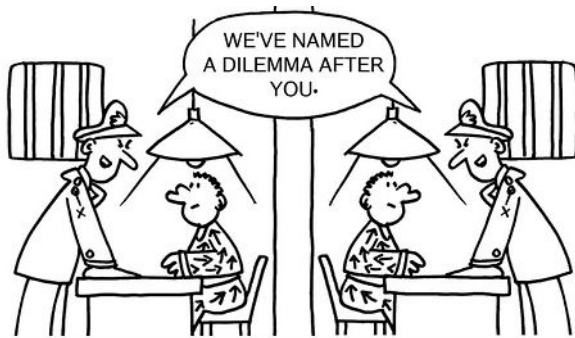


Users provide:

- Storage capacity
- Bandwidth
- Content

# The Dilemma of Social Cooperation

The prisoner's dilemma game has served as prime example of strategic conflict among individuals. It assumes that, when two individuals cooperate, both get the “reward”  $R$ , while both receive the “punishment”  $P < R$ , if they defect. If one of them cooperates (“C”) and the other one defects (“D”), the cooperator suffers the “sucker’s payoff”  $S < P$ , while the payoff  $T > R$  for the second individual reflects the “temptation” to defect. Additionally, one typically assumes  $S+T < 2R$ .



Player 1  
 Cooperate  
 Defect

Player 2  
 Cooperate Defect

$R_1$ $R_2$	$S_1$ $T_2$
$T_1$ $S_2$	$P_1$ $P_2$

For example:

$$S_1 = S_2 = S = -5$$

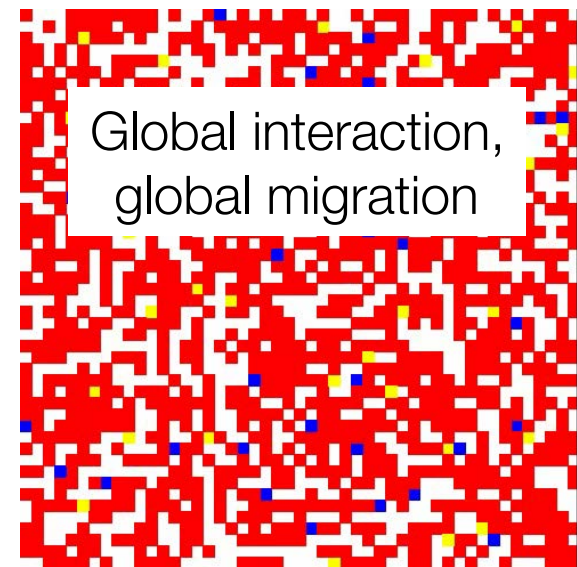
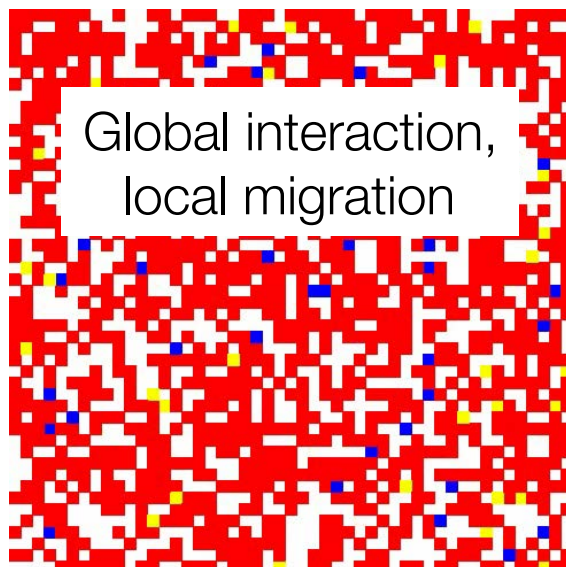
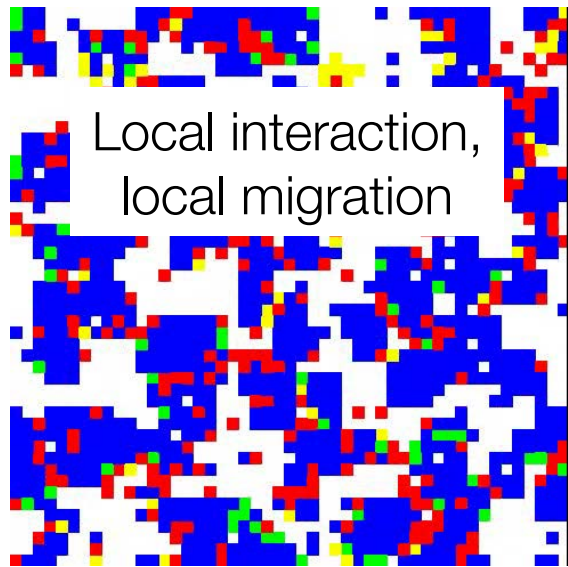
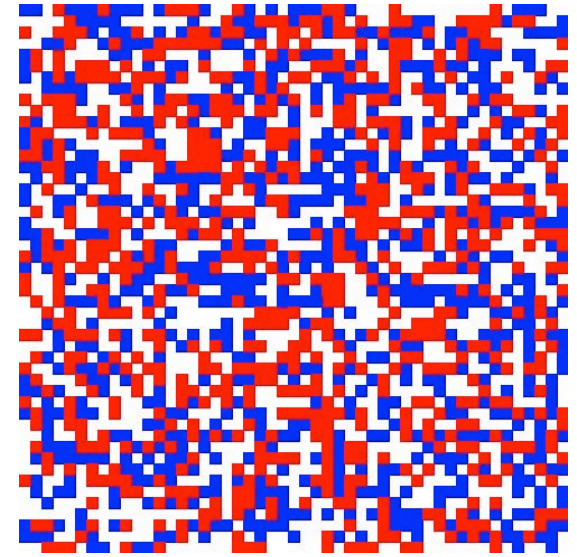
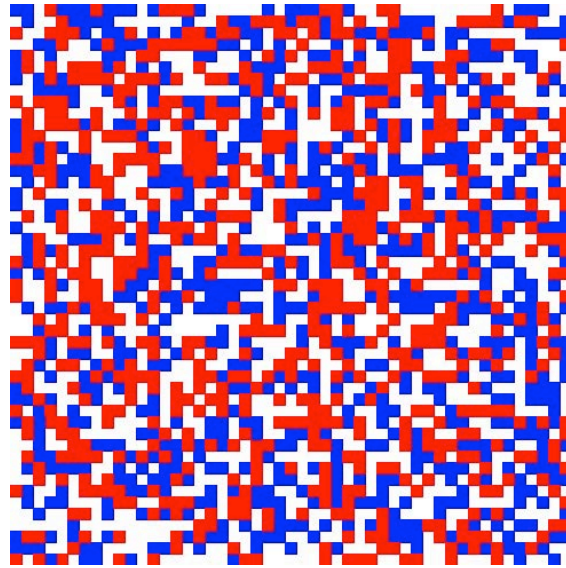
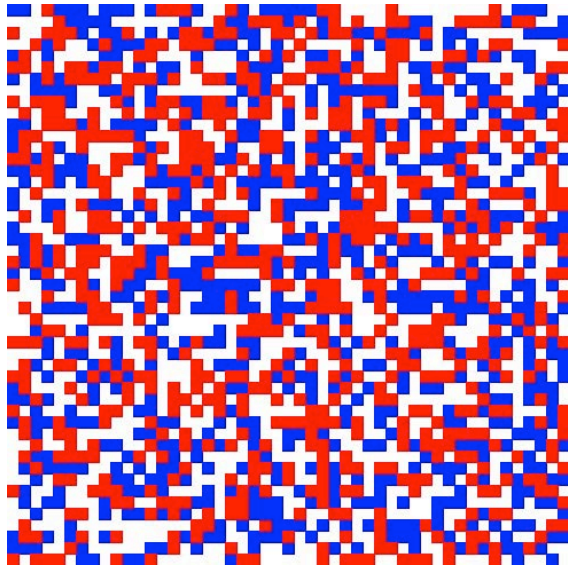
$$P_1 = P_2 = P = -2$$

$$R_1 = R_2 = R = -1$$

$$T_1 = T_2 = T = 0$$

Many “social dilemmas” are of a similar kind (see public goods game)

# More and More Networking Can Endanger Cooperation



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# FuturICT Is Filling Knowledge Gaps

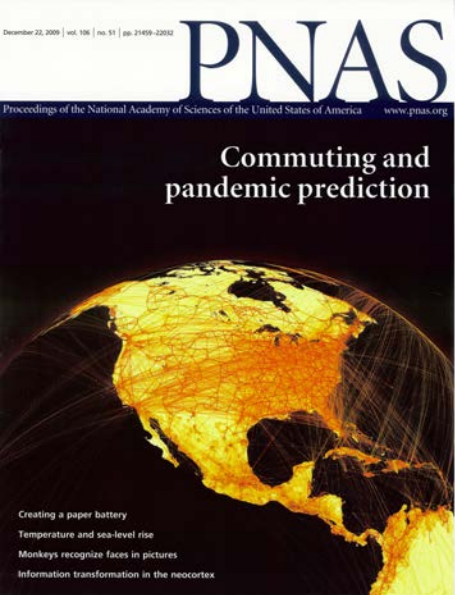
1. Non-equilibrium economics
2. Strongly coupled and interdependent systems
3. Behavior of multi-level complex systems
4. New data science (“social information theory”)
5. Systemic risks
6. Integrated risk management

Create social innovations to benefit society and tackle twentyfirst century challenges

1. Open data platforms
2. Privacy-respecting data mining technologies
3. Trustable web
4. Ethical ICT

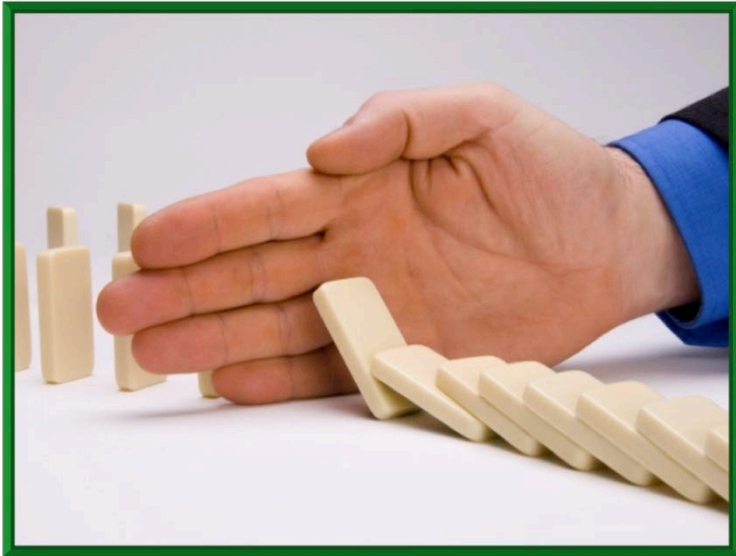


# FuturICT Is Big Science



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# What FuturICT Will Do



- FuturICT will build a [Living Earth Platform](#) for a global-scale simulation of our techno-socio-economic-environmental system and more
  - This will integrate [Crisis Observatories](#) running massive data mining for the advance detection of possible crises:
    - financial market instabilities
    - emerging conflicts
    - health risks and disease spreading
    - environmental changes, etc.
  - [Participatory Platforms](#) will inform decision-makers and involve citizens
  - The focus on [Managing Complexity](#) will develop integrative system designs and new decision-making and governance tools.
  - The [Innovation Accelerator](#) will speed up research, development, and the creation of new business opportunities.
  - New, [socially inspired ICT](#) will be developed
-