Delft Data Science

Seminar
January 26, 2015

Big Data Analytics for
Cyber Situational Awareness

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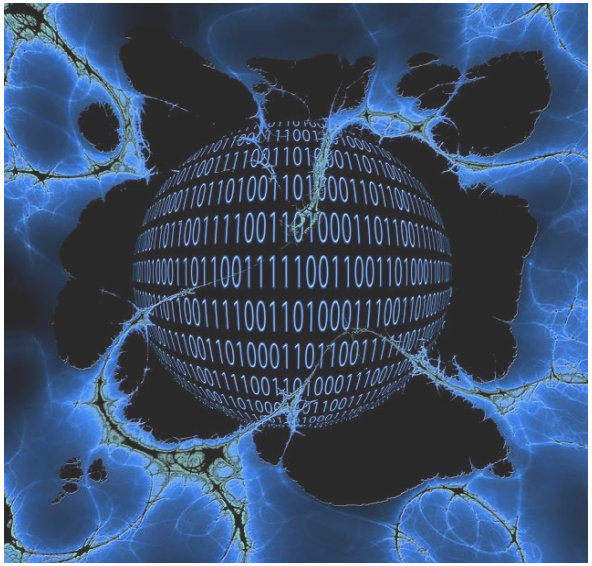
100 billions in
economic and societal **value**

millions of new jobs and
millions of new talent to educate in **technology** to get knowledge and value out of big data

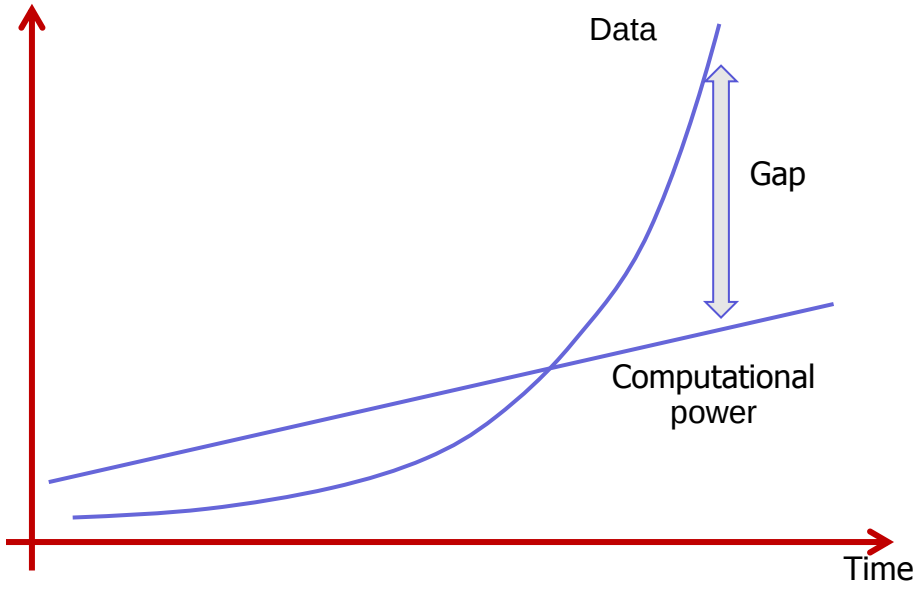
often, (massive amounts of) data from **outside** the system properties that systems are grappling with –
“data, too big to handle”



Big Data can fuel our economy & society

digital (Web) data
and its descriptions of the world
bring a new **complexity** –
for systems to know
(how to handle) the data

a new scientific discipline for
scientific **understanding** and
creating **technology** for
how to create, process, and
understand digital data



Data Science for advancing technology

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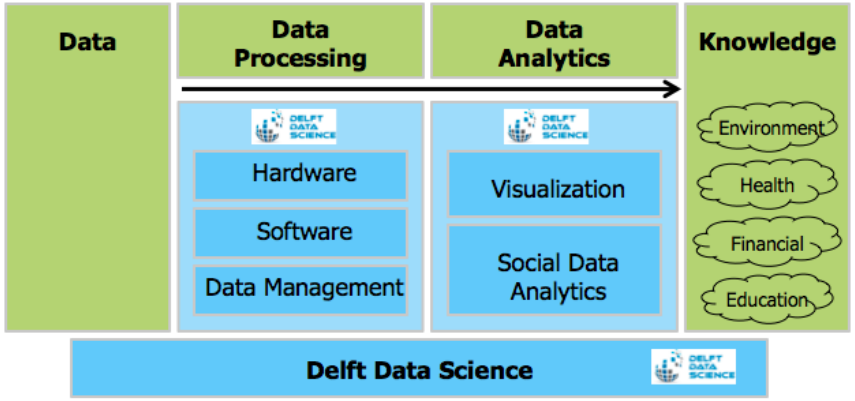
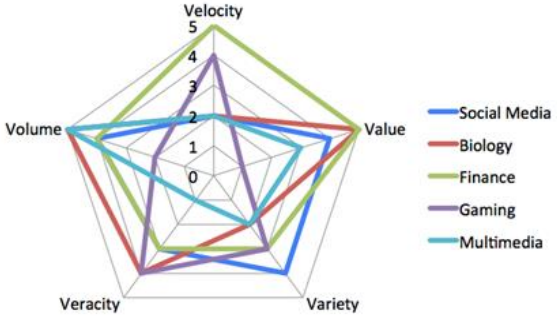
TU Delft coordinating initiative for research, education and training in data science and technology

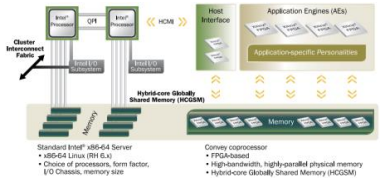


Delft Data Science – research & education for technology & talent

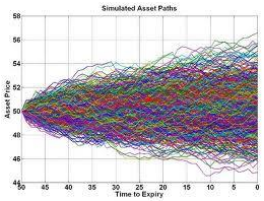
Hardware for Data Science

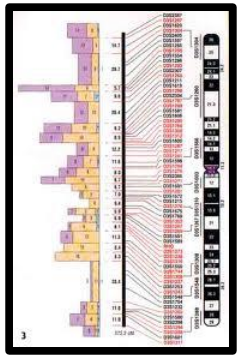


Big Data Computing Systems:
application specific
computing systems and hardware



New Algorithms & Architectures:
application and domain specific
e.g. finance/bio-informatics/seismic





Enabling big data computing systems to adapt to the challenges

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Software for Data Science

Problem: programming multi-core distributed cloud machines with Von Neumann programming languages

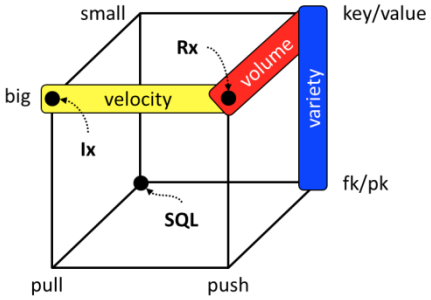
Problem: data engineers and scientists not trained as software engineers

Solution: programming languages that abstract from hardware, close to domain experts

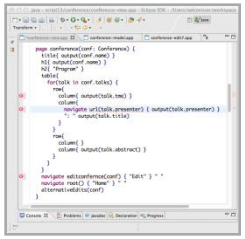
Cloud Programming:
composing computations using mathematically solid foundations

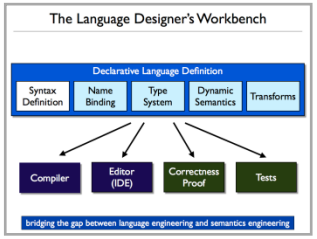
reactive extensions

interactive extensions



Domain-Specific Languages:
enabling software engineers to systematically design & apply DSLs





Enabling programmability of big data analytics

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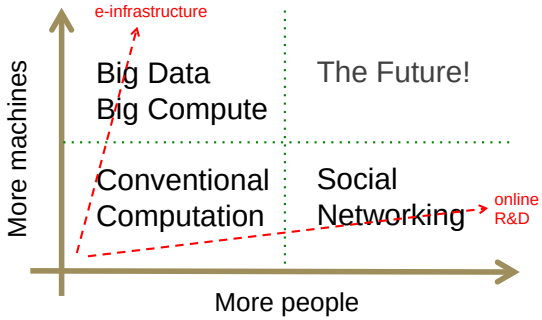
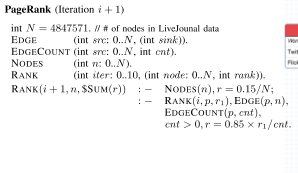
Data Management for Data Science

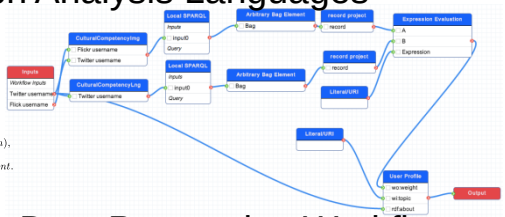


Graph Data Processing:
processing graphs
at big data and web scale

Web-Scale Graph Indexing

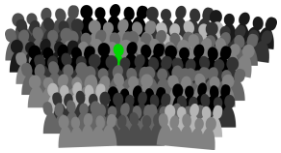
Declarative Graph Analysis Languages



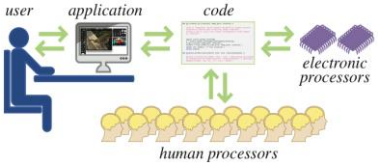


Optimizing Big Data Processing Workflows

Humans interacting in the Process:
enabling systems to include
human computation & interpretation



Crowdsourcing and Human
Computation



Crowd Capacity

Data Generation & Data Curation

Enabling big data management at scale and with human interpretation

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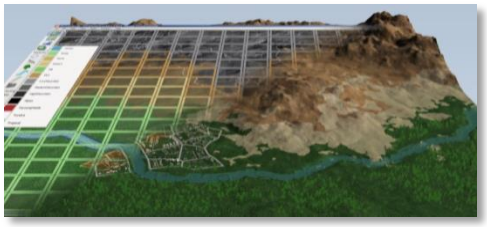
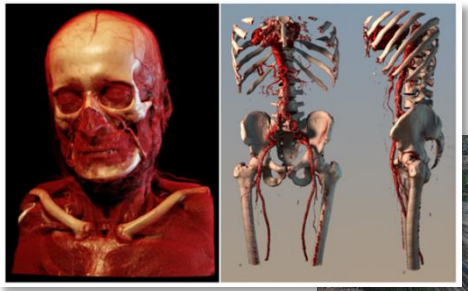
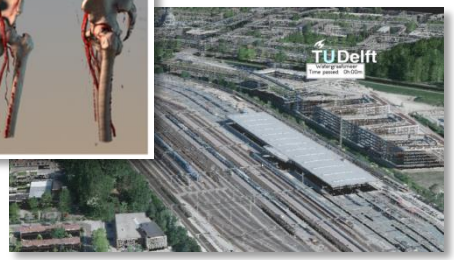
Visualisation for Data Science

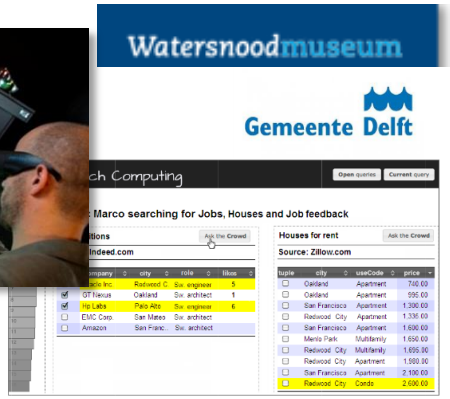


Big Data Visualisation:
for real-time visual analytics
e.g. medicine, environment





Big Data Interaction:
for intuitive big data
exploration and manipulation



Enabling big data visual analytics

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Science of Social Data

Opportunity:
data generated by humans, (re)presenting their take on the world

Challenge: largest source ever made, with yet-to-discover semantics

Social Data Analytics Machines:
repurposing social data that is out there, in controlled & well-understood manner

- Emergencies & incidents
- Intelligent cities
- Massive online education

Data Creation & Interpretation Machines:
including humans & human computing helping software in pro-actively creating & interpreting social data

- Social sensing
- Workforce engagement
- Crowd annotation & knowledge creation

Unlocking human-generated data

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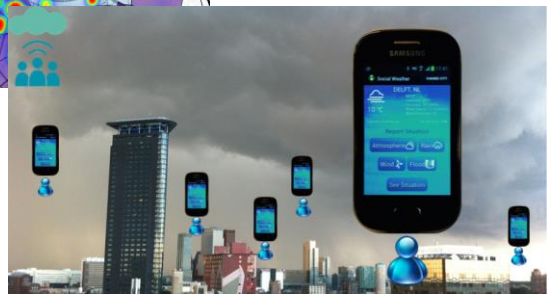
Example: Intelligent Cities

AMSTERDAM INSTITUTE FOR
ADVANCED METROPOLITAN SOLUTIONS



Urban analytics

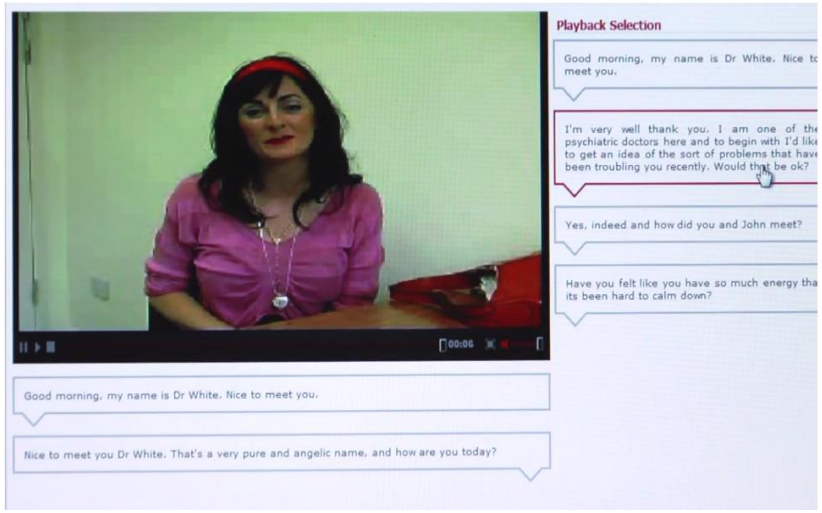
with Amsterdam Institute for Advanced Metropolitan Solutions

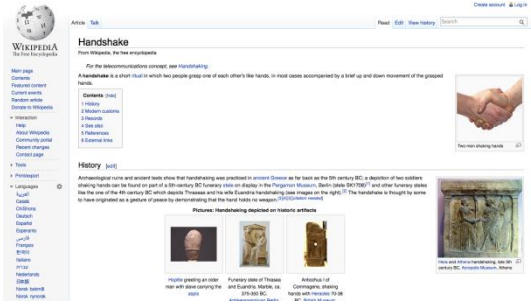
seeing the city through
open *social urban data*
for modeling city flows

data can tell different stories from different perspectives
and different ***semantics***

engaging *people in collecting data about their living environment, and* ***complementing*** *physical sensing and 'official' data*

Example: Online Education





Learning analytics

with Delft Extension School for Open & Online Education

*analytics to make online education truly **learner-centric** and to adapt to the students & their backgrounds*

***massive** online education is about massively adapting to the context of use*

*with increasing diversity comes importance of social and cultural features: **inclusion***

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Previous semester:

DDS seminar on Data Science for Environmental Monitoring

DDS seminar on Data Science for Finance

DDS seminar on Data Science for Health

Next quarter:

DDS seminar on Data Science for Online Education

DDS seminar on Data Science for Open (Government) Data

Today:

DDS seminar on Data Science for Cybersecurity

Delft Data Science Seminars

Cybersec@TUDelft

Data Science & Cybersecurity

TU Delft

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Cybersec@TUDelft mission

"Being an *open* **collaboration platform** for scientists, BSC-, MSc- and PhD-students interested in (*research & education* in) the domain of **Cyber Security"**

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Sections connected

EWI/CYS: section cybersecurity (Van den Berg/Lagendijk)

TBM/POLG: policy, organisation, law, and gaming (Van Eeten)

EWI/NAS: network architectures and services (Van Mieghem/Kooij)

TBM/ICT: cybersecurity within ICT (Marijn/Tan/Vanden Berg)

EWI/SERG: software eng. research group (Van Deursen, Visser)

TBM/SystemEng: systems engineering (Brazier, Verbraeck)

EWI/PDS: parallel & distributed systems (Sips, Epema)

TBM/SSS: safety & security science (Van Gelder, Reniers)

TBM/Philosophy: ethics/philosophy of technology (van den Hoven)

Support by Central Board (~ safety & security science)

Cybersec@TUDelft cooperation (national)

- Cooperation with other universities

  → LDE Center Safety & Security

  → 3TU partners

  → The Hague University of Applied Sciences

- Partnering within "golden triangle"

  (like partners of The Hague Security Delta = HSD)

New education initiatives, ex.'s

- 3TU regular MSc program CyS

  (starting Sept 2015)

- Professional MSc program CyS
  (at Cyber Security Academy The Hague, started January 2015)

- Other arrangements

  → MOOC on Cyber Security Economics

  → Applied crypto course (continuation of TopTech course)

  → Other dedicated courses

  → …

So ?!

Interested in Cyber@TUDelft ? ➔

Please contact us during the breaks!

Agenda

Cybersec@TUDelft

Data Science & Cybersecurity

Data Science & Cybersecurity challenges
Two big research directions:

1. Cyber Security *through (big) data:*

   Monitoring & Analytics for *securing* ***cyber space,*** e.g.

   of data flows, data processing in devices, …

   in social networks, dark web, …

   of financial e-transactions

2. *Securing* Big Data:

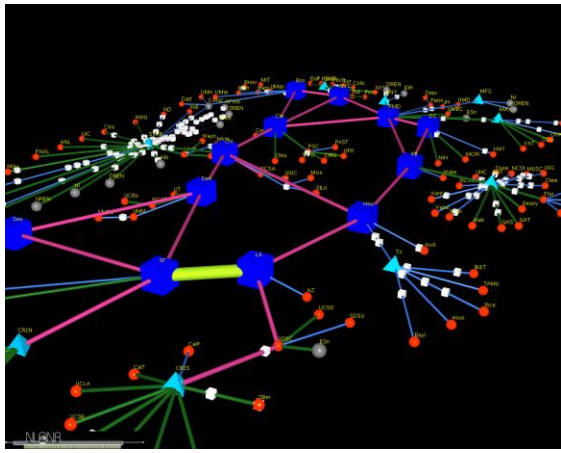
   Big Data for *improved* ***decision making***, e.g.

   marketing, healthcare, finance, …

   environment, sustainable future, …

   individuals, companies, politics,

Cyberspace defined



A global, man-made 'nervous system' with

high speed *connectivity*

huge distributed *data processing* capabilities

huge *data storage* capabilities

millions of '*intelligent systems*' autonomously taking decisions

+/- 3 billion interconnected *human actors*

enabling "cyberacting"

Cyber activities of all kind…

Basic cyber activities

Communication, information retrieval, watching, listening, …

More advanced cyber activities

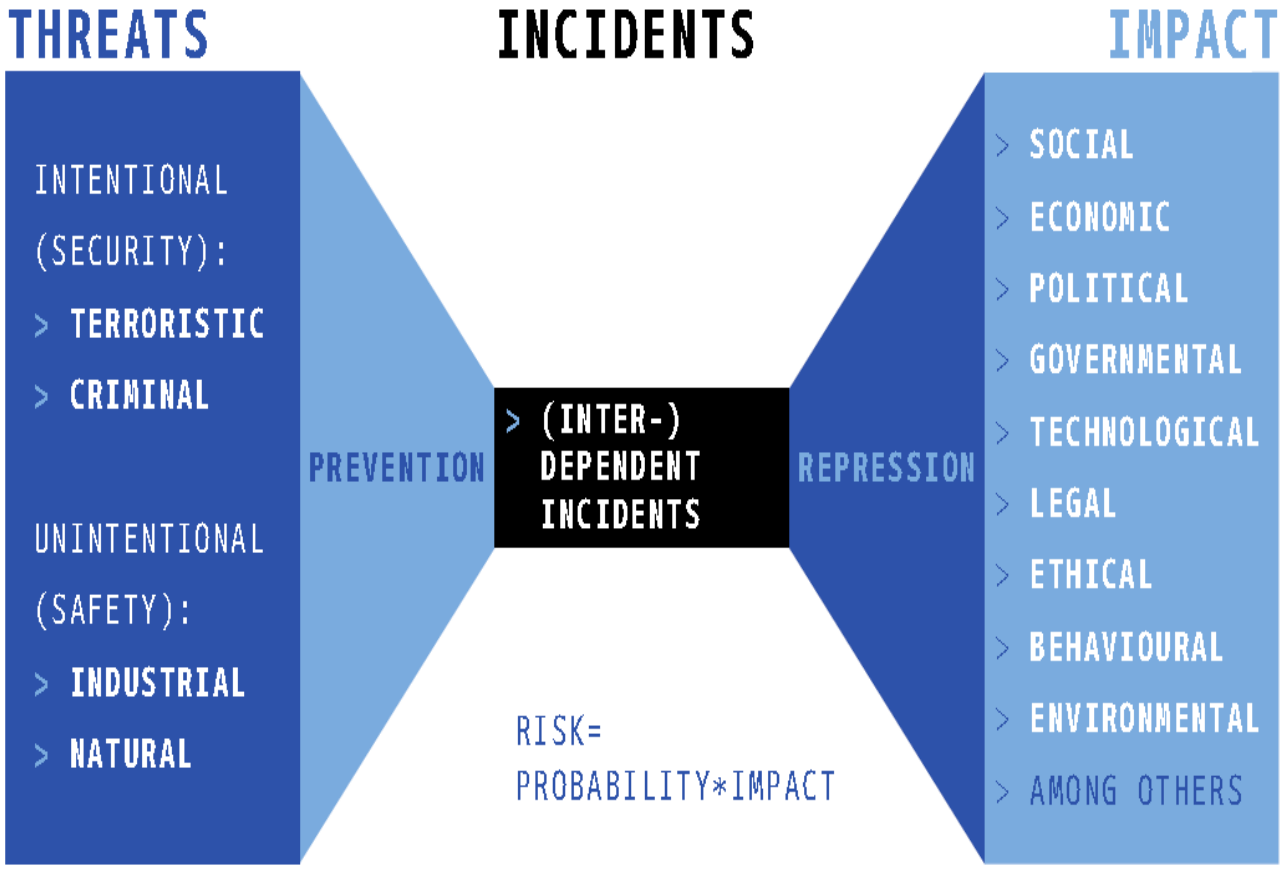
Searching, (automatic) transacting, social gathering, gambling, educating, monitoring & surveillance, supporting business processes of all kind, controling critical infrastructures, …

Less favourable cyber activities

Cyber crime (dark markets), c*yber warfare, …*

Goal: reduction of cyber risks to '*acceptable levels*'

for all stakeholder groups

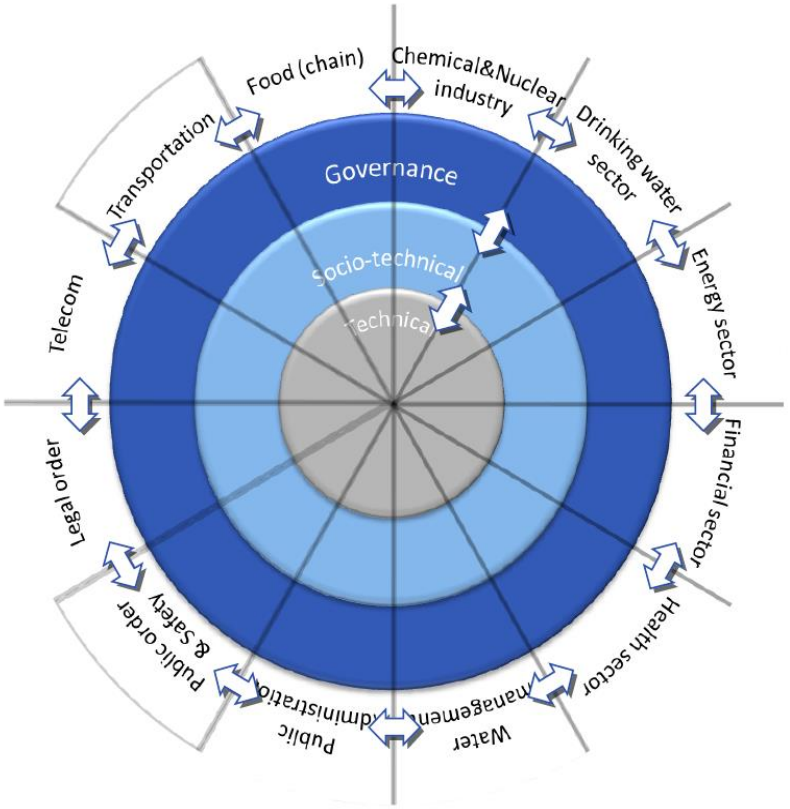


Decomposing cyberspace: layers

Technical layer: **IT services** (Internet, applications, servers, cloud, IoT, BYOD, …, many different devices), world of **information security ~ CIA ~ information security breaches**

Socio-tech layer: **cyber activities** by **3 billion end-users** and (?) **billion autonomous IT systems**, at home/work, in organisations, critical infrastructures, states, … **~ 'Business/ Societal Values' ~ cyber activity breaches** (!)

Governance layer: governance and management activities



- **Stakeholder groups:** end-users/organisations/sectors/states, …

Consequences

- *Cybersecurity* concerns securing cyberspace where

  → Technical layer *enables* cyber activities

  → Governance layer *steers (& constraints)* cyber activities

  → *Cyber activities* focus on the *complex interaction of (autonomous) IT-systems and their users*

- *Proposition:* **in the end, any fruitful discussion on cyber security should pay attention to all 3 layers!**

2. Securing big data

- Classical *information security* criteria

  CIA(A)

- Also *protecting privacy* in all big data application areas like …

  ➔Privacy enhancing technologies

  ➔Homomorphic encryption

  ➔Enabling personal control over data

  ➔Enabling anonymity (TOR, TRIBLER)

  ➔Enforcing the right to become forgotten

  ➔…

Master classes

- *Ad 2: Securing (big) data:*
  Security and Privacy: Conflict or Harmony
  Zekeriya Erkin

- *Ad 1: Securing cyberspace through big data:*
  The Challenge of Bot Detection
  Sicco Verwer and Pieter Burghouwt

- *Ad 1 & 2:*
  Why have a lock at all? On the fallacy of ICT security
  Christian Doerr

Thank you

After the masterclasses the plenary program will start again right here in Hall Boole at 15.00 sharp