EDA – R&T planning
EDA R&T CONFERENCE 25-26 April 2016

David CHINN - EDA R&T COORDINATOR

Overview

- The EDA objective
- CDP
- State of the art on R&T planning
- EDA current approach to R&T planning
- Ideas for improving linkage Capability and R&T linkage: the OSRA approach
- Conclusions

The EDA objectives for OSRA

- **Member states want relevant R&T that is value for money**
- **EDA R&T projects are built on the basis of adhoc funding - this is in EDA's founding documents.**
- **EDA plans its R&T on the basis of requirement and funding available from member states.**
- **The work on the Preparatory Action for Defence Research (and other funding mechanisms) has highlighted some issues with the ad hoc approach**
- **Overall, there is need for a more capability-based coherent approach.**

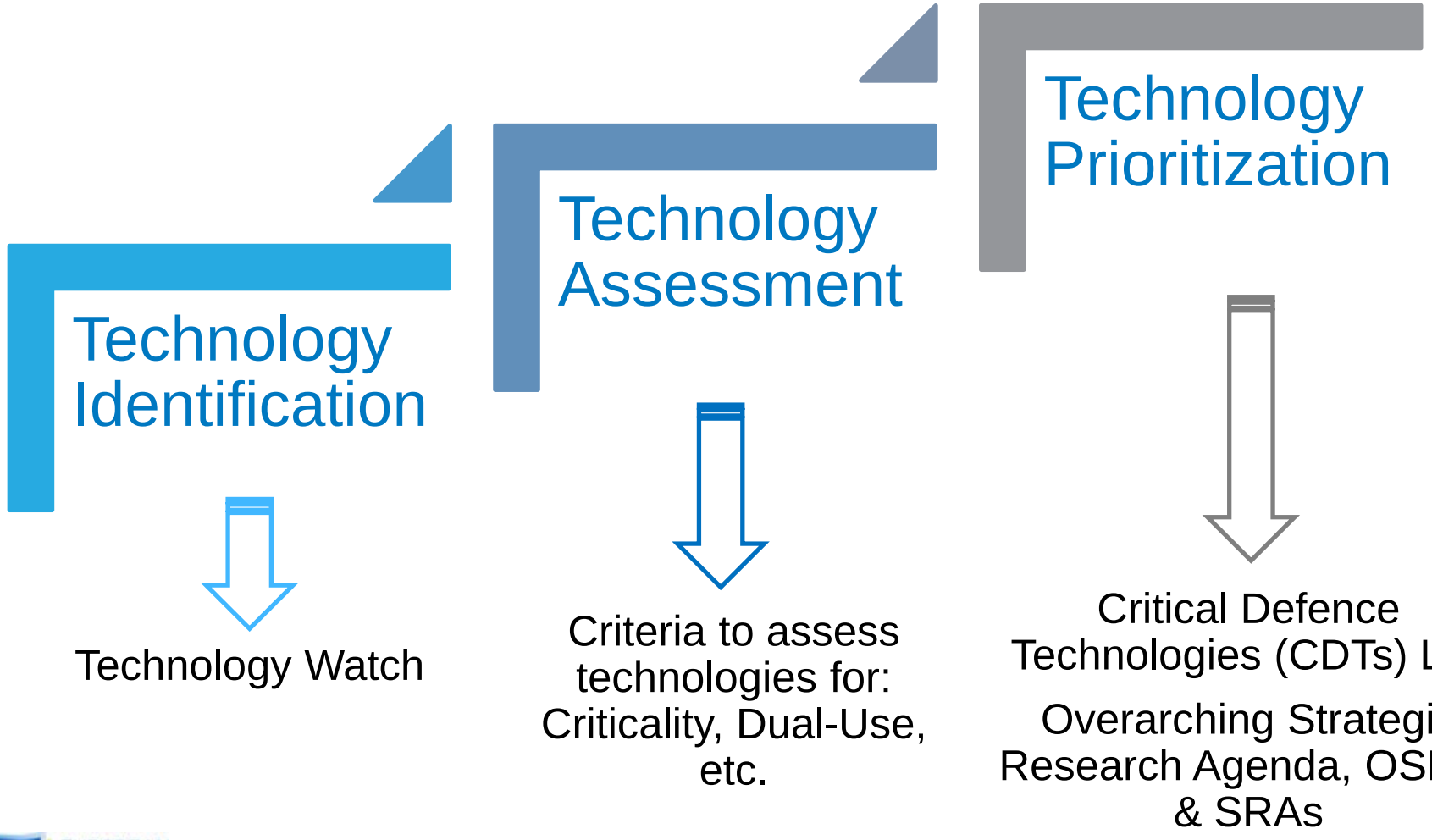
Capability Development Plan CDP

- **Set of capability objectives agreed by Member States at Steering Board level.**
- **The longer term activities are reflected in the Futures Work**
- **“Overall strategic tool”, informing Member States defence planning and driving EDA Work Programme**
- **Connecting short-, medium- and longer-term capability needs**
- **Not a ‘Force Plan’, but informing on future Capability needs**
- **Agreed Priorities**

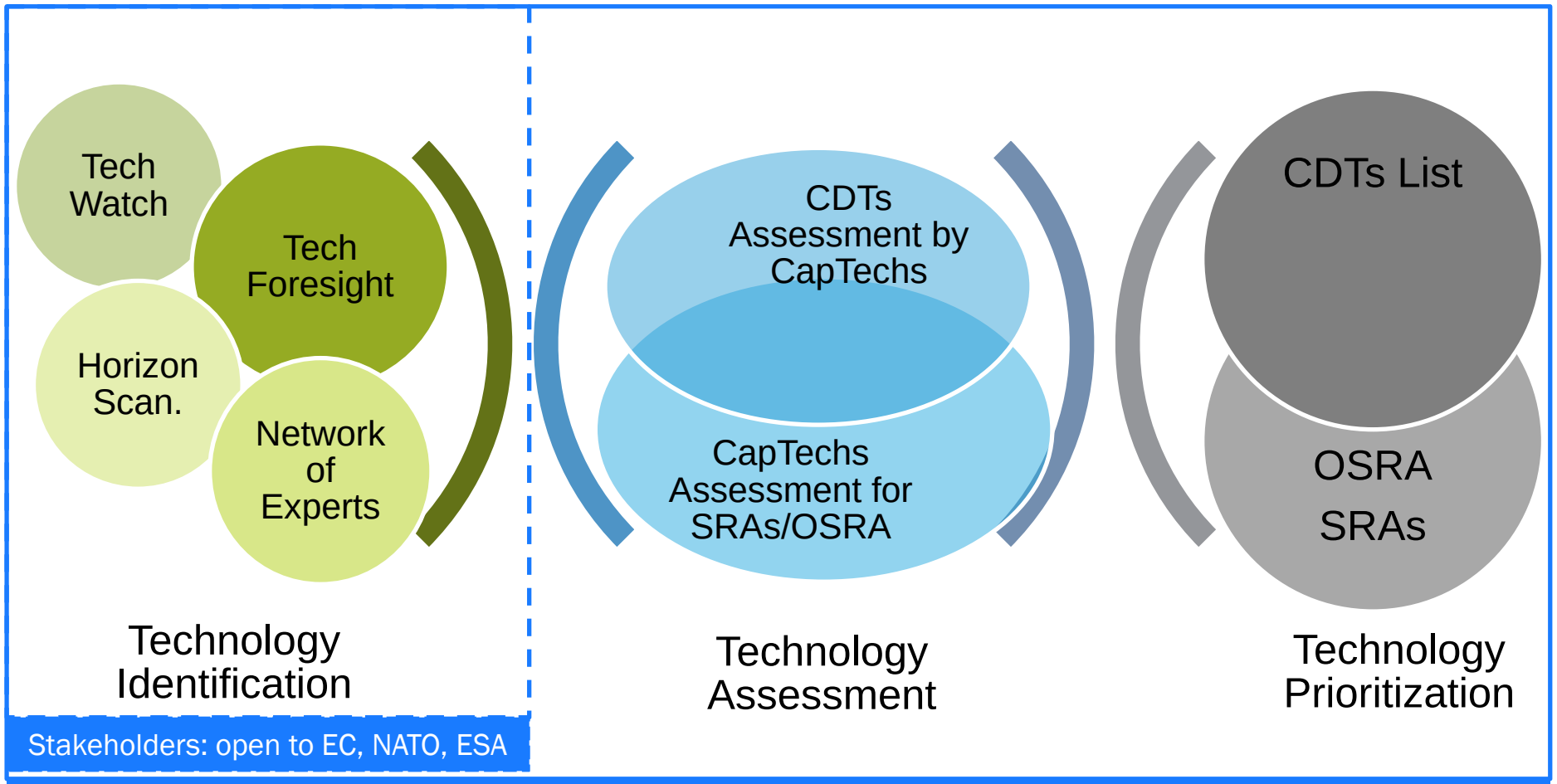
State of the art on R&T planning

- There are a number of standards that provide guidance
- Standards are generic – but not (yet) applied in Defence.
- Many member states do it in a more or less similar manner, nominally driven by capability needs.
- NATO Defence Planning also tries to take this account but has similar challenges to EDA.
- Uncertain about global level of process maturity in formal process terms, but there seems to be generally a large gap in translating consistently the capability needs into R&T requirements.

R&T Planning process in 3 steps



Comprehensive R&T Planning



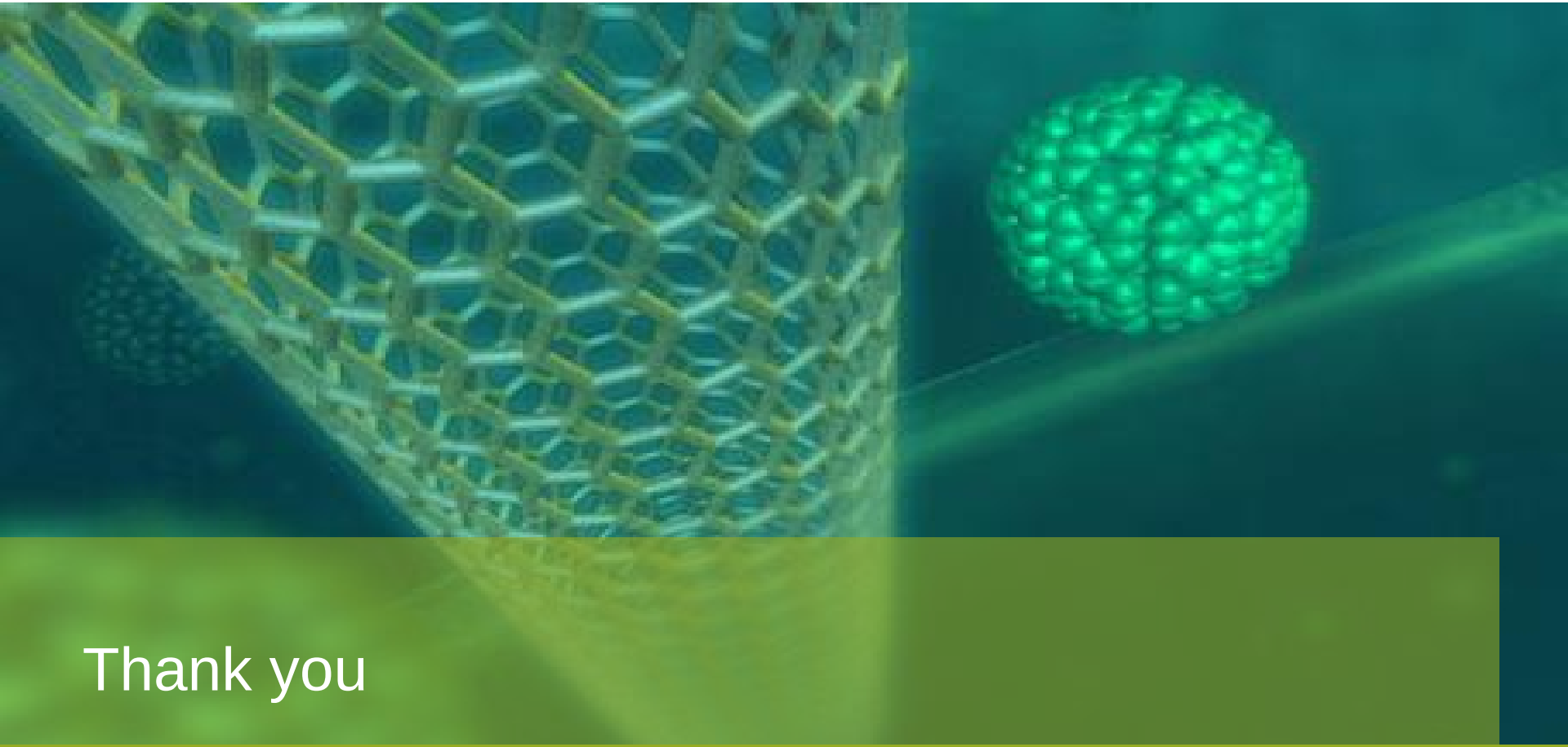
OSRA Process

- Assumes that we can plan on the basis of stable capability needs
- Assumes that we can generate meaningful research goals.
- Difference compared with nation planning processes. EU/EDA will fund and manage some/all of the activity, but exploitation will be through Member States.
- So: funded of R&T “building blocks” need to be defined in some more or less formal manner that is linked to capability needs.
- This is clearly a not new problem, but making the formal connection between capability and R&T needs seems to be more innovative than we thought. OSRA attempts to do this in a systematic manner.

Conclusions

- All member states do this more or less formally, novelty of EDA approach is that it is driven by R&T funding to support MSs' Capability needs.
- We may need to make the capability "hooks" for R&T more explicit.
- May provide a different structure to engage with industry more comprehensively in addition to a CapTech by CapTech basis
- Overall we are seeking to improve the systematic approach to R&T planning for the benefit of Member States.
- Specifically this should enable EDA to provide a coherent input to the Commission for both the Preparatory Action and any future research programme.

EUROPEAN DEFENCE AGENCY



Thank you

Technologies that will Change the World
How to find them?

A JRC perspective

Olivier Eulaerts
Joint Research Centre

The JRC in the Commission

President Jean-Claude Juncker

27 Commission Members

… DG Environment

DG Climate Action

DG Agriculture and Rural Affairs

DG Mobility and Transport

DG Energy

Commissioner Tibor Navracsics

Education, Culture, Youth and Sport

Joint Research Centre (JRC)

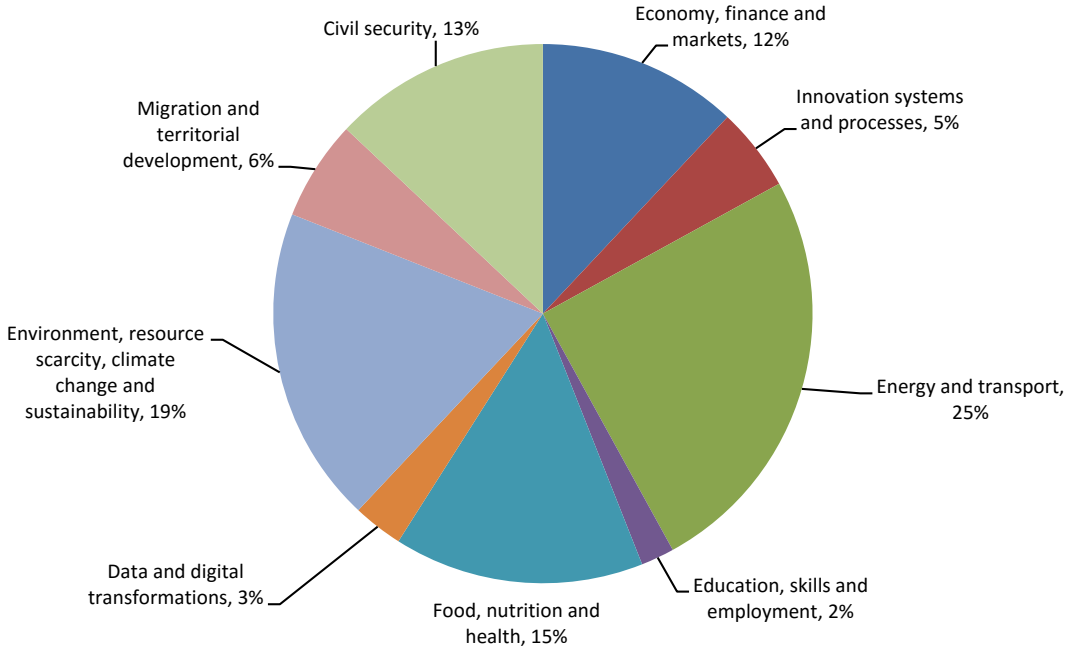
DG Education and Culture

JRC Director-General
Vladimir Šucha

JRC Mission: "As the science and knowledge service of the Commission our mission is to support EU policies with independent evidence throughout the whole policy cycle."

Established 1957

- *7 institutes in 5 countries*
- *3055 scientific, technical and administrative personnel*
- *1 370 contributions to EU Policy*
- *689 peer-reviewed scientific publications in 2014*
- *Budget: €375 million annually, plus €73 million earned income*



Questions

How to detect new Technologies?

How to detect technologies that will impact the (policy) world?

Expert Opinion
Delphi, Focus groups, Interviews, Critical technologies...

Horizon Scanning
Human scanners

Descriptive Methods
Bibliometrics, State of the future indeX, Impact lists, ...

Causal Analysis
Requirements analysis, Institutional analyses, Stakeholder analyses, Social Impact Assessment, Mitigation strategizing, Sustainability Analyses, Action analyses, Relevance Trees, Futures Wheel

Technology Watch
Patent landscaping, Bibiometrics ...

Statistical Methods
Risk analysis, Correlations, ...

Matrices approaches
Analogies, Morphological analysis, Cross-Impact analyses,...

ROADMAPPING
Backcasting, Technology/Product Roadmapping, Science Mapping

Scenario-Simulation (gaming), Trend Impact Analysis

Trend Analysis
Extrapolation, Impact analysis, long wave

Decision analysis
Cost-Benefit, Analytical Hierarchy Process, Data Envelopment, Multicriteria Decision, ...

Creativity
visioning, Future workshops, ...

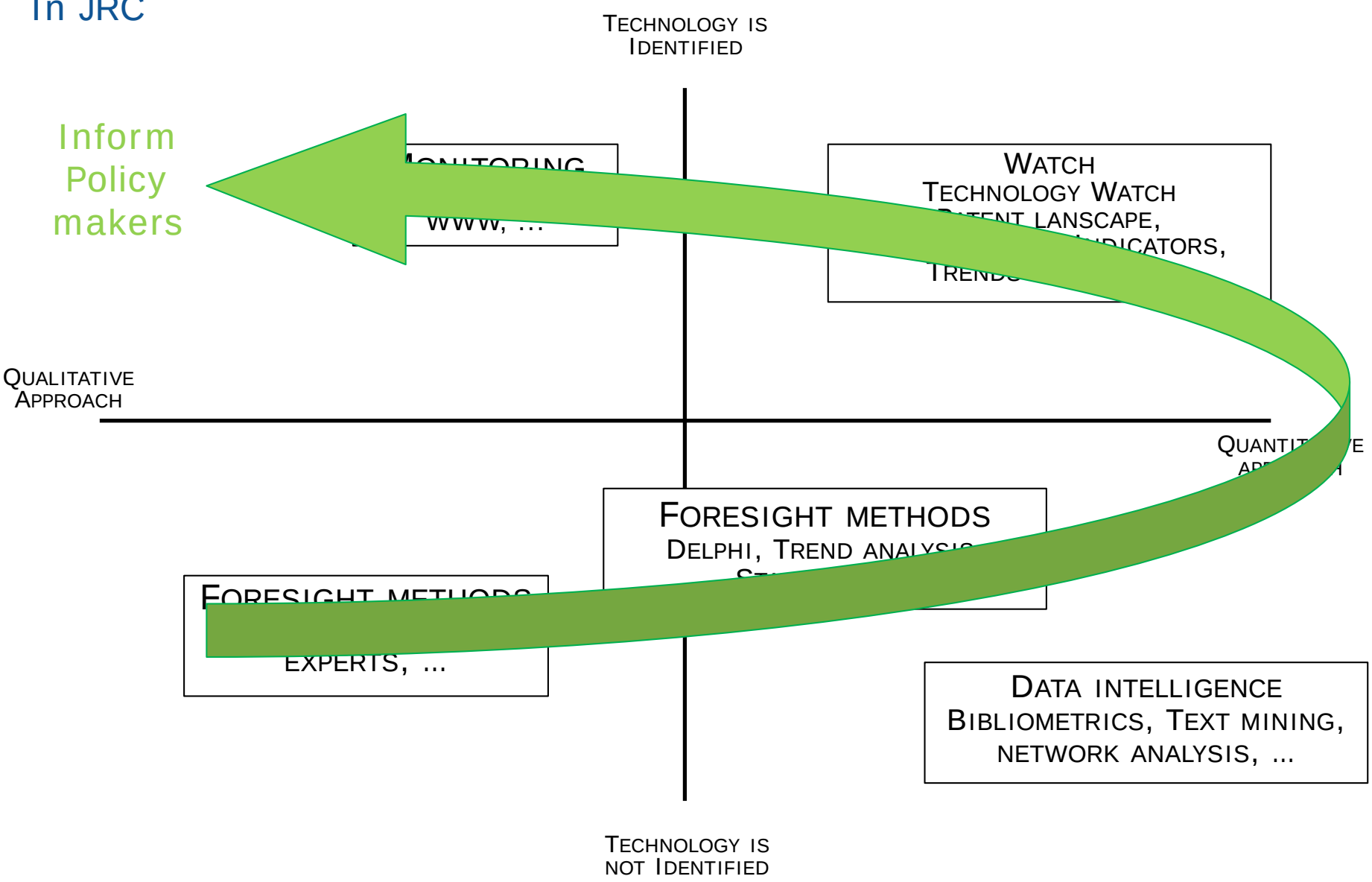
Problem Solving
TRIZ

Modeling/Simulation
Innovation Systems descriptions, Complex Adaptive Systems modeling, Chaotic regimes modeling, Technology Diffusion or Substitution analyses, Input-Output modeling, Agent-based modeling

Scenarios
Management approach, Quantitatively based scenarios

Monitoring
Media, Web, specialised Press

In JRC


TECHNOLOGY IS IDENTIFIED
Inform Policy makers
WATCH
TECHNOLOGY WATCH
QUALITATIVE APPROACH
FORESIGHT METHODS
DELPHI, TREND ANALYSIS
EXPERTS, ...
DATA INTELLIGENCE
BIBLIOMETRICS, TEXT MINING, NETWORK ANALYSIS, ...
TECHNOLOGY IS NOT IDENTIFIED

Explore the unknown: Policy Lab

A collaborative and experimental space for innovative policy making

The EU Policy Lab is both a physical space and a way of working that combines FORESIGHT, HORIZON SCANNING, BEHAVIOURAL INSIGHTS and DESIGN THINKING to explore, connect and find solutions for better policies.

EXPLORE
Foresight and Horizon Scanning explore long-term futures and creates shared visions for policy-making.

CONNECT Policy and People
Behavioural insights can improve policy-making by applying the knowledge of how people make decisions.

POLICY innovation
Bringing together foresight, HS, and behavioural insights in design thinking can engage stakeholders to find, prototype and test innovative policy solutions.

METHODS
Collaborative and Co-design
Experimentations
Systems-thinking
Cross-disciplinary

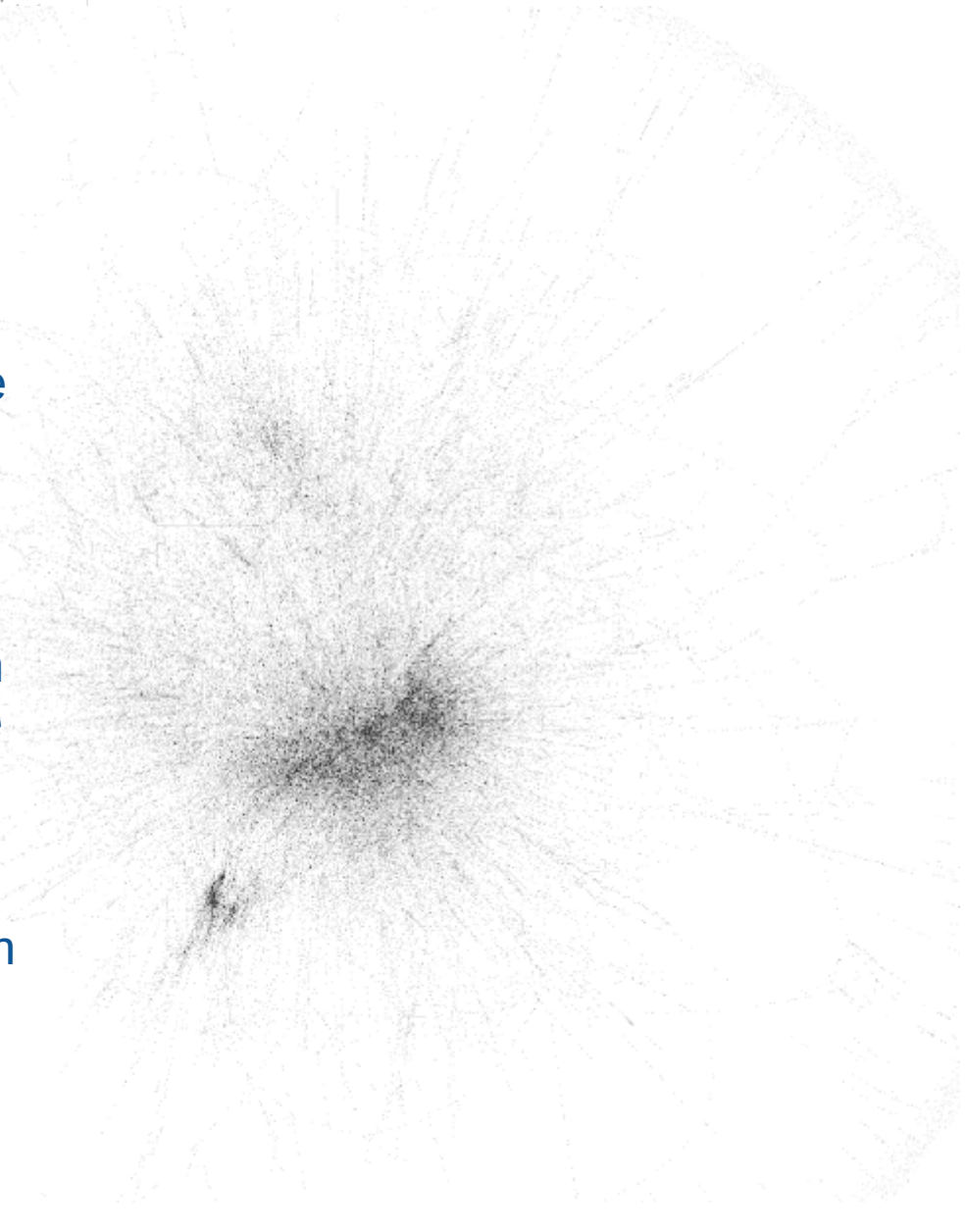
Explore the unknown: network analysis and text mining

To detect emerging trends in science and technological development.

Detect Weak signals by:

- using text mining on datasets such as scientific publications, conference proceedings, grant proposals, patents.

- following evolution of networks with time to spot significant changes



Watch the identified emerging technologies

To spot early signs of Society interest/market applications

Why? Early alert to policy makers to give more time to design policy and avoid the development of ideological arguments

How? By monitoring technological development from various perspectives

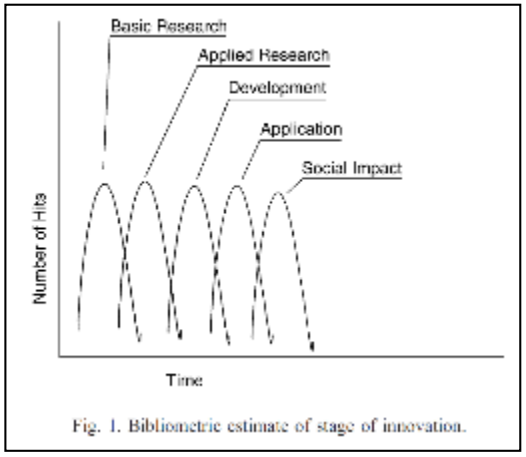


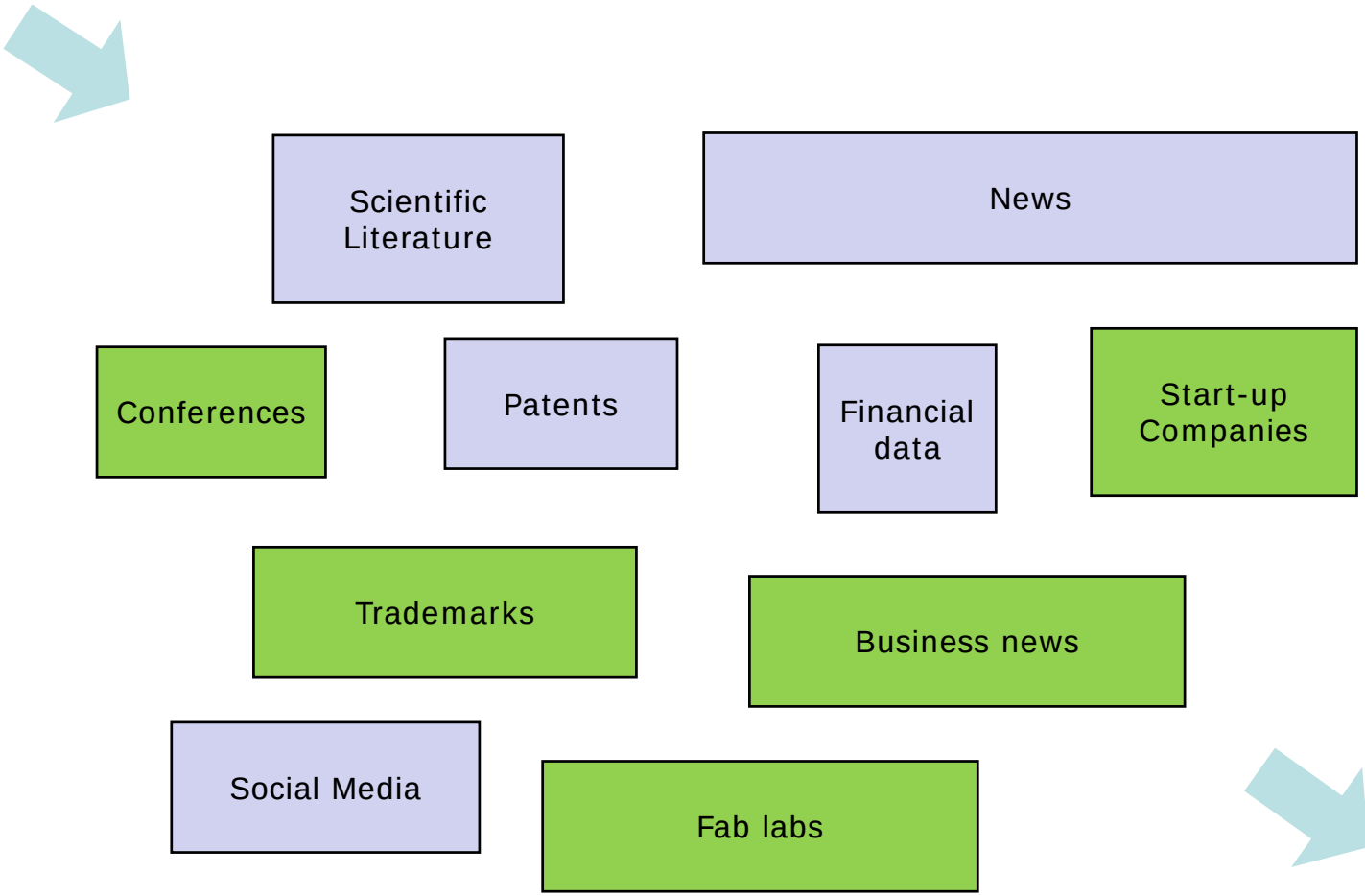
Fig. 1. Bibliometric estimate of stage of innovation.

Technology forecasting

Martino, J. P. (2003). A review of selected recent advances in technologic al forecasting. *Technological Forecasting and Social Change*, *70*(8), 719–7 33

Idea

No standard trajectory



Product or Service

Detect the technology trace

Qualitative

Use text mining and semantic analysis techniques to track technology development in:

Press Media

Twitter

www

Quantitative

Build indicators of technological development by using text mining on various databases:

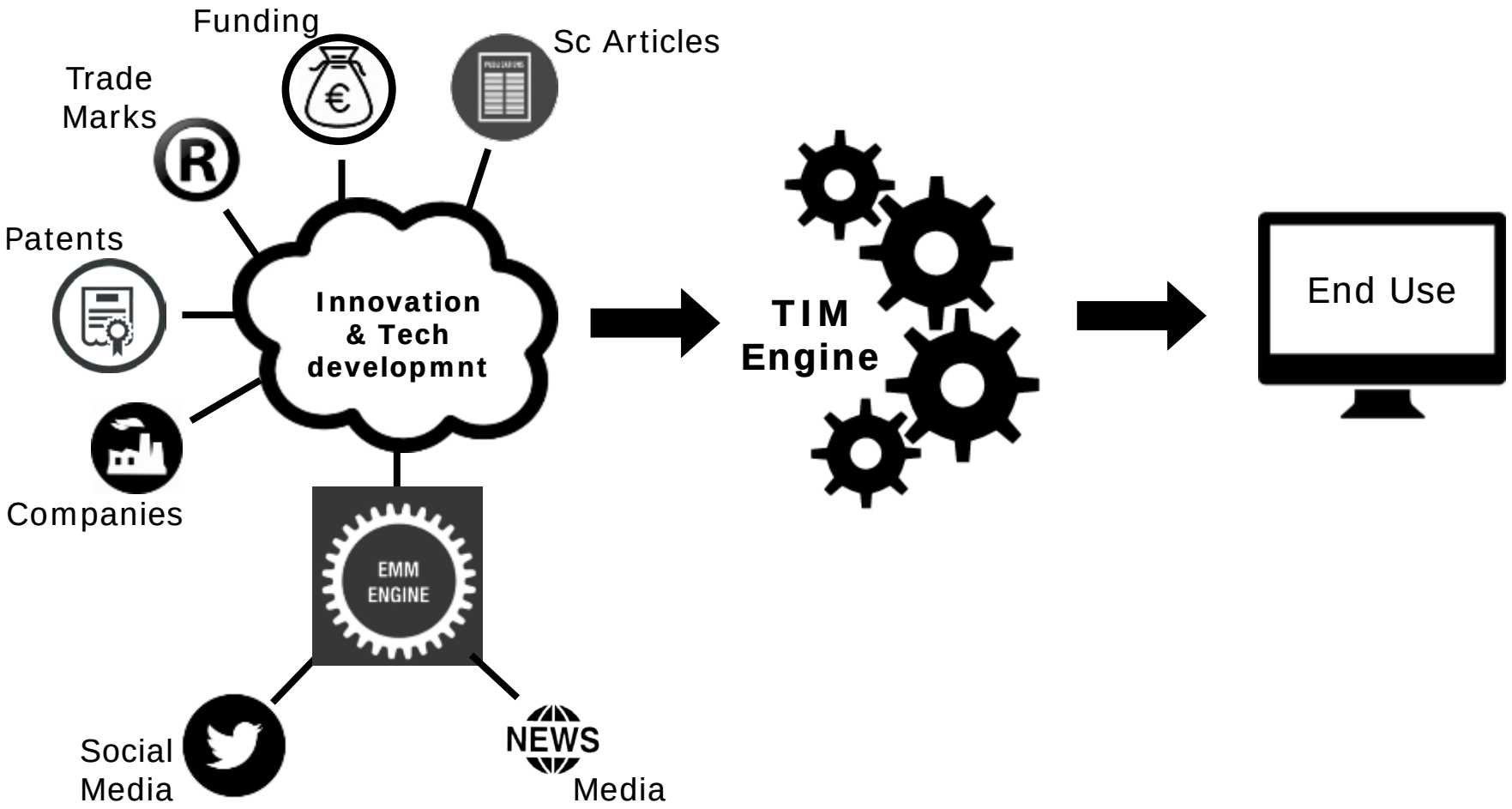
Scientific Articles

Conference Proceedings

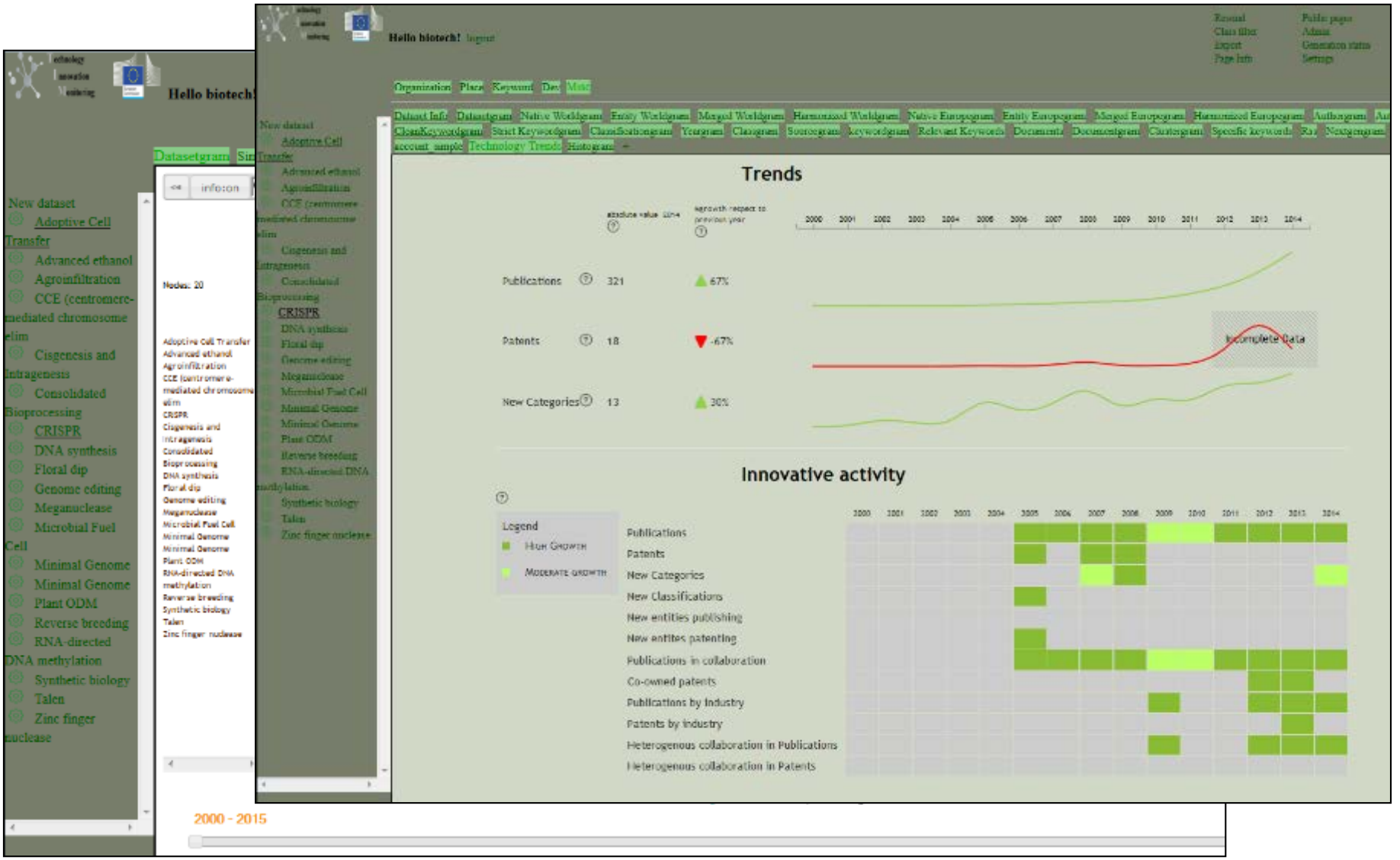
Trademarks

Patents

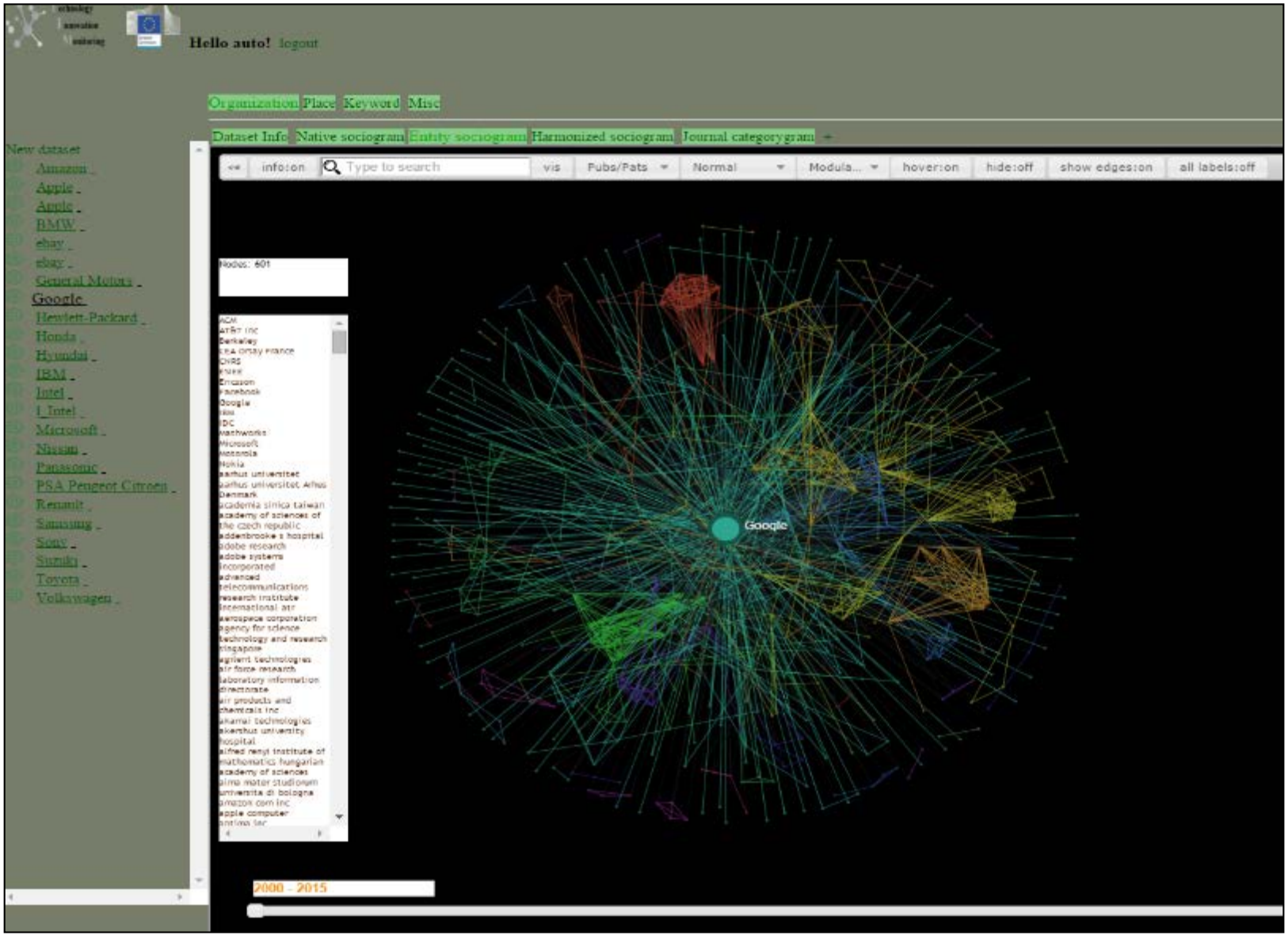
T.I.M. Tools for Innovation Monitoring



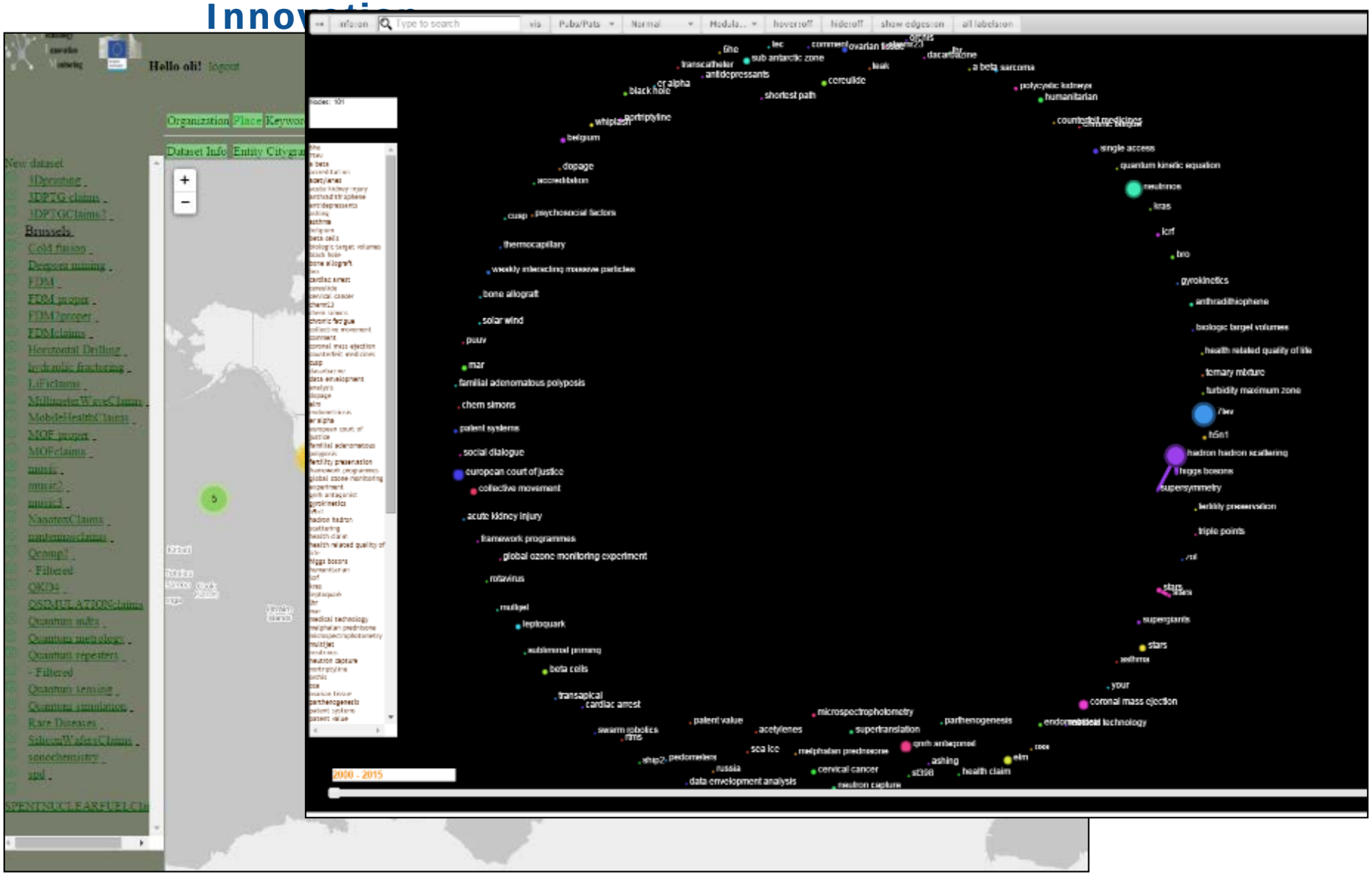
Monitoring technology emergence



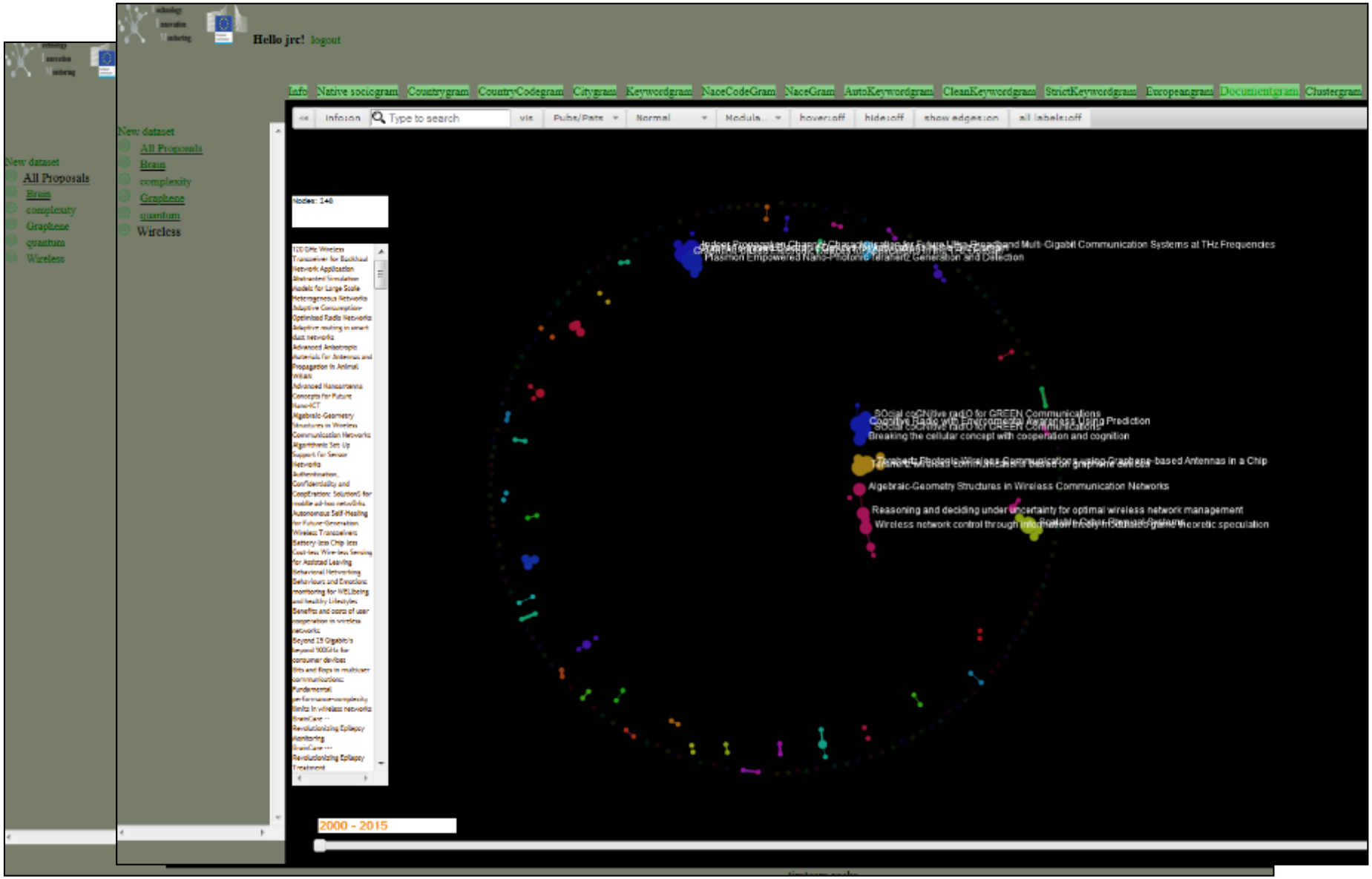
Monitoring Industry innovation



Monitoring Territorial Innovation

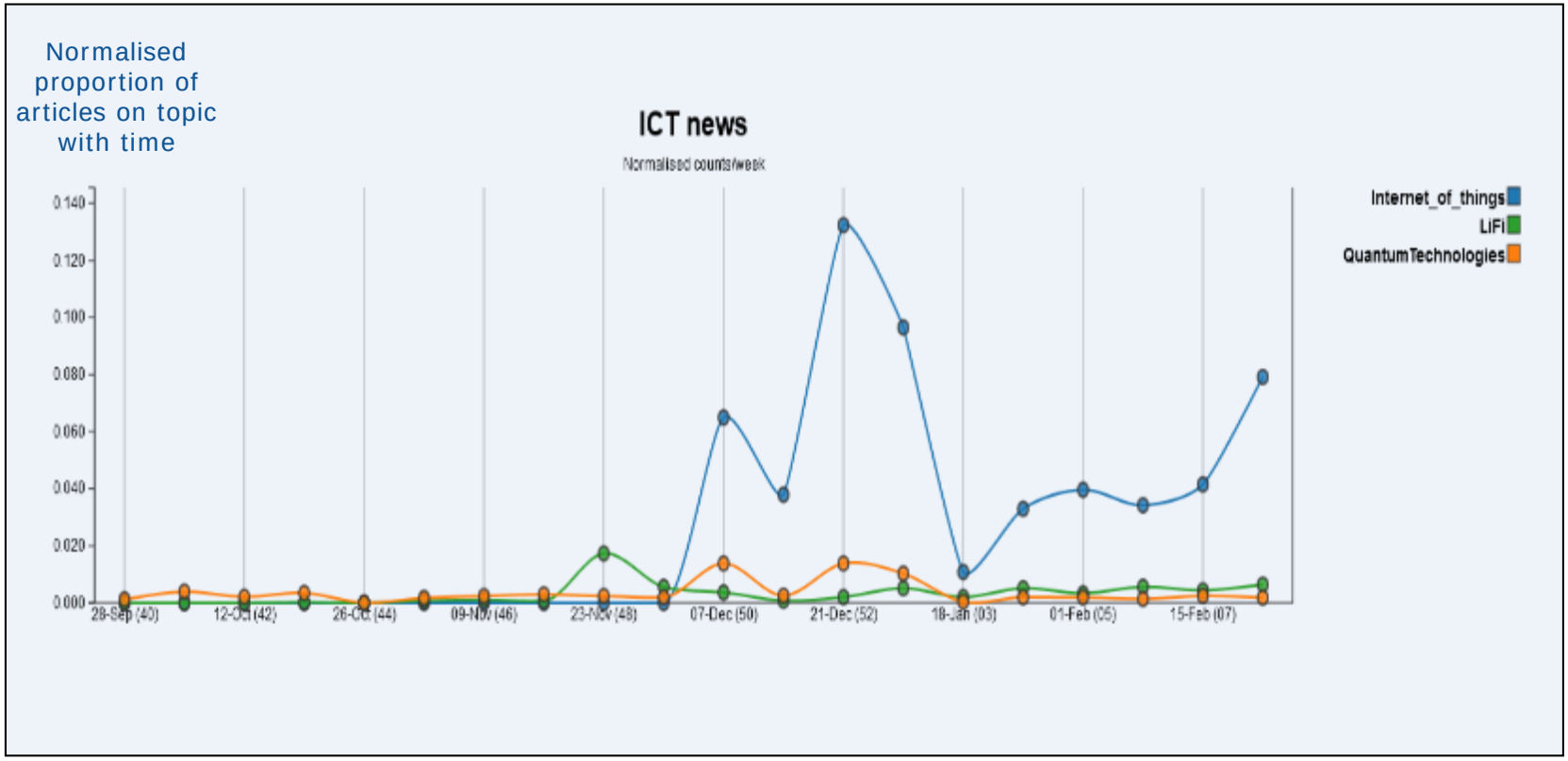


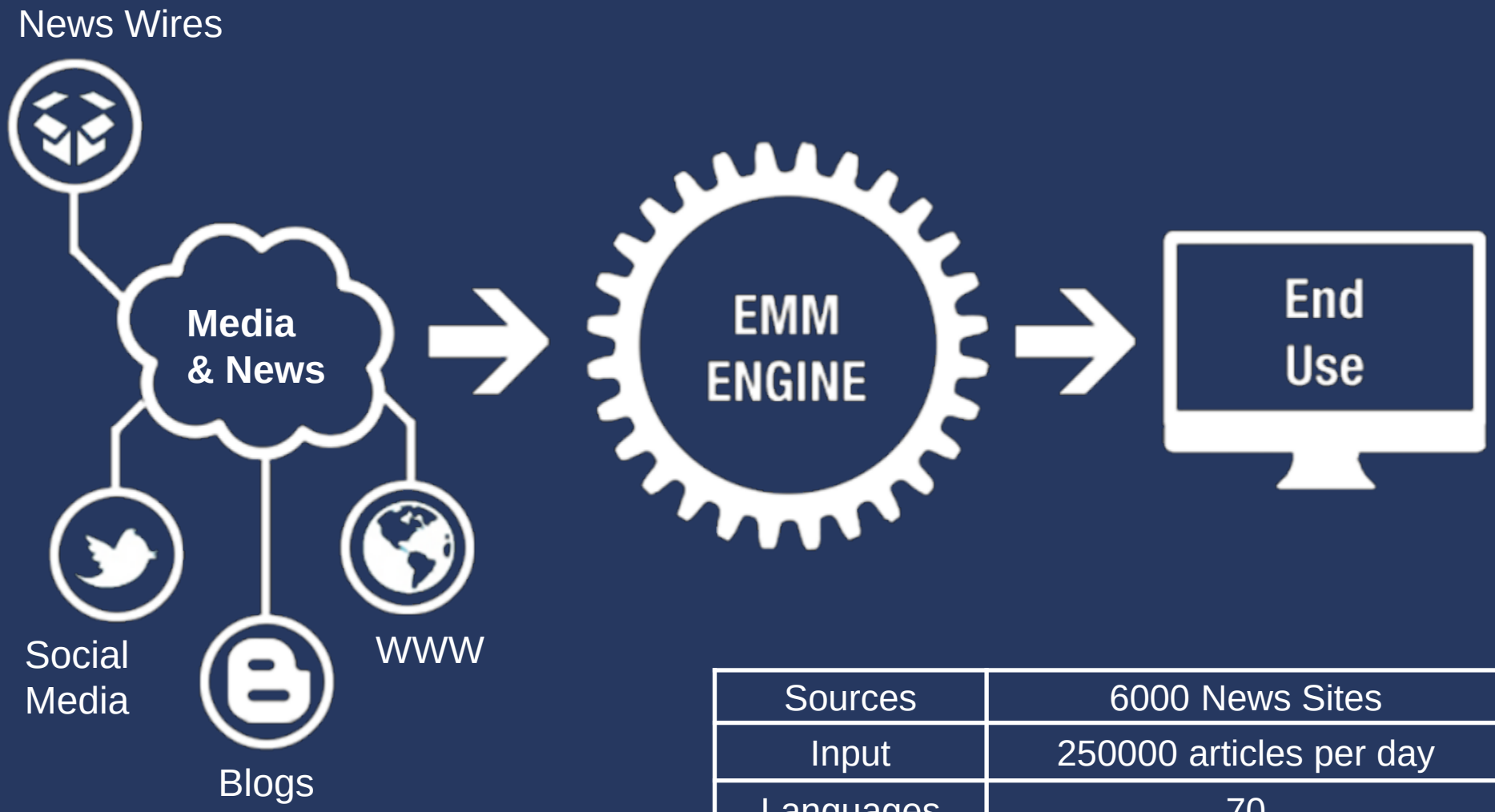
Monitoring Grant Proposals



Monitoring Innovation in Media

Normalised proportion of articles on topic with time



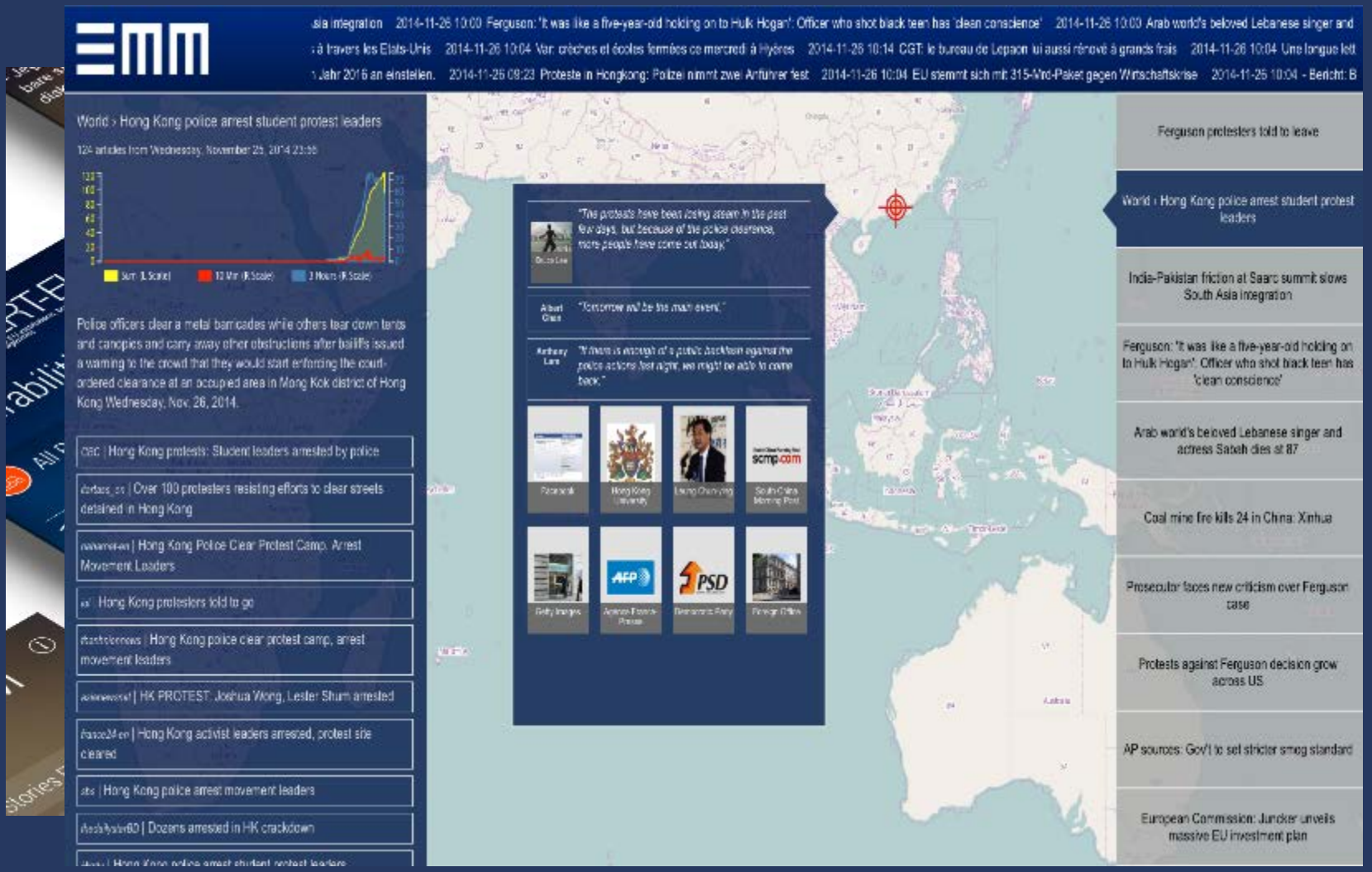


Sources	6000 News Sites
Input	250000 articles per day
Languages	70
Categories	1000 classes
Classes	30000 keywords
Runs	24/7
Visitors/day	25000

End Use

Emm.newsbrief.eu

End Use

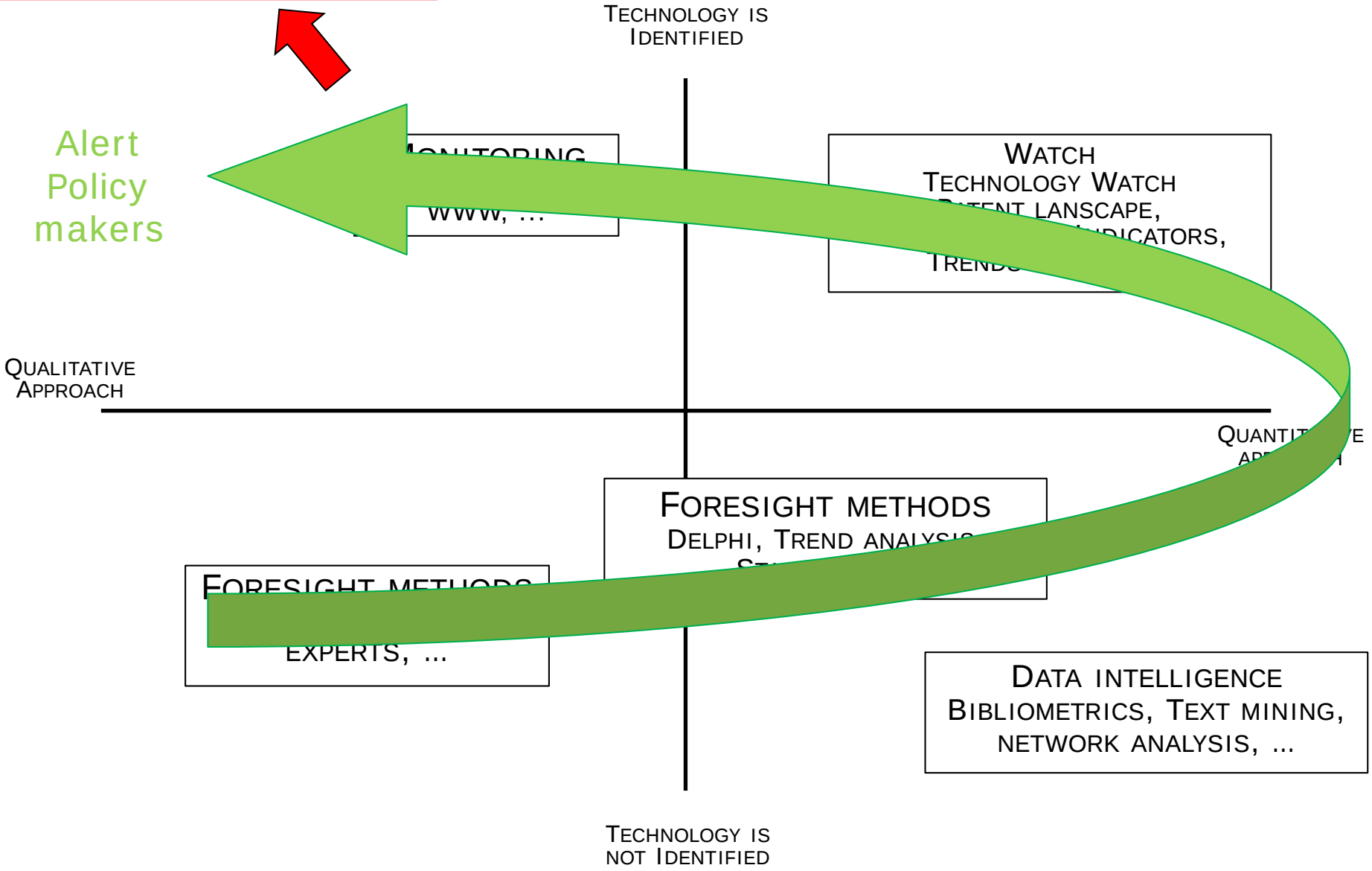


CERT-EU, Europol, Frontex, International Press Association (Brussels), OAS, AU and JRC Visitors Centre

Conclusions

- Detecting and monitoring emerging technologies complex issue and resource intensive
- No one size fits all method – highly user/context driven
- Mix qualitative and quantitative approaches
- Monitor all types of innovation => Mix various DB
- Growing importance of citizen's dimension
  - Behavioural insights
  - Sentiment analysis
  - Citizen innovation
- Automation of technology watch to serve wide audience => stop silo thinking and duplication
- Feedback to PM on lessons learned – what has an impact?

Feedback to PM. What works in innovation funding.



Thank you!

US Defence Innovation

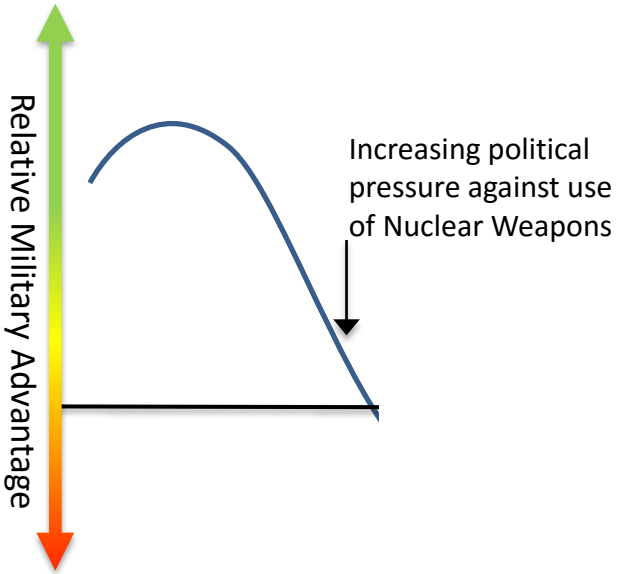
Dan Jenkins
djenkins@rand.org

RAND EUROPE

US Defence innovation has historically been driven by capability shortfalls…

- US policy has focused on developing strategies to counter an opponents inherent strengths through use of alternative (sometimes, although not always cheaper) means to tip the balance of military capability.
- As a result innovation, research and development has tended to be more targeted than traditional “blue sky” thinking.
- Termed offset strategies
- Characterised by:
  - Clearly articulated problem space
  - High degree of industrial competition
  - High degree of federal funding

First Offset:
Tactical Nuclear Weapons



1950s

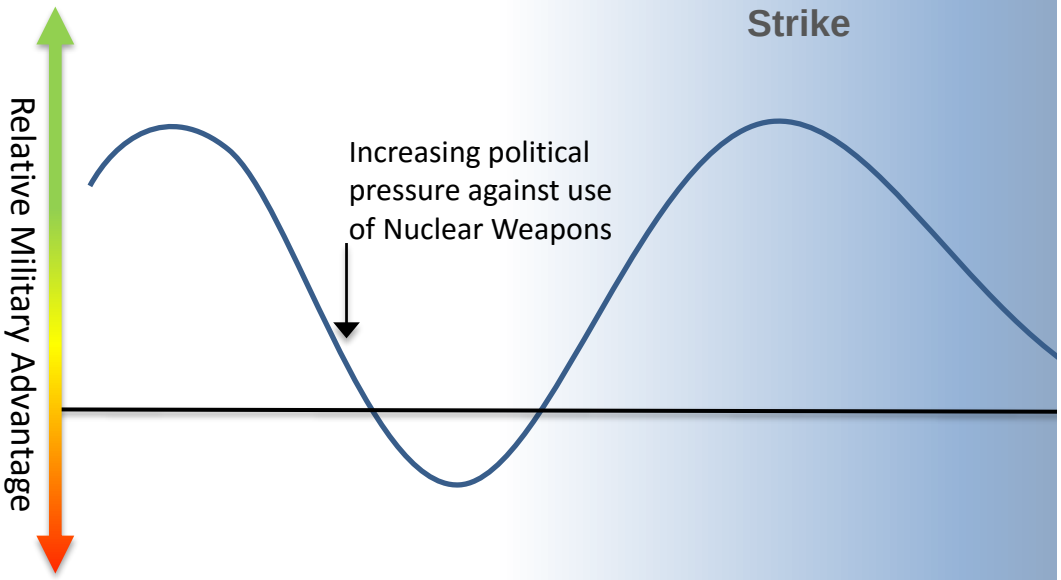
Threat: Massed Warsaw Pact Armies

Doctrine: evolutionary doctrine Pentomic Army, Defense in Depth, Active Defense

Concept: One shot, many kills – small arsenal of tactical nuclear weapons offsets large numerical deficit; conventional weapons are still many shots, one kill.

First Offset:
Tactical Nuclear Weapons

Second Offset:
Sensing, Targeting, Stealth & Precision Strike



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1970s

1990s

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Concept: Surgical strike, use of stealth to achieve One Shot, One Kill – increased effectiveness of conventional weapons allows medium size arsenal to overwhelm defenses

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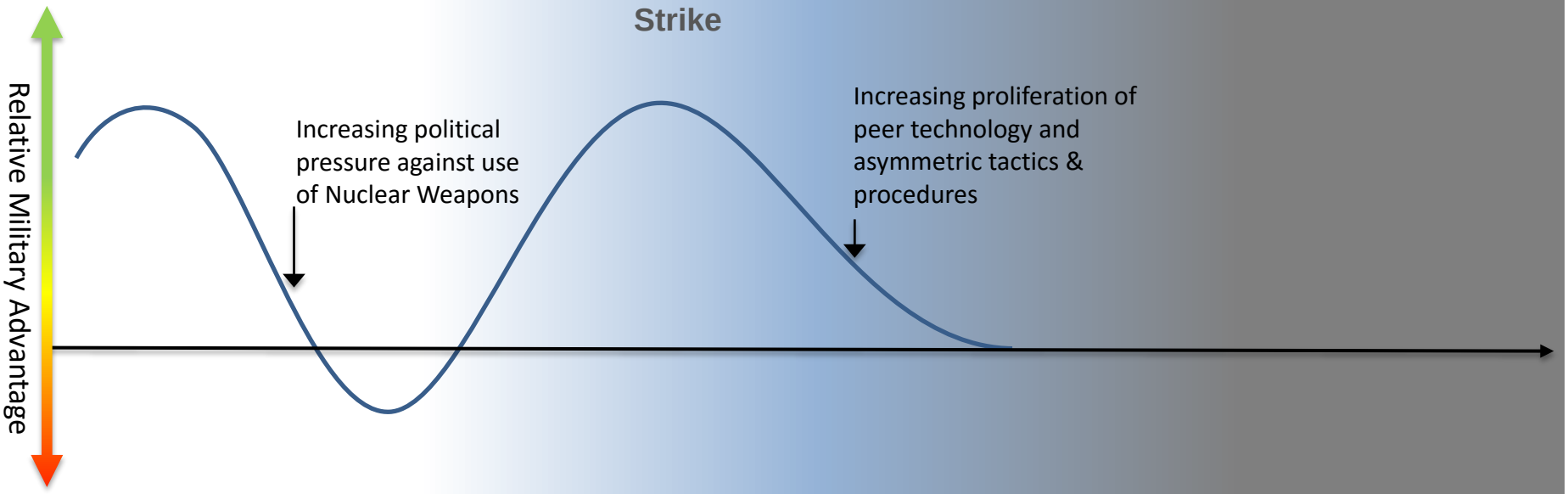

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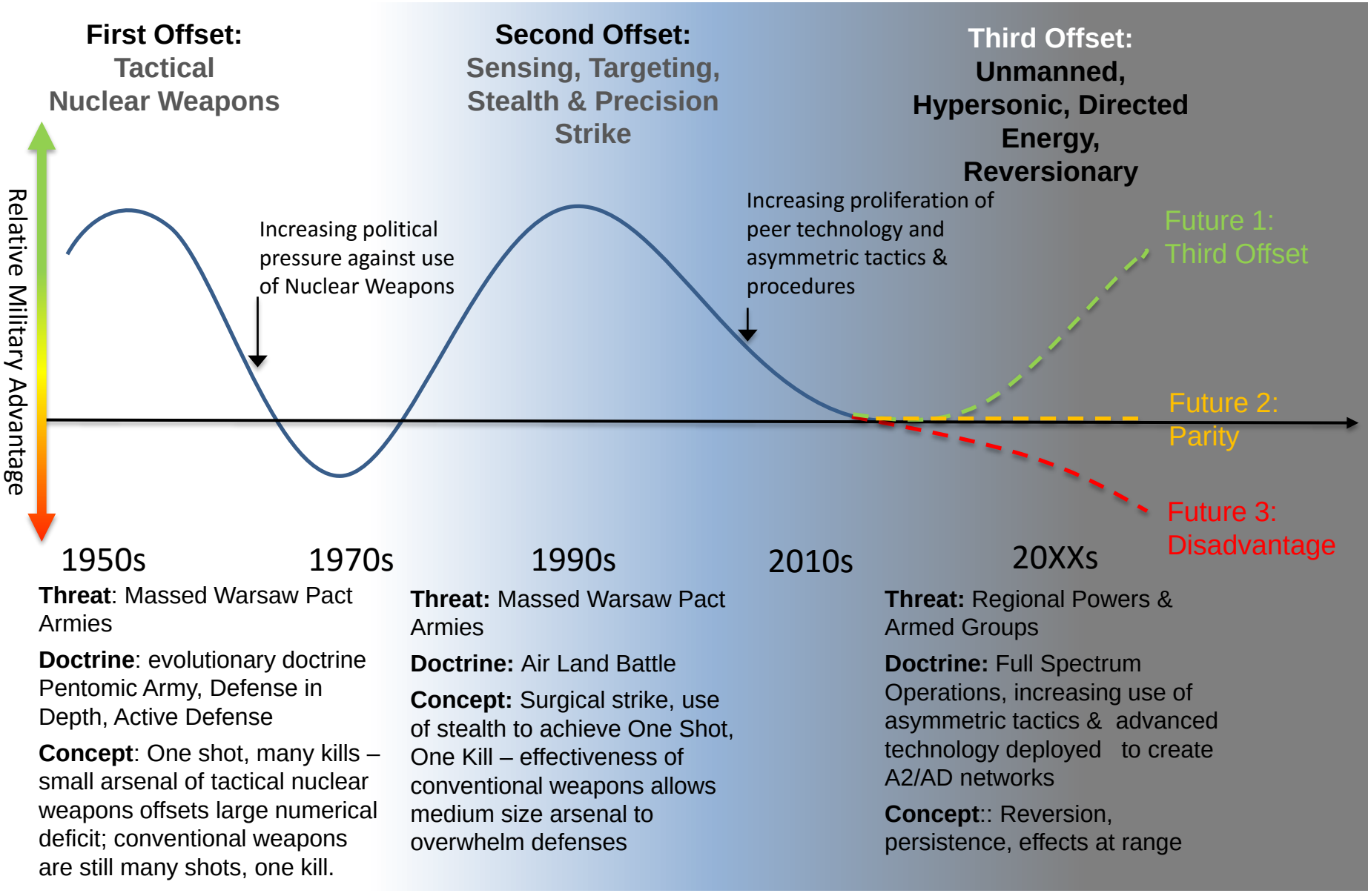
2010s

Threat: Regional Powers & Armed Groups

Doctrine: Full Spectrum Operations

Concept: Minimal allowance for one-shot many kill (against blue force), shift in focus from lethality to protection



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Doctrine: Air Land Battle

Concept: Surgical strike, use of stealth to achieve One Shot, One Kill – effectiveness of conventional weapons allows medium size arsenal to overwhelm defenses

Threat: Regional Powers & Armed Groups

Doctrine: Full Spectrum Operations, increasing use of asymmetric tactics & advanced technology deployed to create A2/AD networks

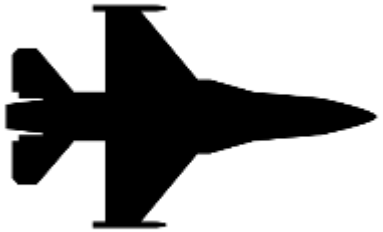
Concept:: Reversion, persistence, effects at range

The strategic aims of the third offset are focused on exploitation of technology to change the concept of operations…

- Exploit enduring sources of technological advantage to maintain persistent forward presence
- Project power when and where necessary, including against adversaries with robust A2/AD networks
- Reduced dependence upon increasingly vulnerable forward land and sea bases
- Shift from a direct attack conventional deterrence to one that places more emphasis on deterrence by denial and punishment.

How is the US taking the strategy forward?

- Identify the problems to overcome, such as:
  1. Increased vulnerability from land based fires at range
  2. Increased number and vulnerability of Integrated Air Defence Networks
  3. Increased ability to track, identify and engage maritime vessels at range
  4. Denial and loss of sanctuary in Space
- Setting out a series of programmes to deliver the required new / augmented capabilities
- Invited both defence and commercial industry alike to participate
- Undertaking an on-going assessment of likely innovation space and potential capabilities



Looking to existing and future technology

- Development of existing platforms in the **short-term**
  - Strategic Capabilities Office (Future Years Defence Programme) 5 years
    - Improved sensor capability in munitions (to counter GPS denial)
    - Unmanned vehicles (land, air, sea and sub-surface)
    - Further development of the USN rail-gun
    - EW and reversionary modes
- Technology development in **long-term**
  - 3rd offset technologies (Long-Range R&D Programme Plan) 15-20years
    - Passive sensor technology distributed networks
    - Autonomous “deep learning” machines
    - Man-machine collaboration
    - Semi-autonomous weapon systems

Long-Range R&D Programme Plan

- Identify high return technologies investments to be developed in the 2020's and fielded in the 2030's
  - Space Technology
  - Undersea Technology
  - Air Dominance and Strike Technology
  - Air and Missile Defense
  - Technology-Driven

- DOD increasingly interested in commercial research and development – the silicon valley fund $45M in FY16 set up the Defense Innovation Unit (Experimental) to evaluate commercial technology
- Assessing relative impact of technology through war games and evaluation. Not picking winners, allowing technologies to mature and fail if necessary

All this comes at some significant cost…

The DOD expects to spend $71.8Bn (€63.8Bn) on research and development in FY17 and of that $11.7Bn (€10.4bn) on third-offset technology development:

- Anti-access and area-denial ($3 billion)
- Guided munitions ($500m)
- Undersea warfare ($3 billion)
- Cyber and electronic warfare ($1.7 billion)
- Human-machine teaming ($3 billion)
- War-gaming and development of new operating concepts ($500 million)

Final thoughts

Europe has a number of choices:

1. **Disregard**

   TOS could be an internal DOD diversion for the better prioritising the defence budget and increase the marketing of existing US technology (e.g. UCAV, smarter smart bombs etc.)

2. **Accept**

   Accept that TOS will inevitably lead to a capability gap between the US and NATO/Europe, particularly as the US develops technology to counter A2/AD. Maintain contribution to NATO utilising existing tactics and equipment, upgraded and developed as funding allows

3. **Engage**

   Use the TOS as an opportunity to collaborate and jointly develop technology with the US. Europe has potentially much to offer (experience of ever smaller budgets, coordination of capability and vast experience of civ-mil commercial incubators)

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University of Amsterdam:
Applied Sensor Networks
Software Defined Networks
Cyber Security

Lives in Drachten

- 3rd 300m National Championship 2013
- 2nd 300m National Championship 2011

TNO: IJkdijk Foundation
www.ijkdijk.nl

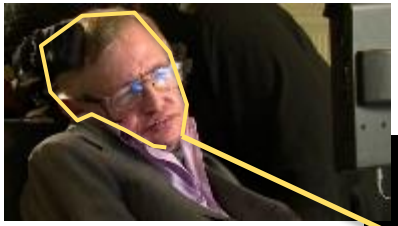
WHEN ARTIFICIAL INTELLIGENCE AND CYBER MEETS ROBOTICS

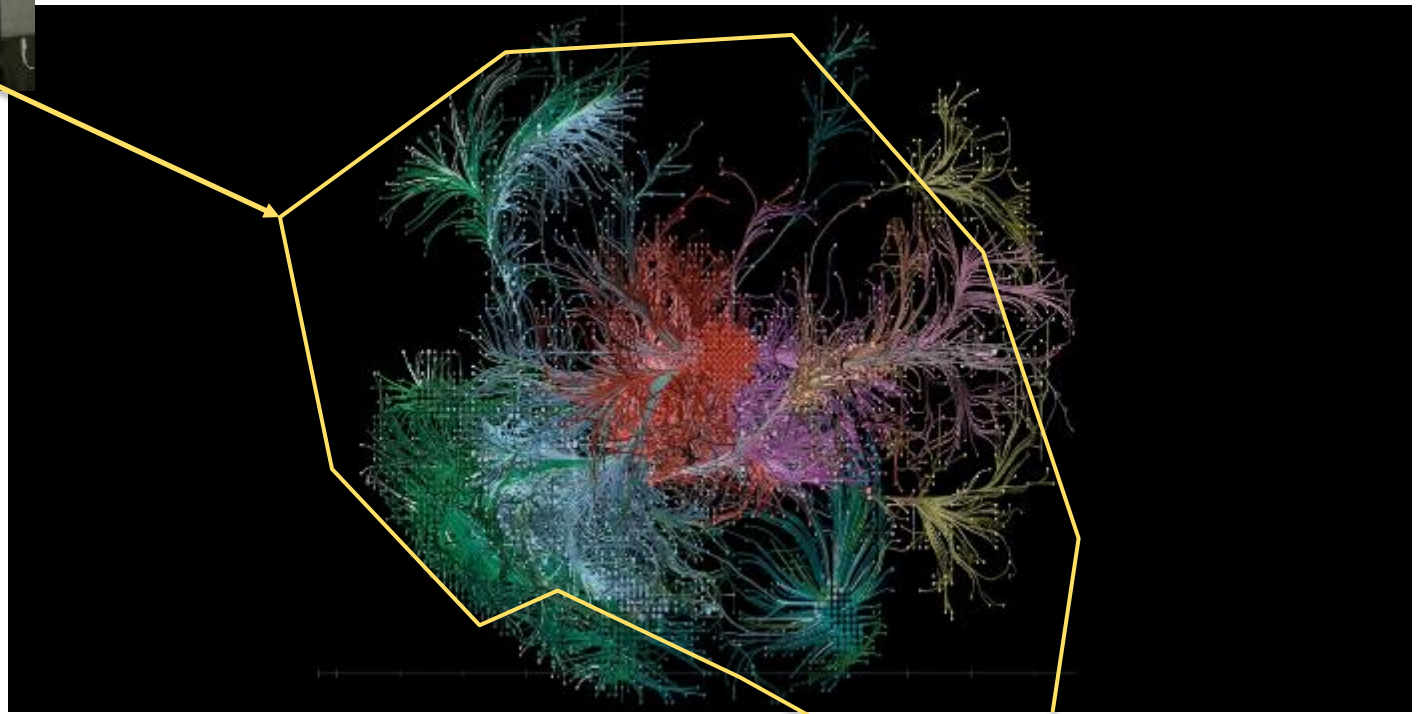
PROF DR ROBERT MEIJER – TNO & UNIVERSITY OF AMSTERDAM

AI

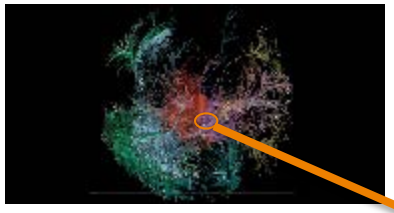
- Steven Hawking
  - Famous Black Hole Physicist
  - “~AI is dangerous”
- http://www.bbc.com/news/technology-30290540

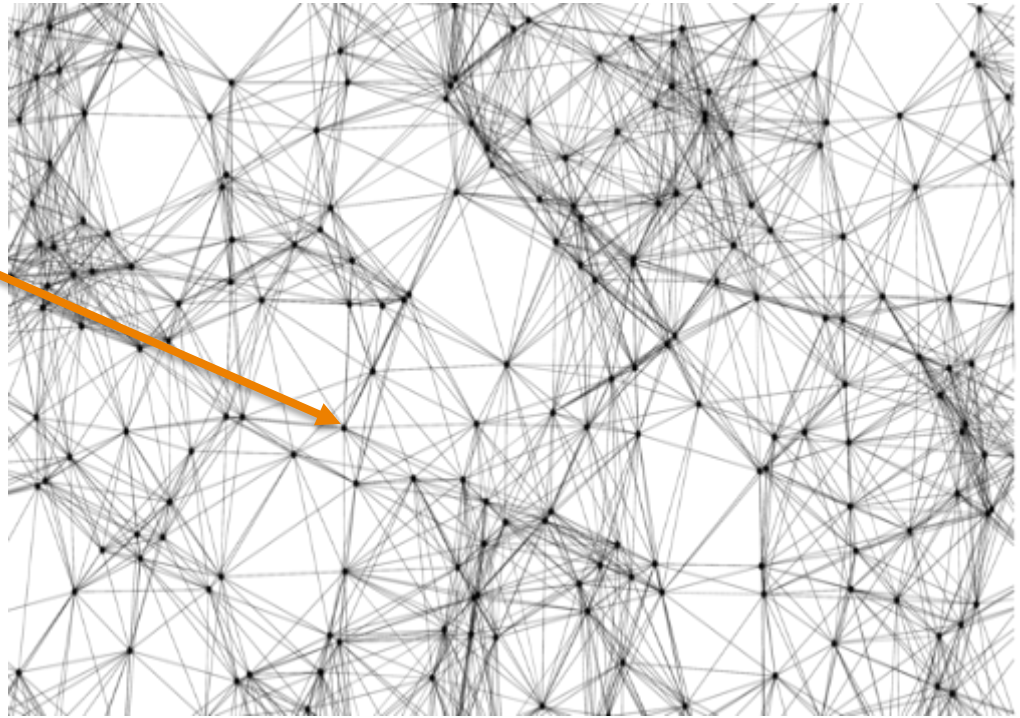
THE CREATION OF AI





CREATION OF AI





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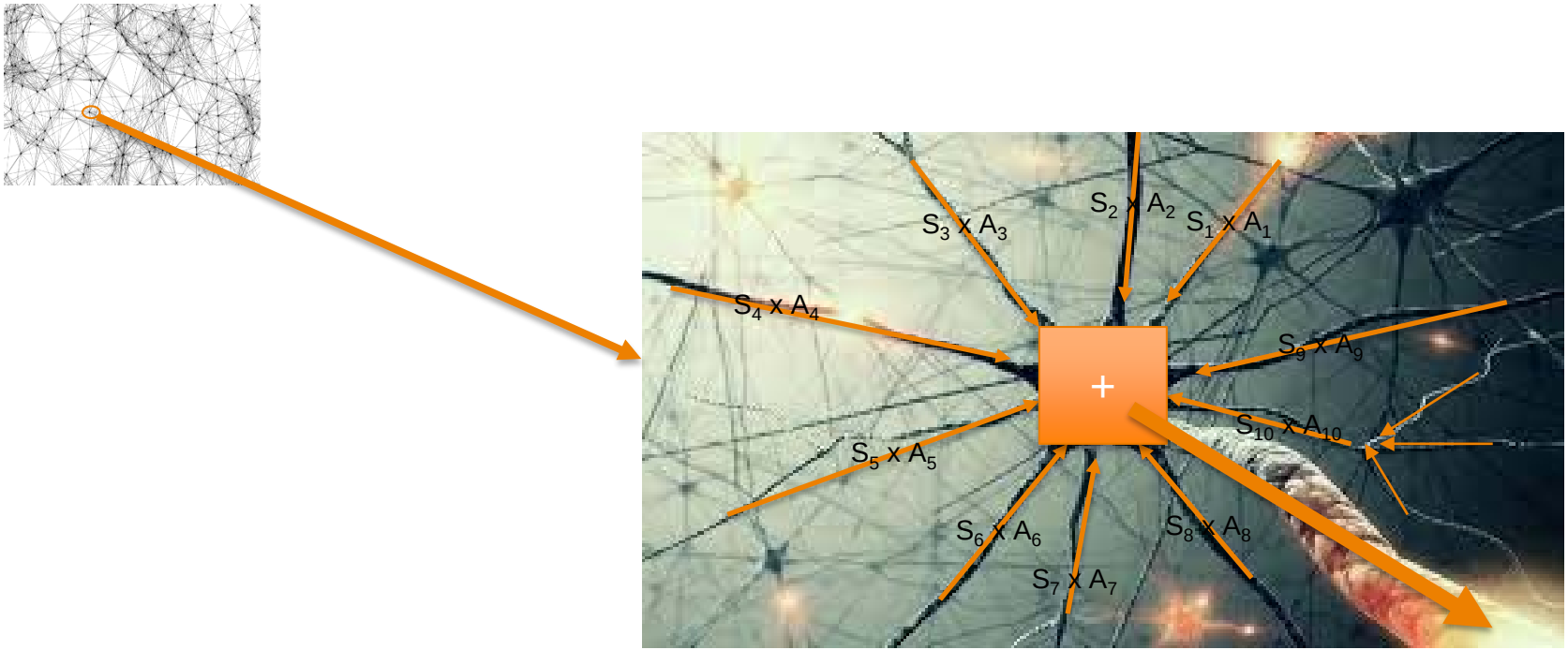
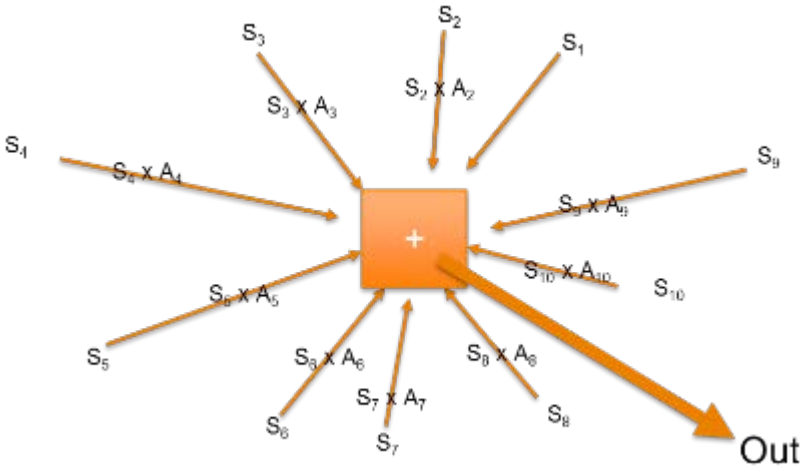


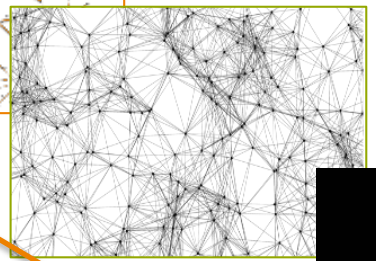
CREATION OF AI
THE PROBLEM 1

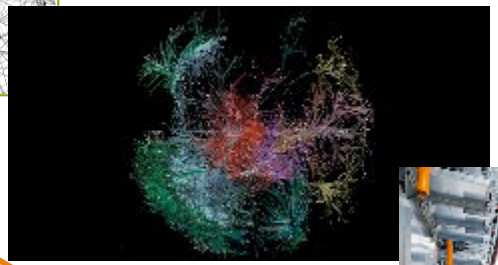
Finding A_1,A_2, …A_{10}



Finding the interconnecting network

THE PROBLEM 2 – HOW TO GET IT IN COMPUTERS





And the winner is:
the computer

PROBLEM SOLVED FOR SEVERAL CASES

Computer brute force
+
human tweaking

Designed for

"Jeopardy TV show"

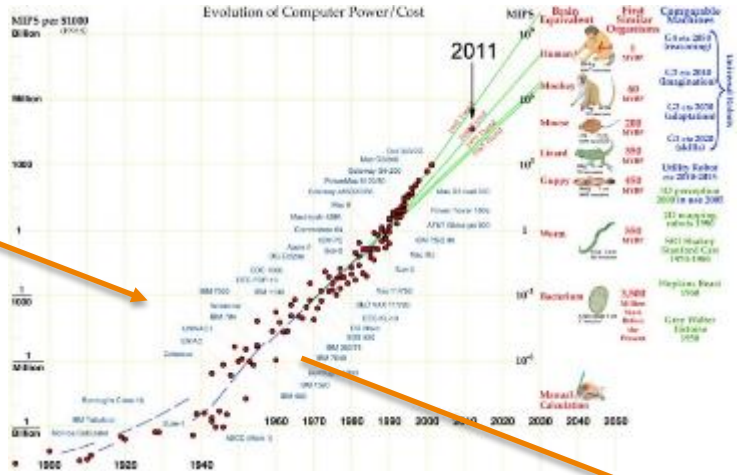
Computer brute force
+
human tweaking

Designed for

"Go Boardgame"

AI:
COMPUTERS ARE “OPPONENTS”

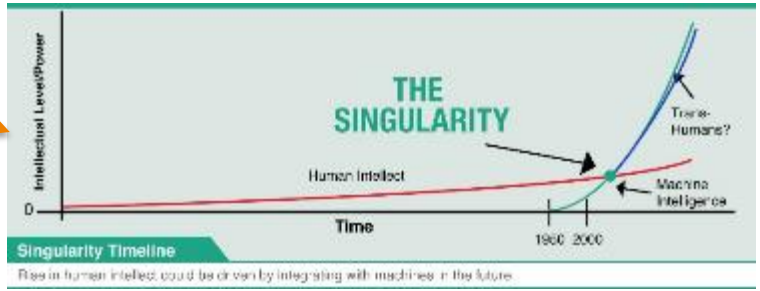
Ray Kurzweil



Larry Tesler:

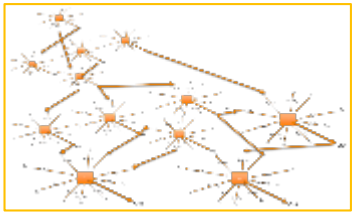
- "It’s not true in the same way that airplanes aren’t like birds

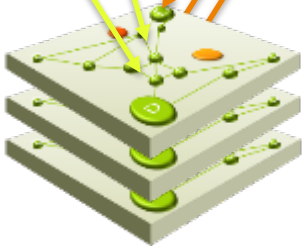
http://www.theverge.com/2016/2/29/11133682/deep-learning-ai-explained-machine-learning

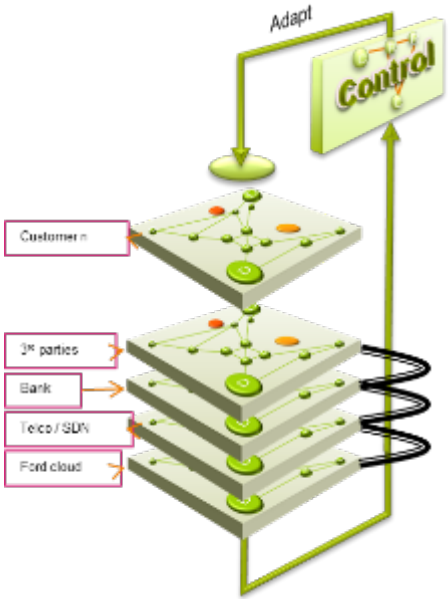


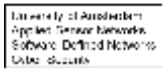
AI MEETS CYBER
SOFTWARE DEFINED INFRASTRUCTURE

FINDING THE INTERCONNECTING NETWORK



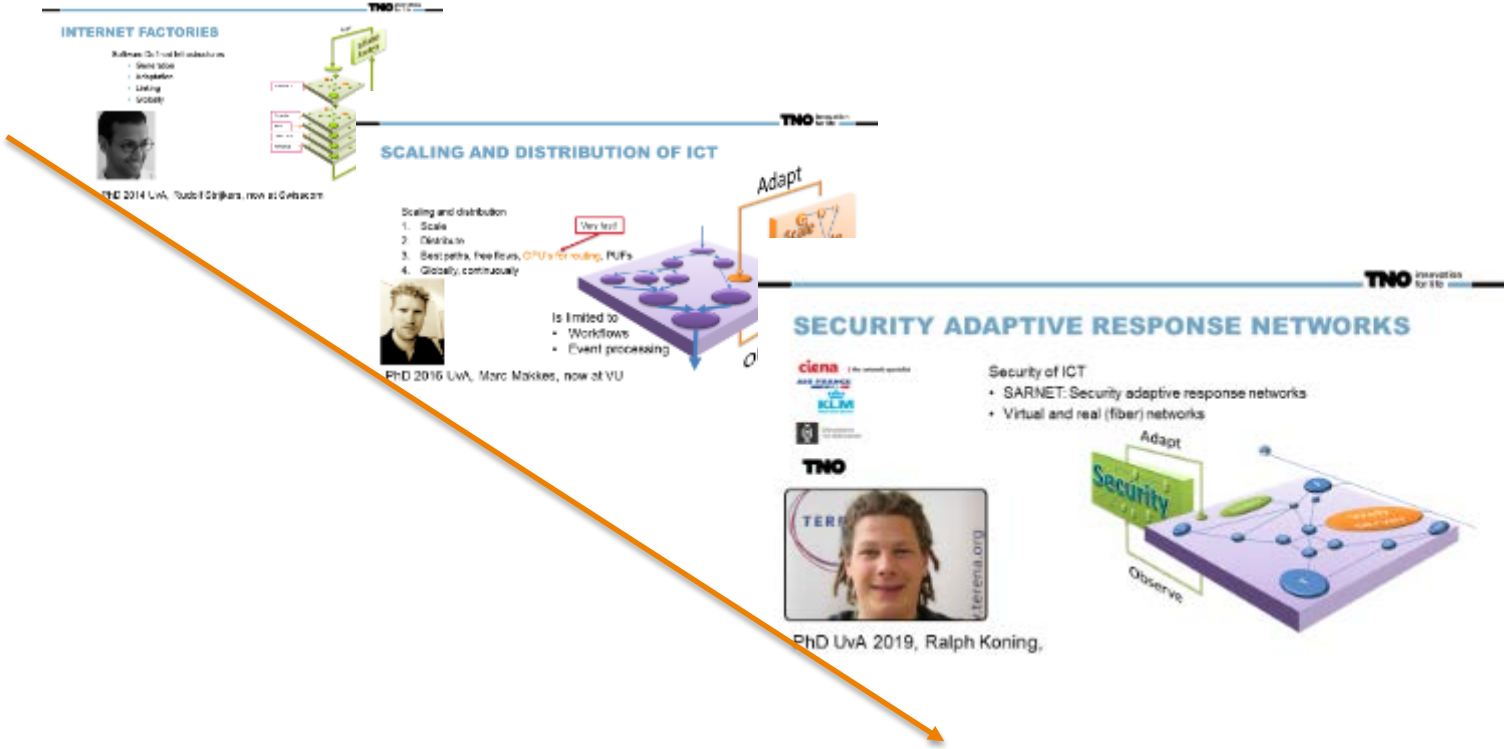






Software controlled network + computer
Software controlled ICT

R&D UNIVERSITY OF AMSTERDAM & TNO
CONCEPTS TO GENERATE ICT INFRASTRUCTURE



VIDEOS

1 world wide wide

2 programming and compiling

3 it works

4 feedback

5 feedback world

6 SARNET reliability

http://youtube.com/user/ciosresearch

FROM CREATING INFRASTRUCTURES TO CONTROL

TNO innovation for life

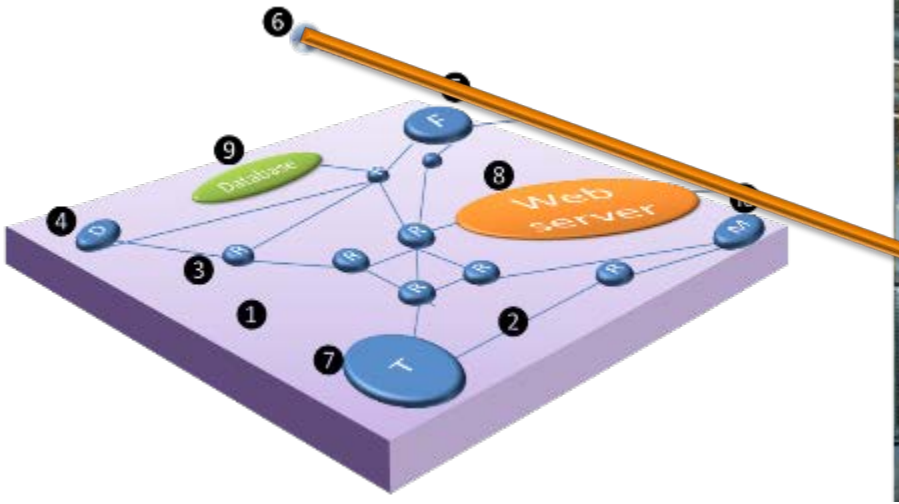
MOBILE NETWORK CONTROL

Master BsC 2016 TU Ilmenau (Germany), Adarsh Nayak

AI MEETS CYBER

CYBER CONTROLS ROBOTICS

(SERVICES) THAT CONTROL MACHINES

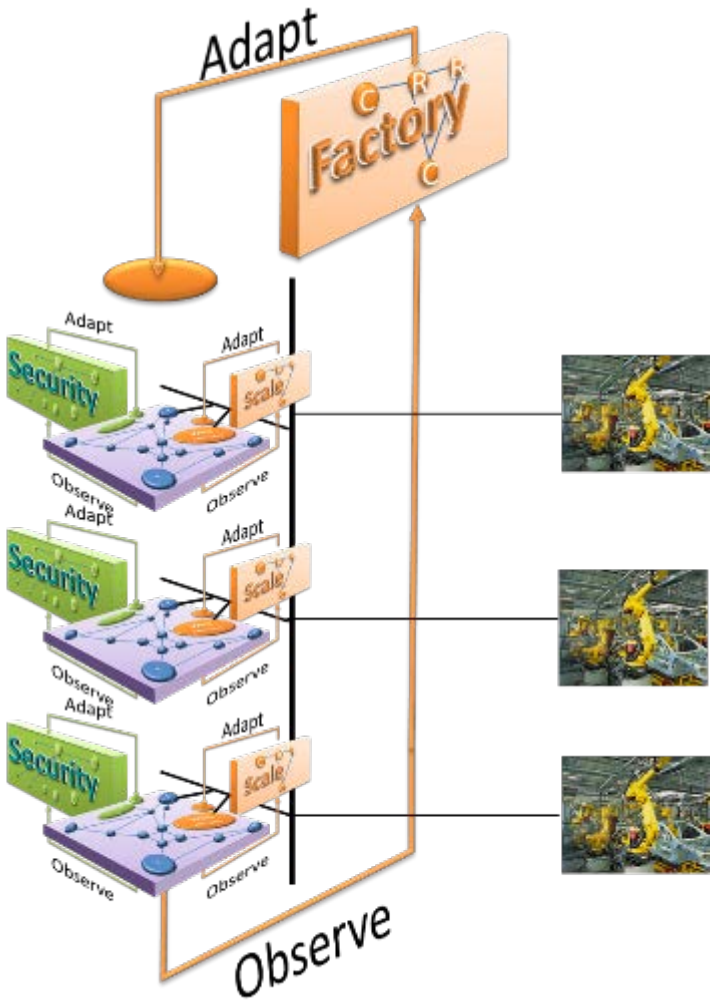


Factory robot

SMART FACTORY

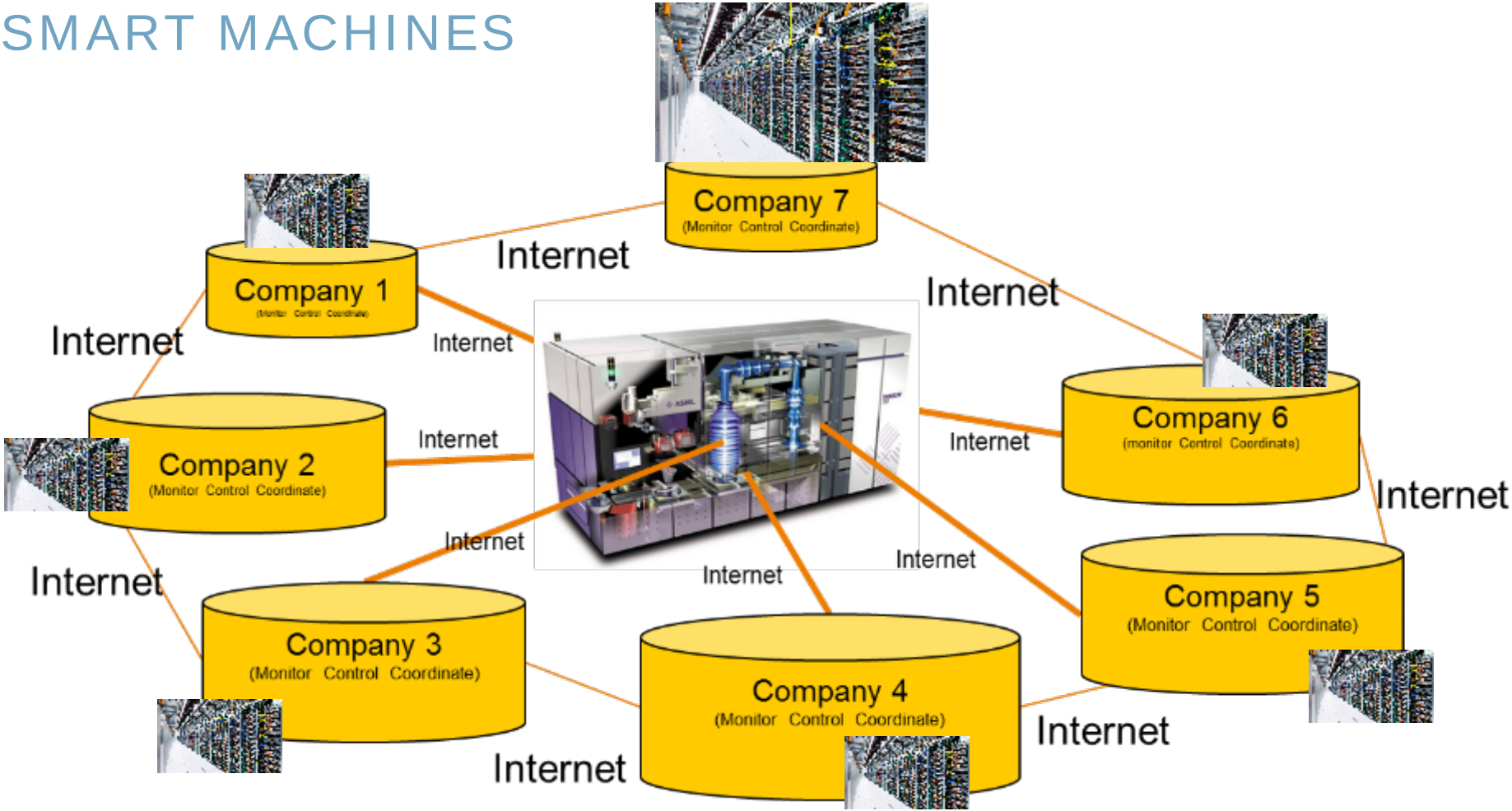
Computer brute force
+
human tweaking

Computer brute force
+
human tweaking



FUTURE WAFER STEPPERS -
10^6 WIRELESS SENSORS AND ACTUATORS

SMART MACHINES



FUTURE OF ROTTERDAM AND THE HAGUE

TNO innovation for life

This is not a car..

..it's a software upgradable transport system on wheels

This is not a dairy farm..

..it's a software upgradable milk production system

This is not a greenhouse..

..it's a software upgradable growth centre for food and flowers

This is not a port..

..it's a software upgradable goods handling system of systems

Computer brute force
+
human tweaking

Computer brute force
+
human tweaking

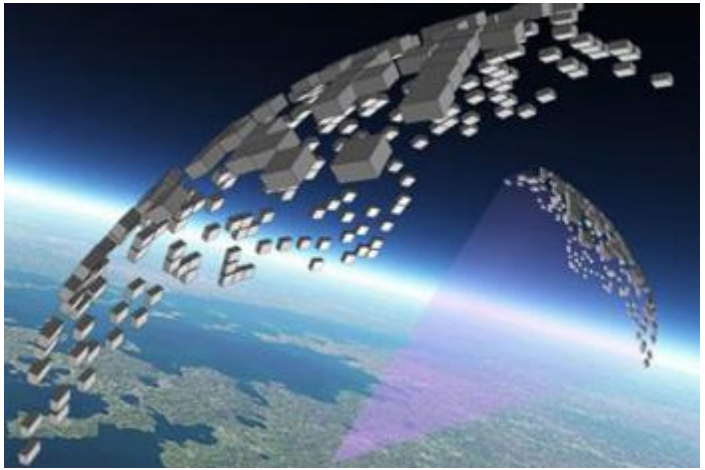
Rotterdam the Hague
IS A SOFTWARE
UPGRADABLE

…

SMART CITY

Oops
!!!

THIS IS NOT A ...
IT IS A SOFTWARE UPGRADABLE ...



And the winner is:
The smartest army

AI TO CONTROL MACHINES AND SYSTEMS OF MACHINES

Computer brute force
+
human tweaking

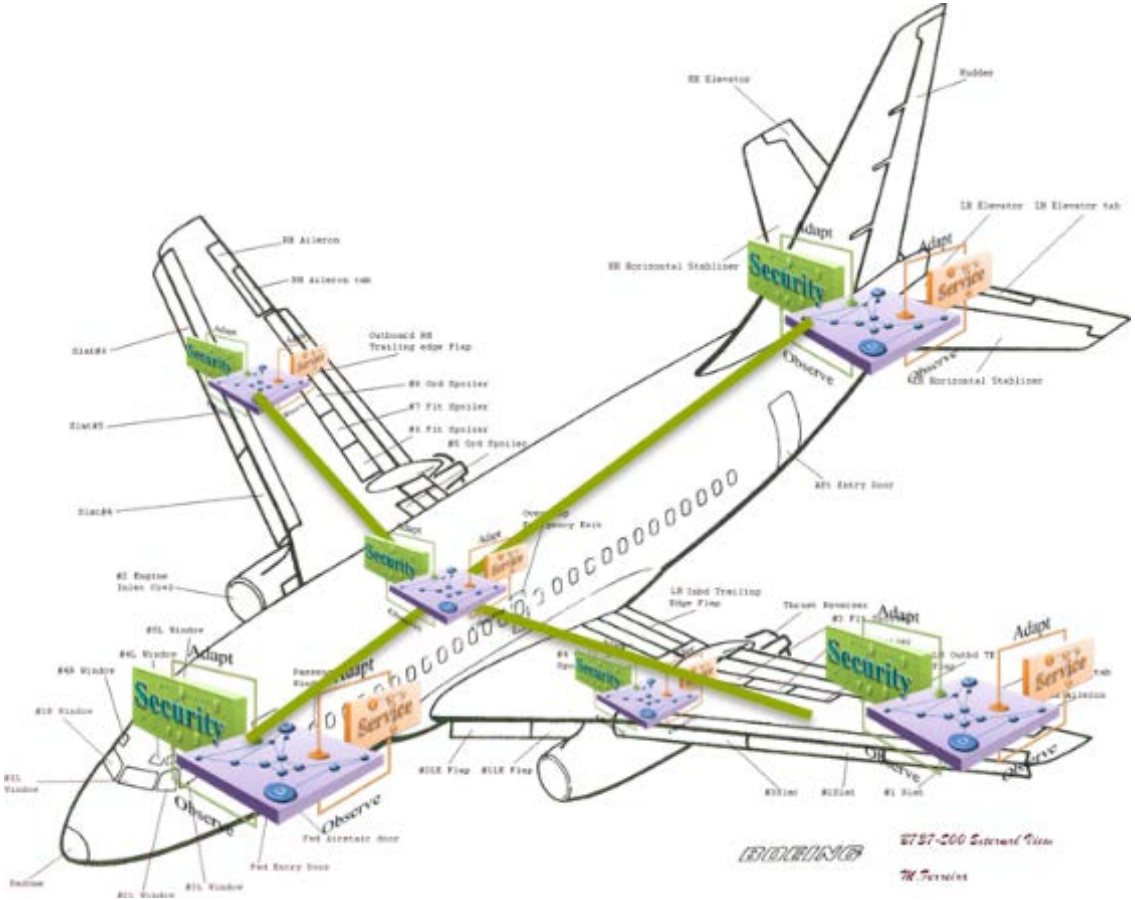
Designed for

Computer brute force
+
human tweaking

Designed for

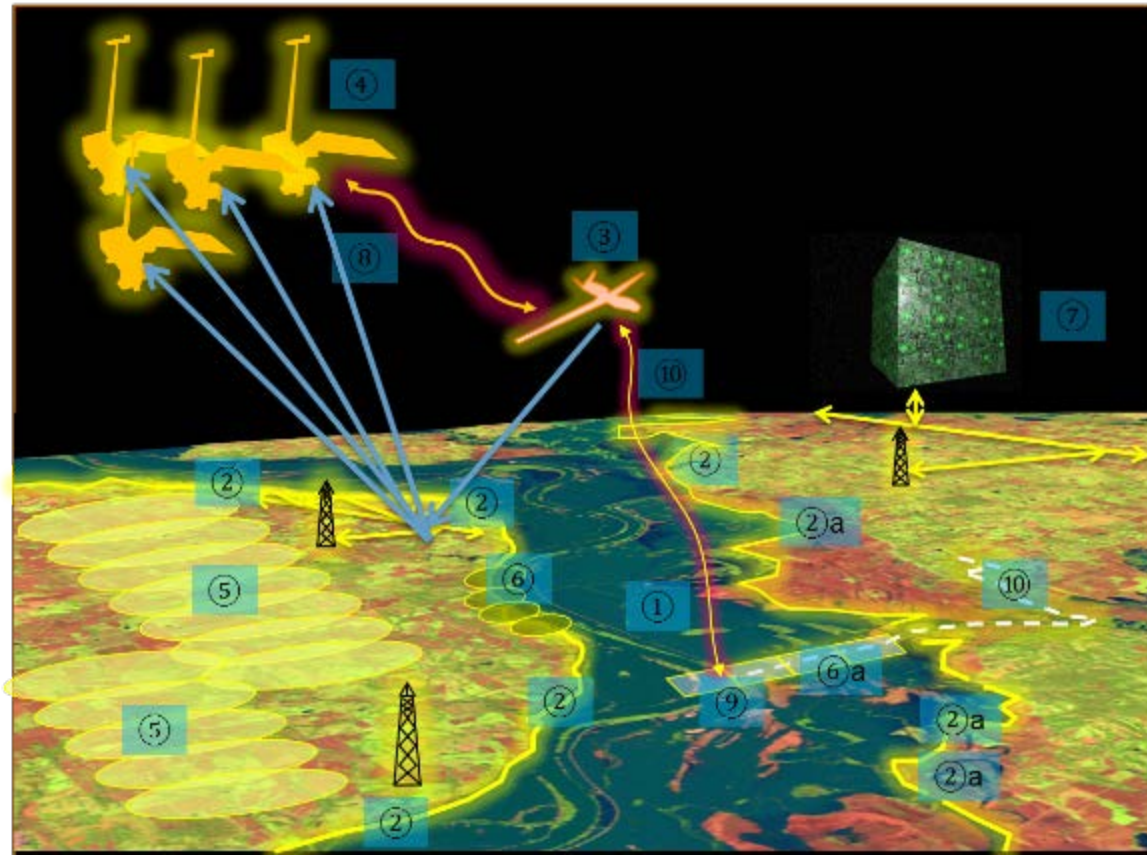
... THERE IS NOT ALWAYS A DATACENTRE ...

Software controlled ROBOTS



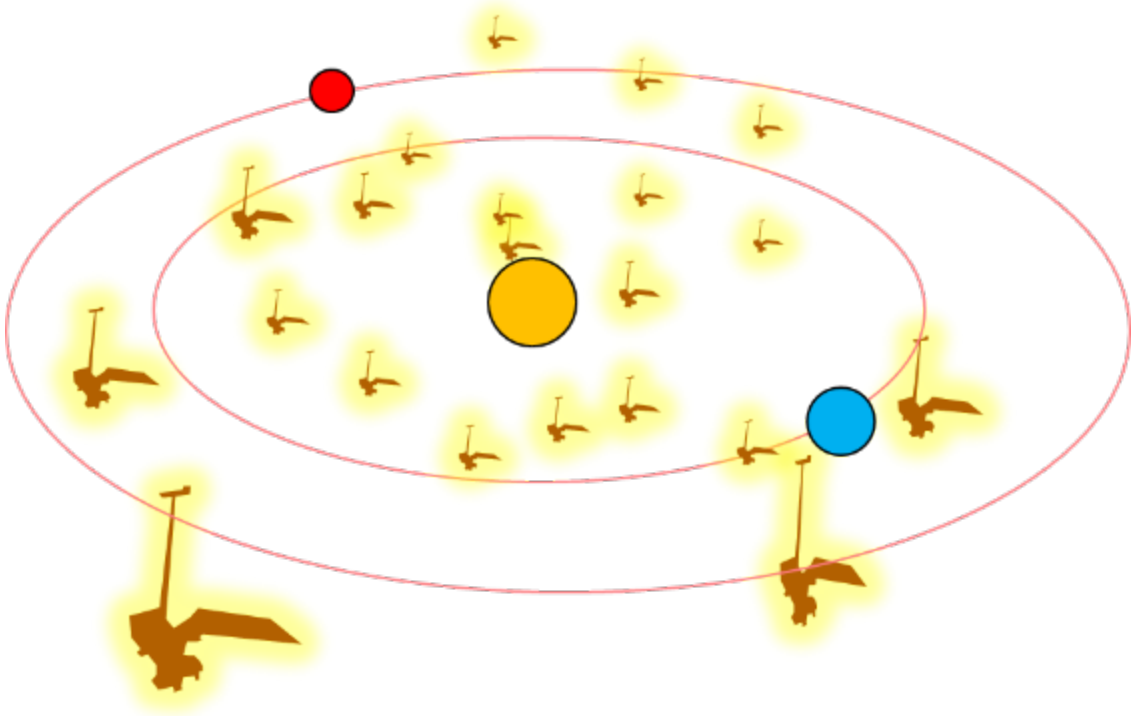
… THERE IS NOT ALWAYS A DATACENTRE …
500 RADAR SATS

Software controlled ROBOTS



... THERE IS NOT ALWAYS A DATACENTRE ...
INTERPLANETARY TELECOMMUNICATION SYSTEM

Software controlled ROBOTS



AI MEETS CYBER

CYBER CONTROLS ROBOTICS

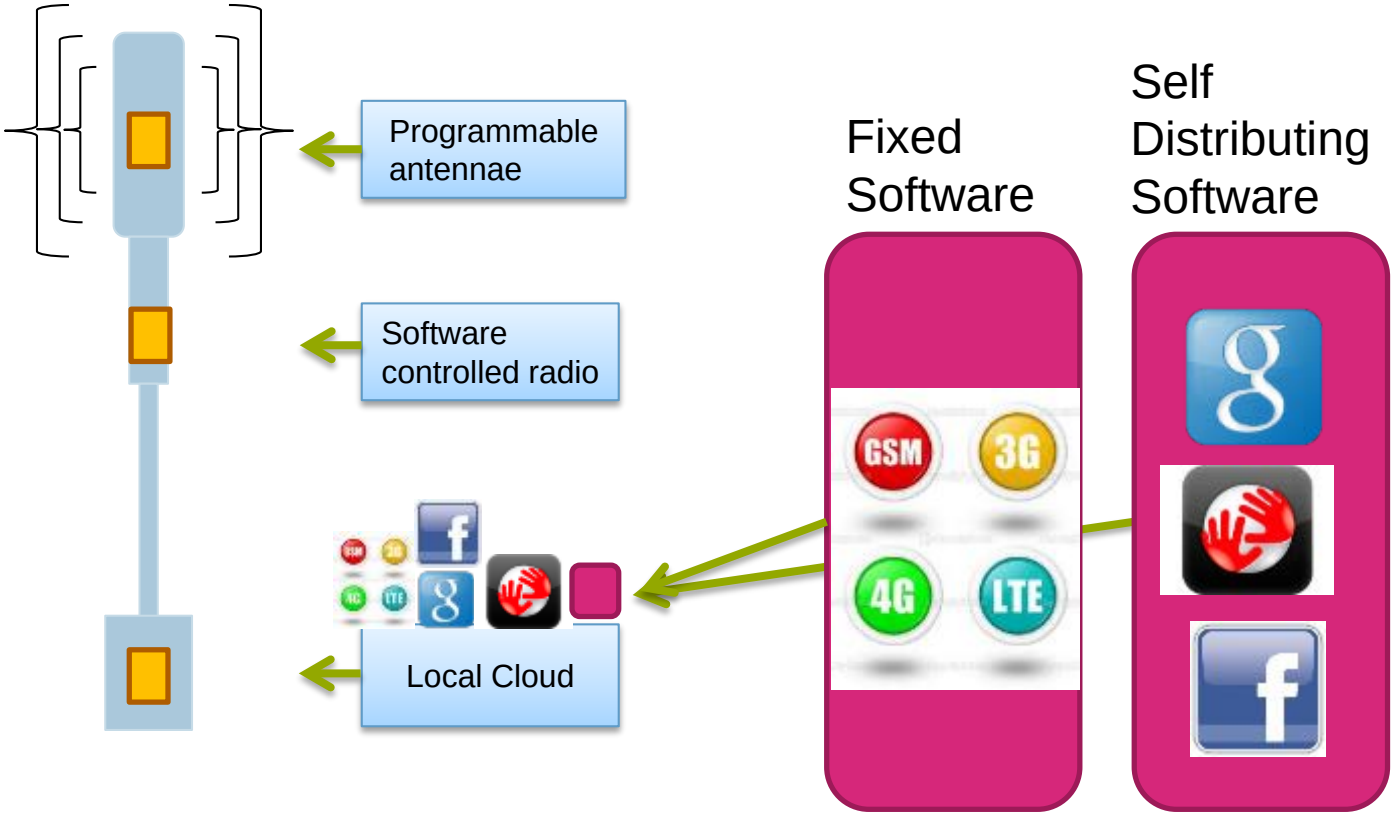
CYBER MEETS CYBER

DYNAMIC NETWORKED ARCHITECTURES DNA

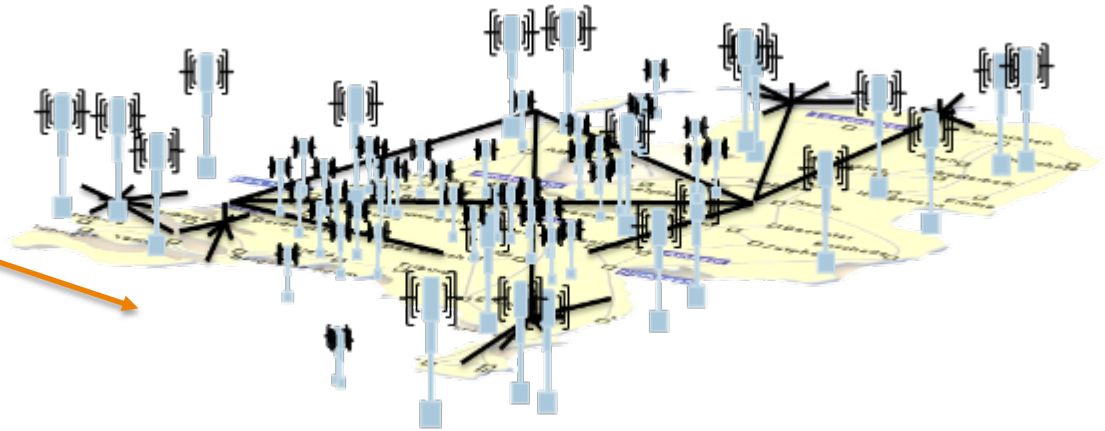
- Method for
  - Self Optimization
    - (Genetic programming)
  - Self Distribution
  - Self Organisation
  - Recursive Infrastructures

2012-2015 UvA, Jan Sipke van Der Veen

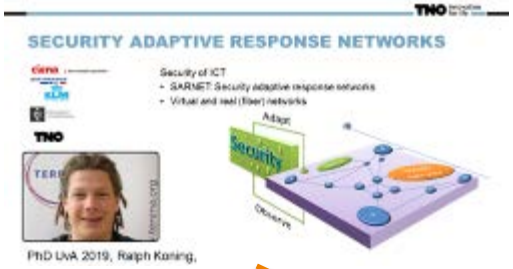
PROGRAMMABLE TELECOM MAST

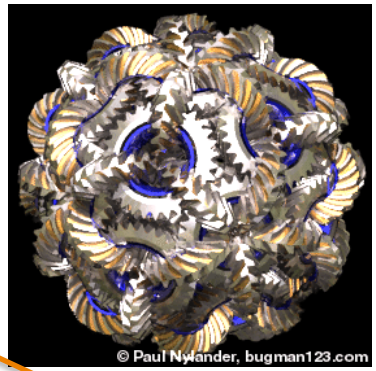


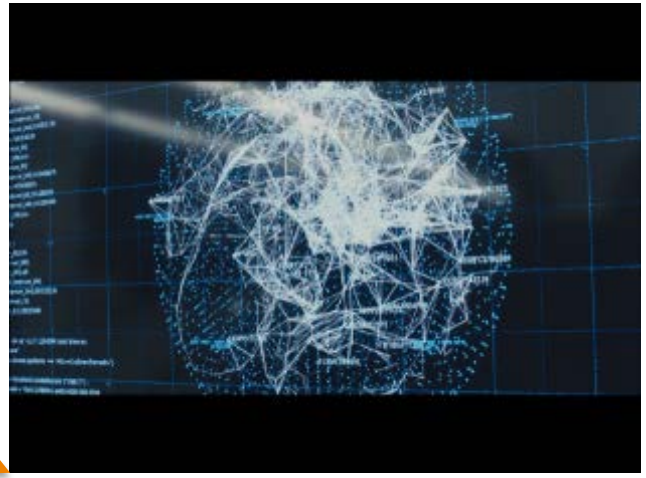
SOFTWARE CONTROLLED CYBER
SELF DISTRIBUTING TELECOM AND SOFTWARE



NETWORKS THAT CHANGE BEFORE THEY ARE REVERSE ENGINEERED







THE PROGRAM IS THE ONLY THING WE UNDERSTAND

- PROGRAM → Dynamic Network Architecture
- DNA

```
Program new_web_front_end(DC) {
Rent(3)_computers on datacenter(DC);
Start computer(1)(2)(3) on
                datacenter(DC);
Run router(1)(2)(3) on
                computer_(1)(2)(3) on
                datacenter(DC);
Connect_router(1)(2)(3) on
                datacenter(11) with
                router(6)(7)(8) on
                datacenter(DC);
Start services on computer (1)(2)(3);
}
```

How it currently works

How it transforms

How it can be understood

007: “He hacked me”

DNA: CREATE DATA CENTRE AND NETWORK

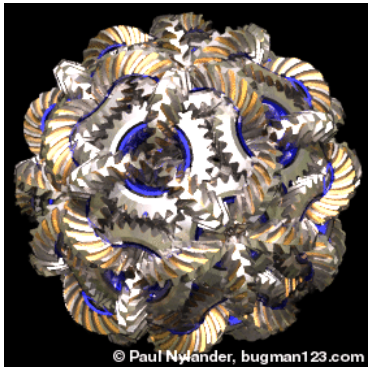
Computer brute force
+
human tweaking

Designed for

Computer brute force
+
human tweaking

Designed for

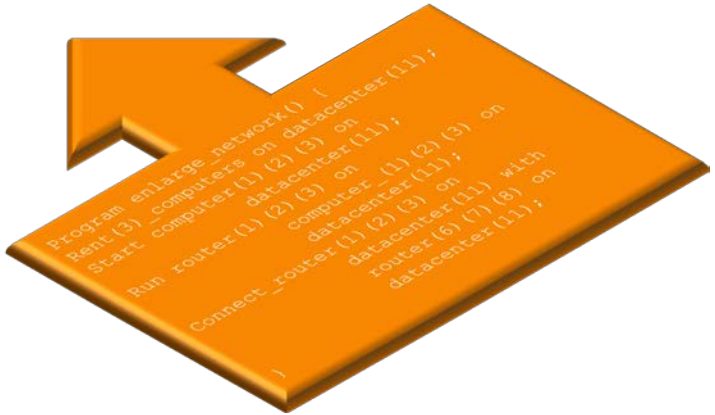
DNA: DISTRIBUTE DNA



DYNAMIC NETWORKED ARCHITECTURES DNA

A long shot

Lives in Drachten
- 3rd 300m National Championship 2013
- 2nd 300m National Championship 2011



AI MEETS CYBER

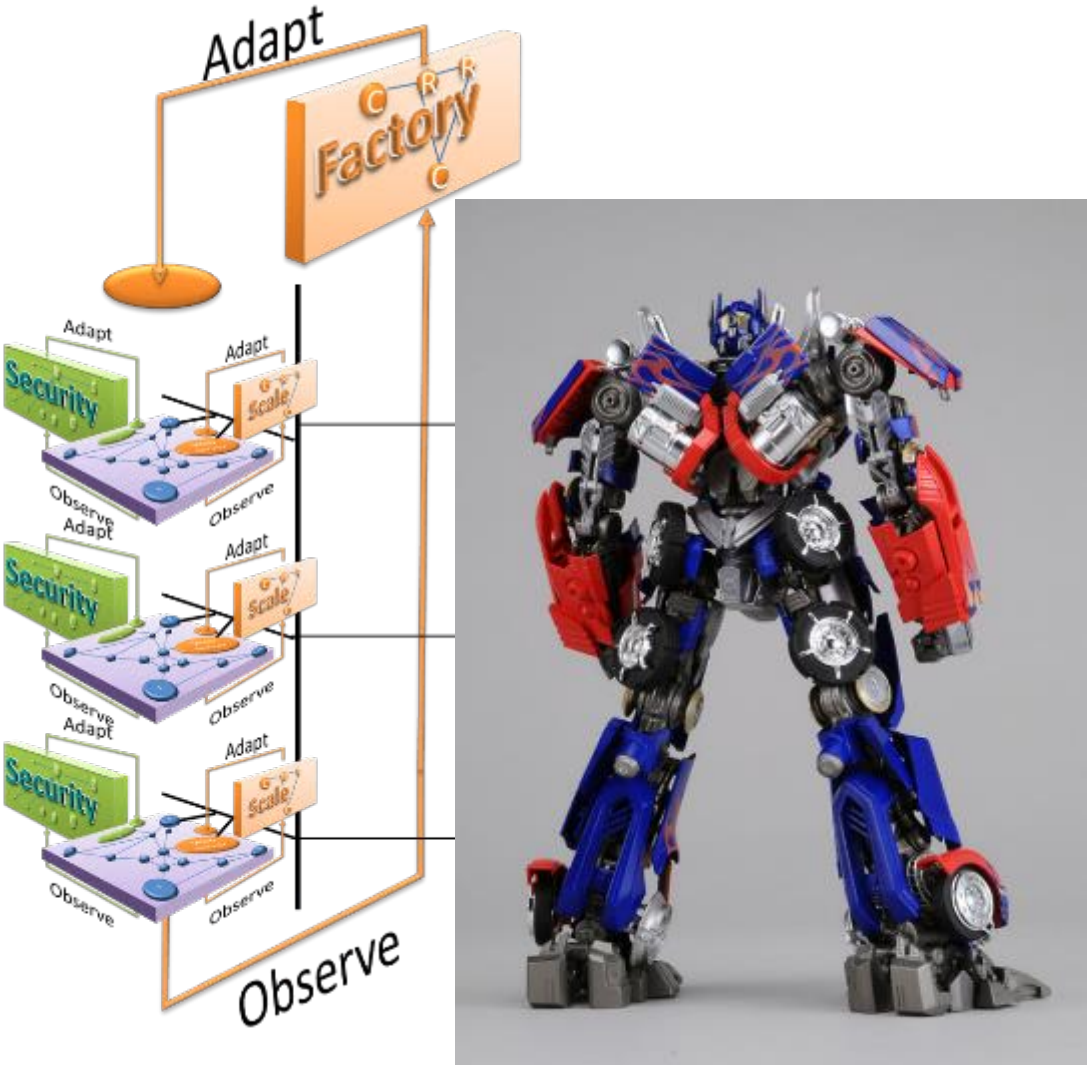
CYBER CONTROLS ROBOTICS

CYBER MEETS CYBER

CYBER MEETS ROBOTICS

MULTISCALE COOPERATION

MULTISCALE COOPERATION



MULTISCALE COOPERATION

DNA

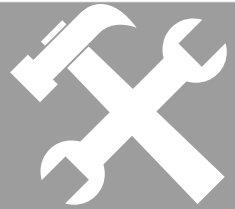
- THANK YOU,

AI: REALITY

R&D DISTRIBUTED SYSTEMS:

- SOFTWARE FOR COLLABORATIVE ROBOTS
- CYBER SECURITY
- SMART MACHINES
- SPACE

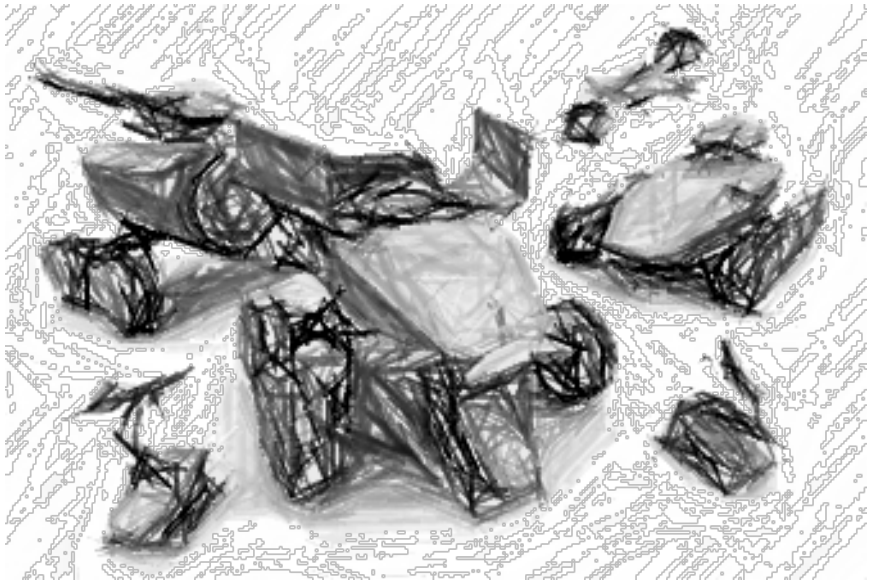
TNO innovation for life



Q? A?

Emerging technologies and long term technological trends impacting defence

Panel session I “From Emerging to Critical Technologies”



Source: modified from UK MoD

EDA R&T Conference 2016, Amsterdam, 25 April 2016

Hans-Martin Pastuszka

Fraunhofer-Institute for Technological Trend Analysis - INT

Background:
Defence Technologies Foresight @ Fraunhofer INT

- Scientific based decision support to German MoD R&T planning since 1974
- Focus: identification & assessment of “long-term oriented” (5 – 30 years) technological developments of potential relevance for defence applications
- Quarterly reports on basic technologies and future systems concepts (11 topics per year)

- Product: *“Wehrtechnische Vorausschau” (WTV)* – Defence Technologies Forecast

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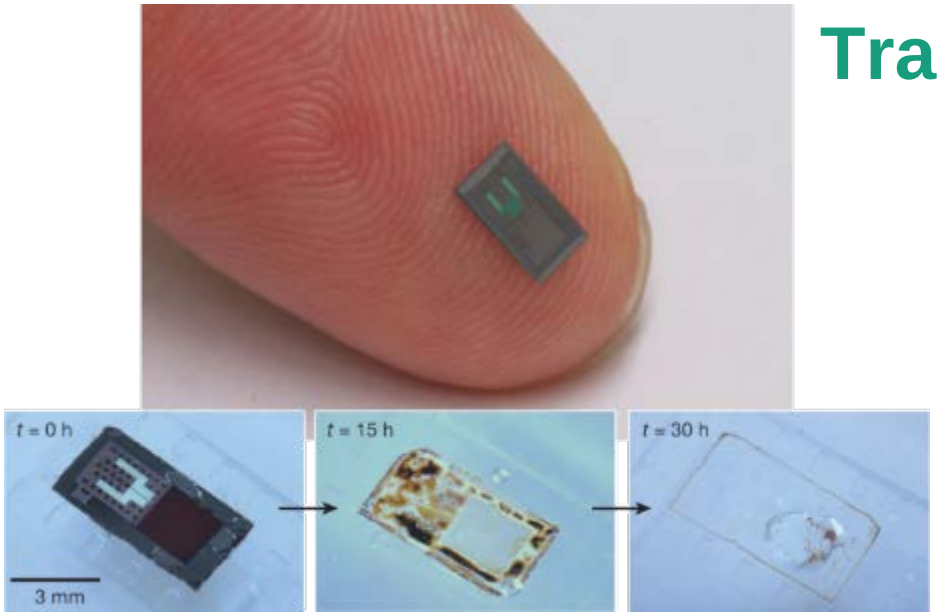
What are actually “emerging technologies”?

- Are they just visions of the future / science fiction?
- Are they at the stage of early conceptual ideas / theoretical sciences?
- Are they emerging when they are mentioned first in scientific publications?
- Until when can a technology be qualified as “being emerging” -
  - As long as it is not (successfully) commercialized / operationalized?
  - As long as it has not been demonstrated in a relevant environment (i.e. < TRL 6)?
  - As long as there is no experimental proof of concept (i.e. < TRL 3)?
- […]?

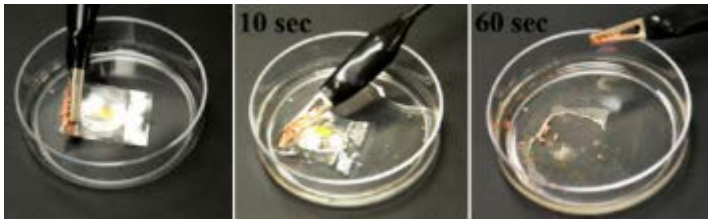
Example #1

Emerging technology?



Sources: arstechnica, Kang et al.

Transient Materials



Source: Kun et al.

Status: Proof of concept

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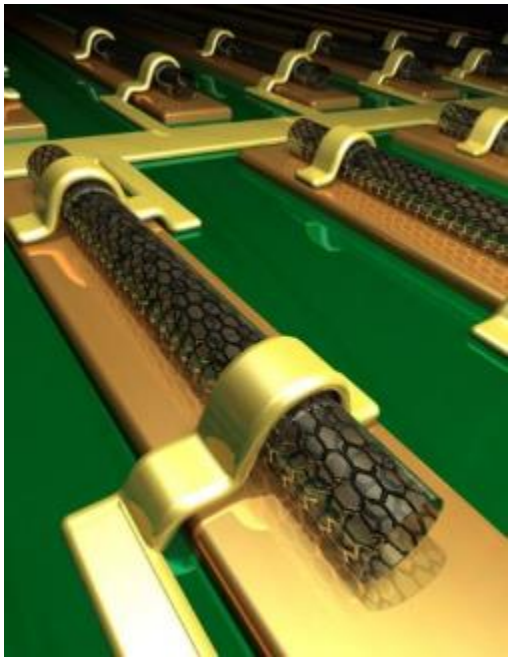
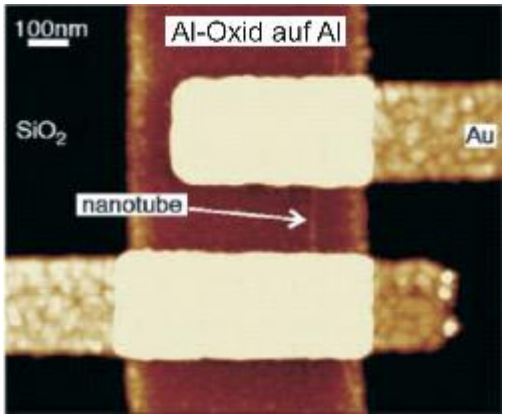
Example #2

Emerging technology?



Source: TU Delft, Cees Dekker Lab

CNT-based chem/bio sensors



Source: Baughman, Ray H. et al

Status: first commercial products

-- but for defence?

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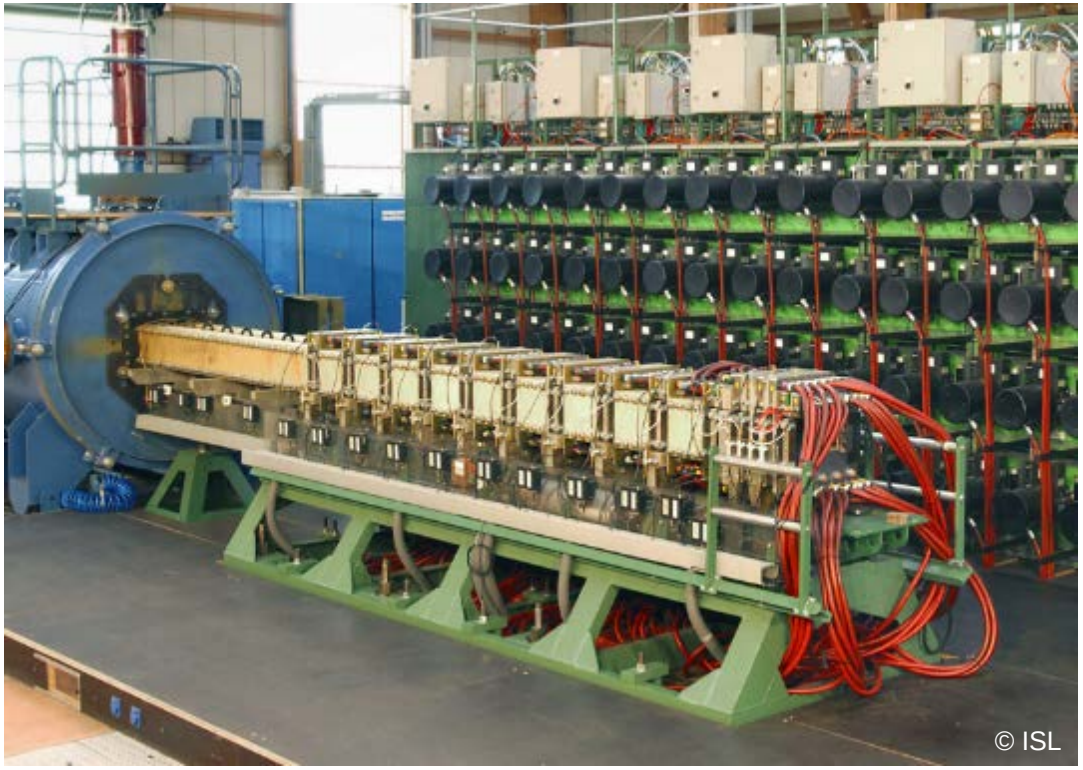
Example #3

Emerging technology?



Source: Hundertmark, Stephan et al.

EM gun

Here:

PEGASUS railgun @ ISL

Status:

Possibly TRL 6/7

?

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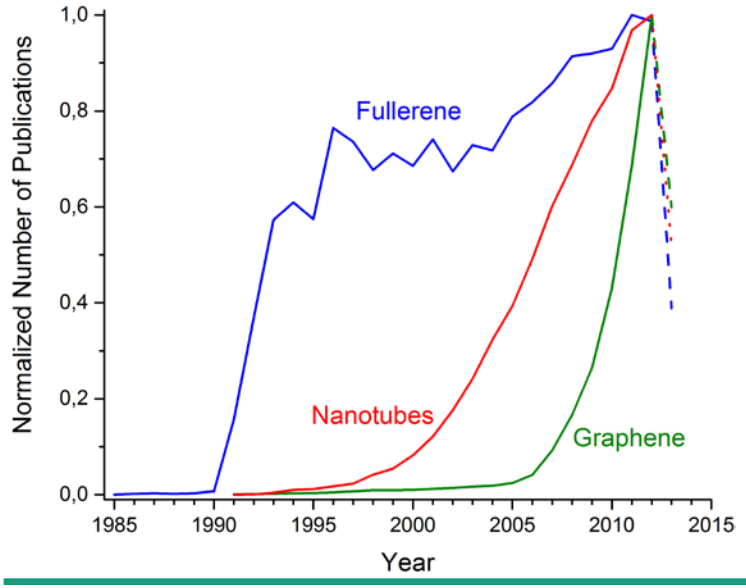
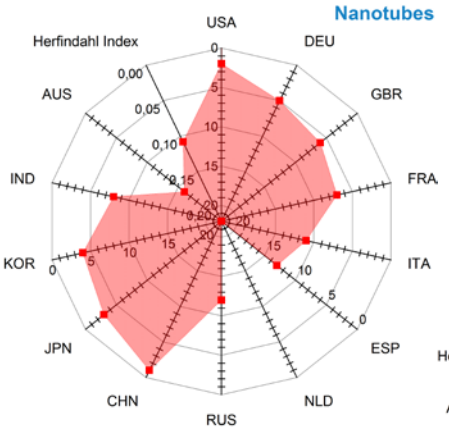
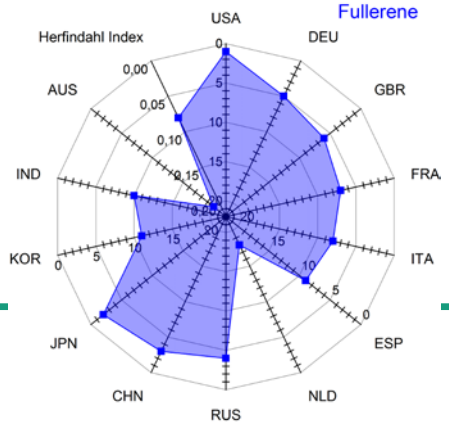
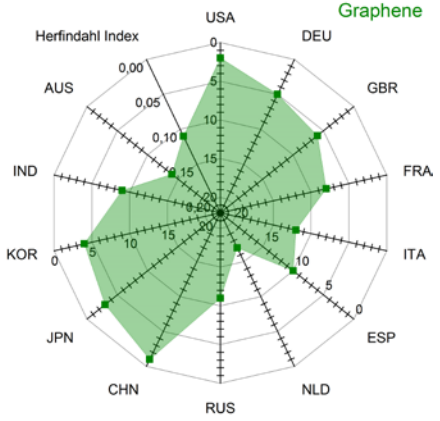
How to identify “emerging technologies”?

- Through dedicated research by foresight experts scanning key information sources (“technology horizon scanning”)
- By applying supporting tools, such as
  - Bibliometric analyses









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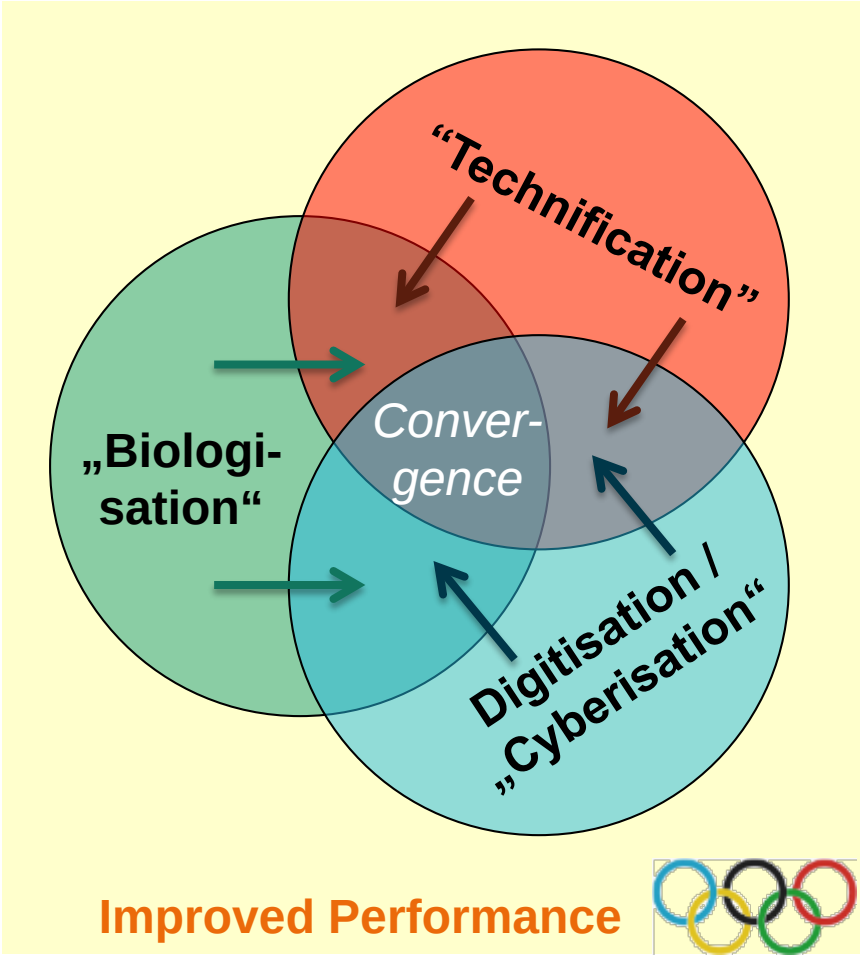
Long term "mega trends/drivers" – one view of many



Dynamic cross-cutting themes:

- Materials science
- Robotics
- "Web 3.0" and Big Data
- Human Enhancement

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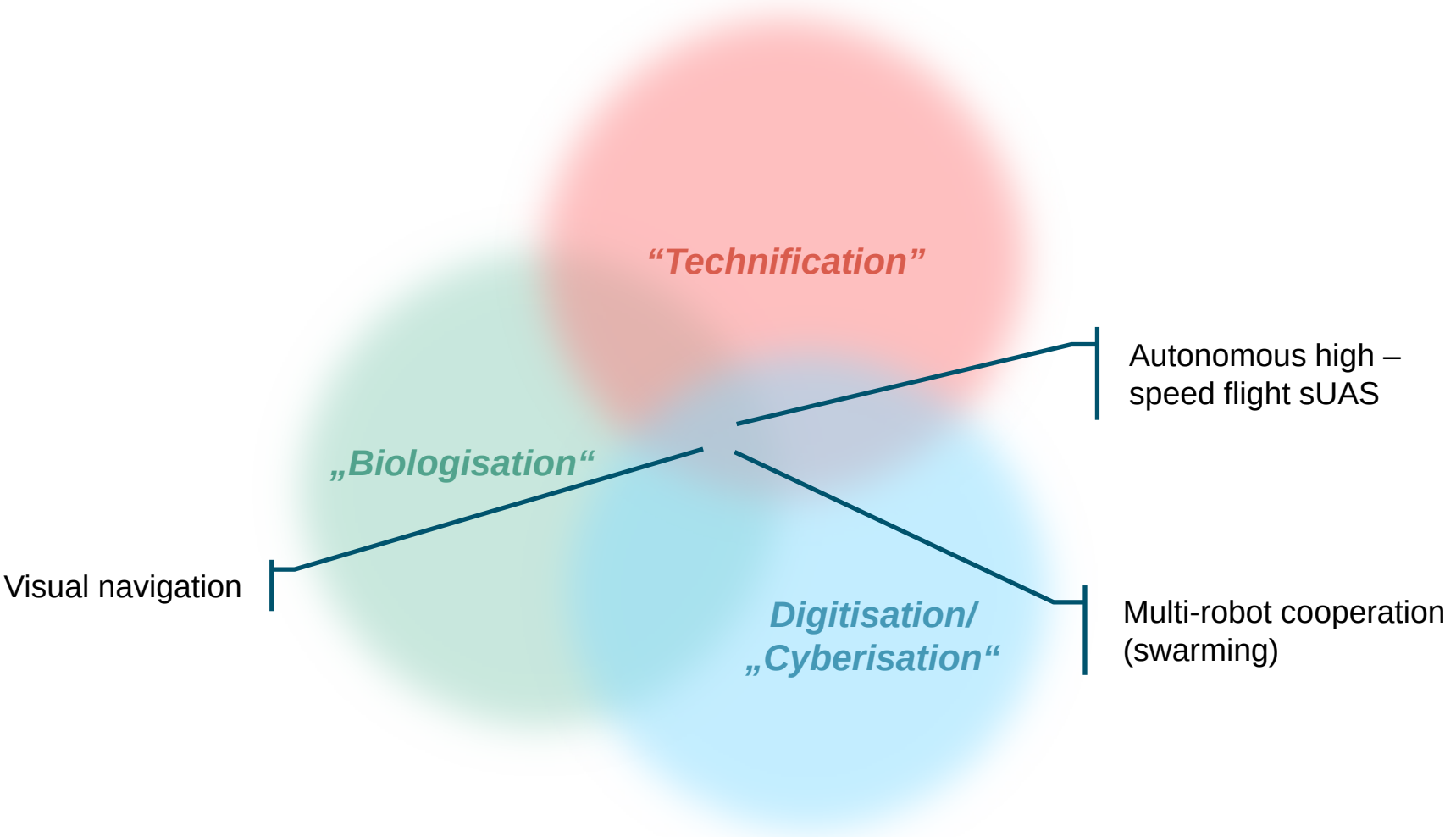
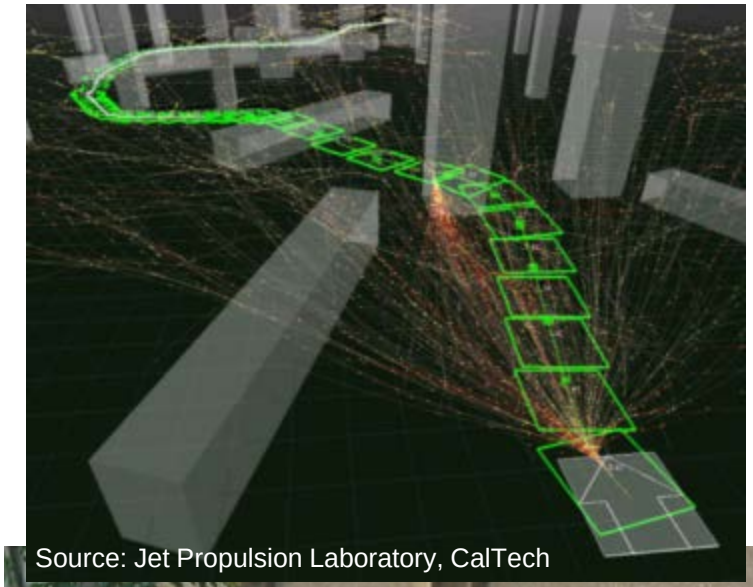
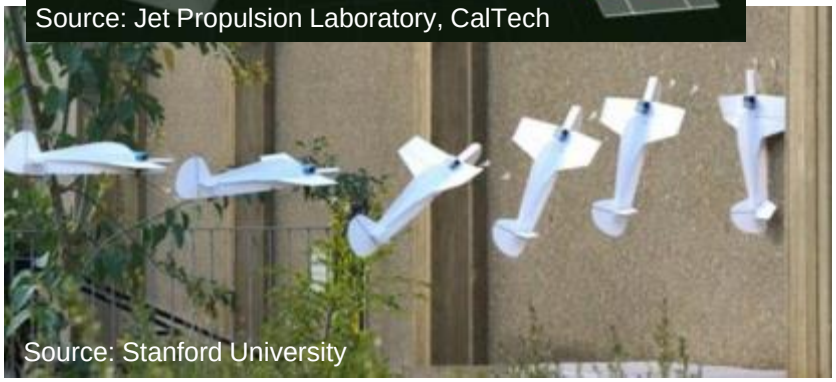
Some examples for emerging technologies “impacting defence”



Autonomous high-speed & aggressive flight manoeuvres of sUAS



Source: Jet Propulsion Laboratory, CalTech



Source: Stanford University

State of the art:

- Experimental research

Expectation:

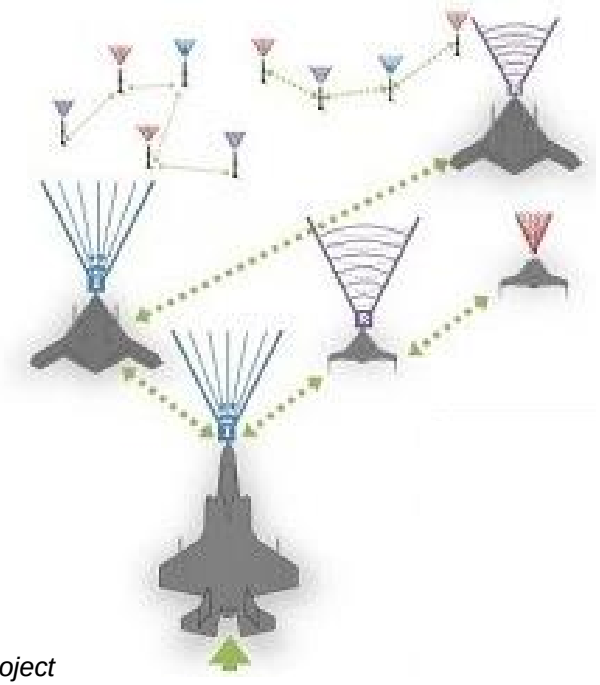
- Autonomous operation of sUAS in complex / cluttered environment

Defence relevance:

- sUAS support to MOUT and in forest areas
- Overwhelming / outpacing C-UAS measures
- Collision avoidance in UAS swarms
- Active landing / docking systems for UAS, …

Multi-robot cooperation / Manned-Unmanned Teaming

Source: ETH Zürich



Source: DARPA - Project SoSITE

State of the art:

- Experimental / basic research

Expectation:

- Ensuring e.g. future air superiority

Defence relevance:

- Collision avoidance in UAS and MUT swarms
- Cooperative handling of military tasks
- Effective and secure operation of UAS and MUT swarms under battlefield conditions (evasion manoeuvres etc.)

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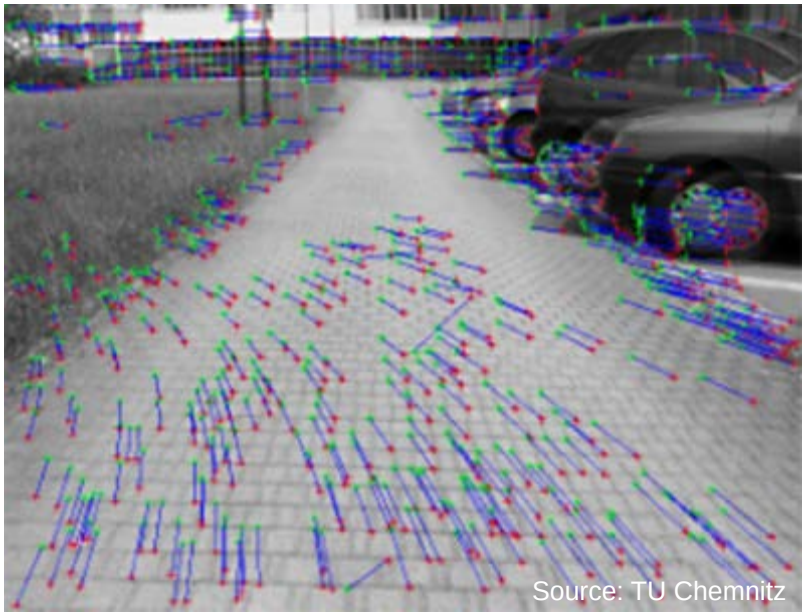
Visual navigation


Source: TU Chemnitz

State of the art:

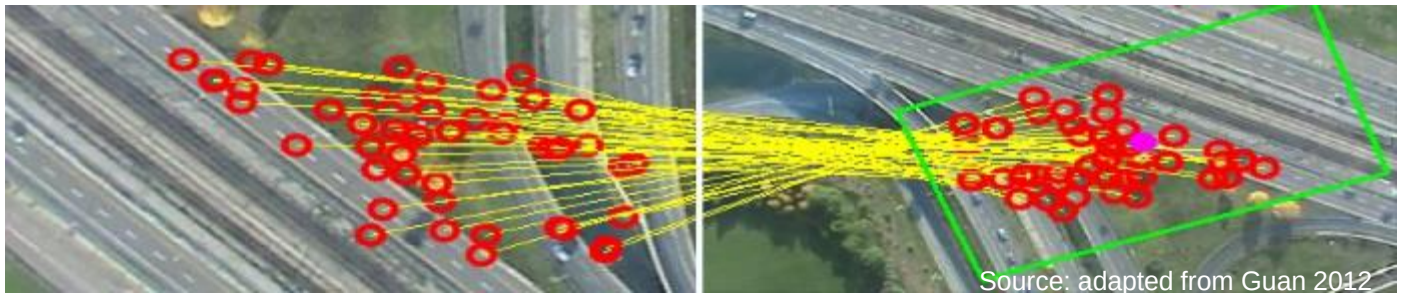
- Depending on application

Expectation:

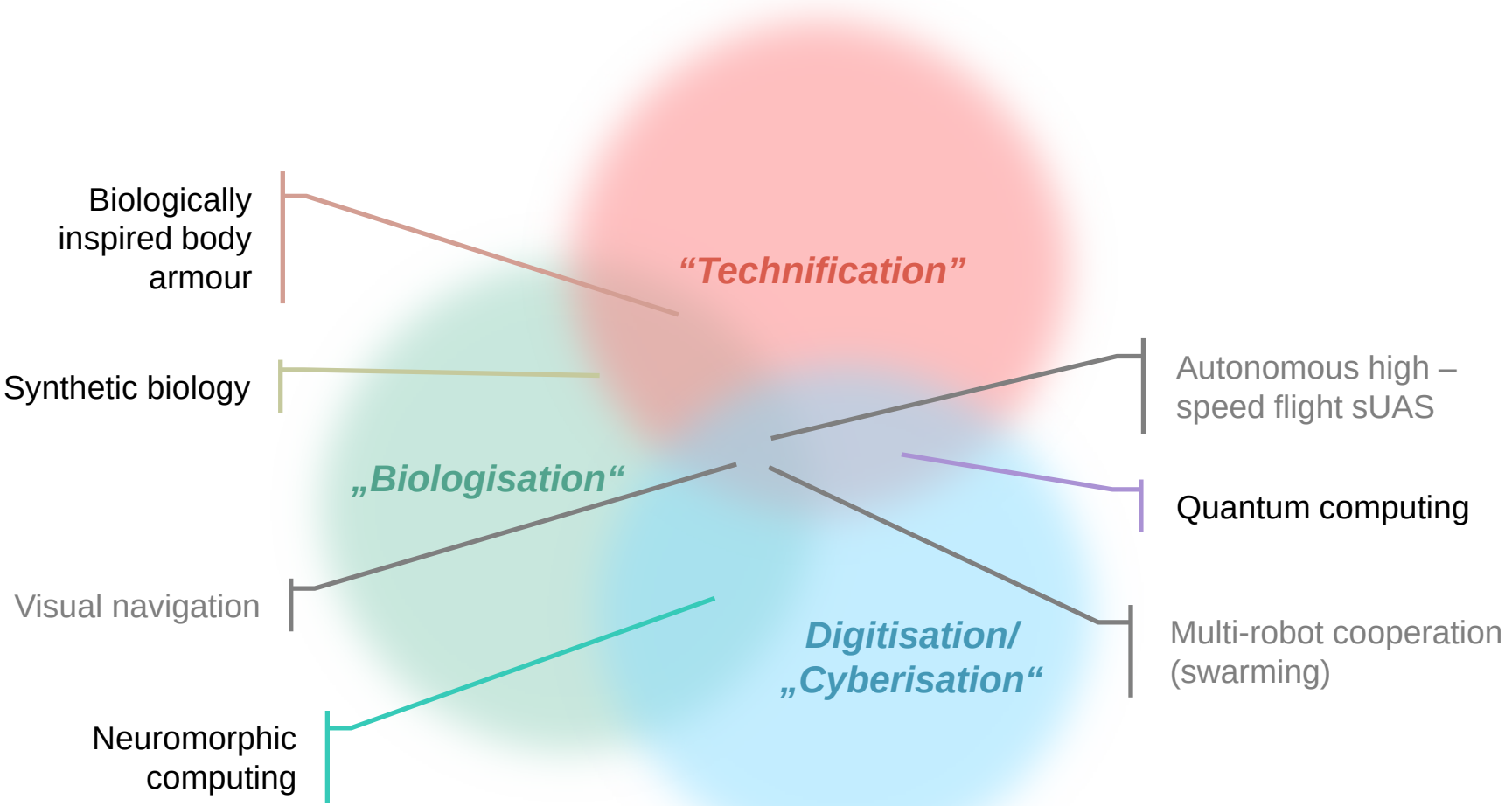
- High-precision, passive navigation

Defence relevance:

- Indoor navigation & navigation in urban terrain
- Independent from GNSS signals
- Covert operations
- Smart munitions


Source: adapted from Guan 2012

Some examples for emerging technologies “impacting defence”



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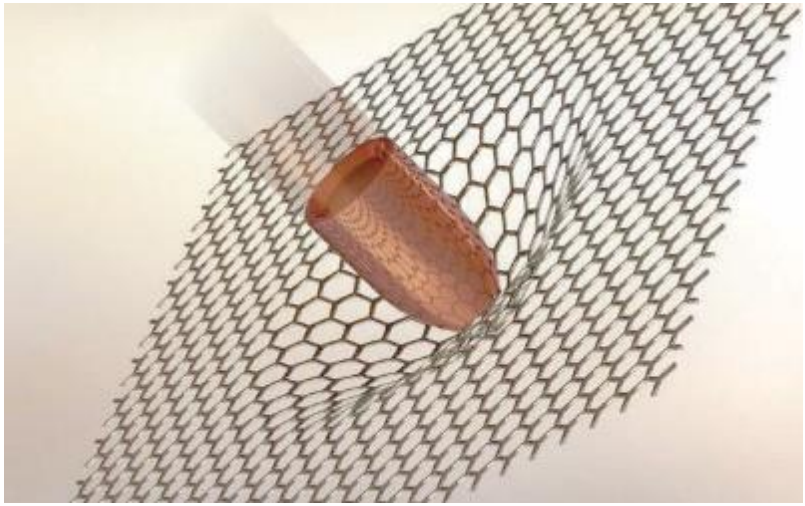
Biologically inspired body armour
- e.g. CNT-reinforced spider silk -



Source: Graphenow

State of the art:

- Basic research

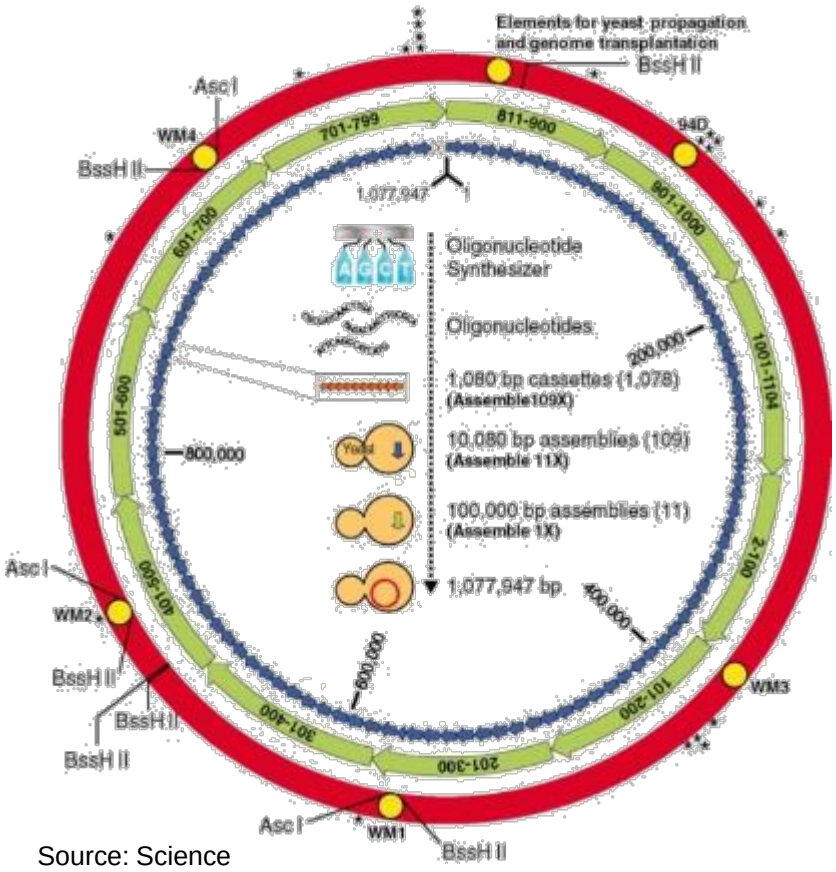
Expectation:

- Completely new protection concepts

Defence relevance:

- Improved survivability and agility of soldiers through lighter & more flexible body protection
- Increased protection beyond current body coverage

Synthetic biology



Source: Science

State of the art:

- Experimental proof of concept

Expectation:

- Disruptive potential for enabling technologies (e.g. DNA sequencing & synthesis)

Defence relevance:

- „Living Foundries“ for tailored production of e.g.
  - Materials
  - Fuels
  - Chemicals
- Bio sensors, information storage, etc.

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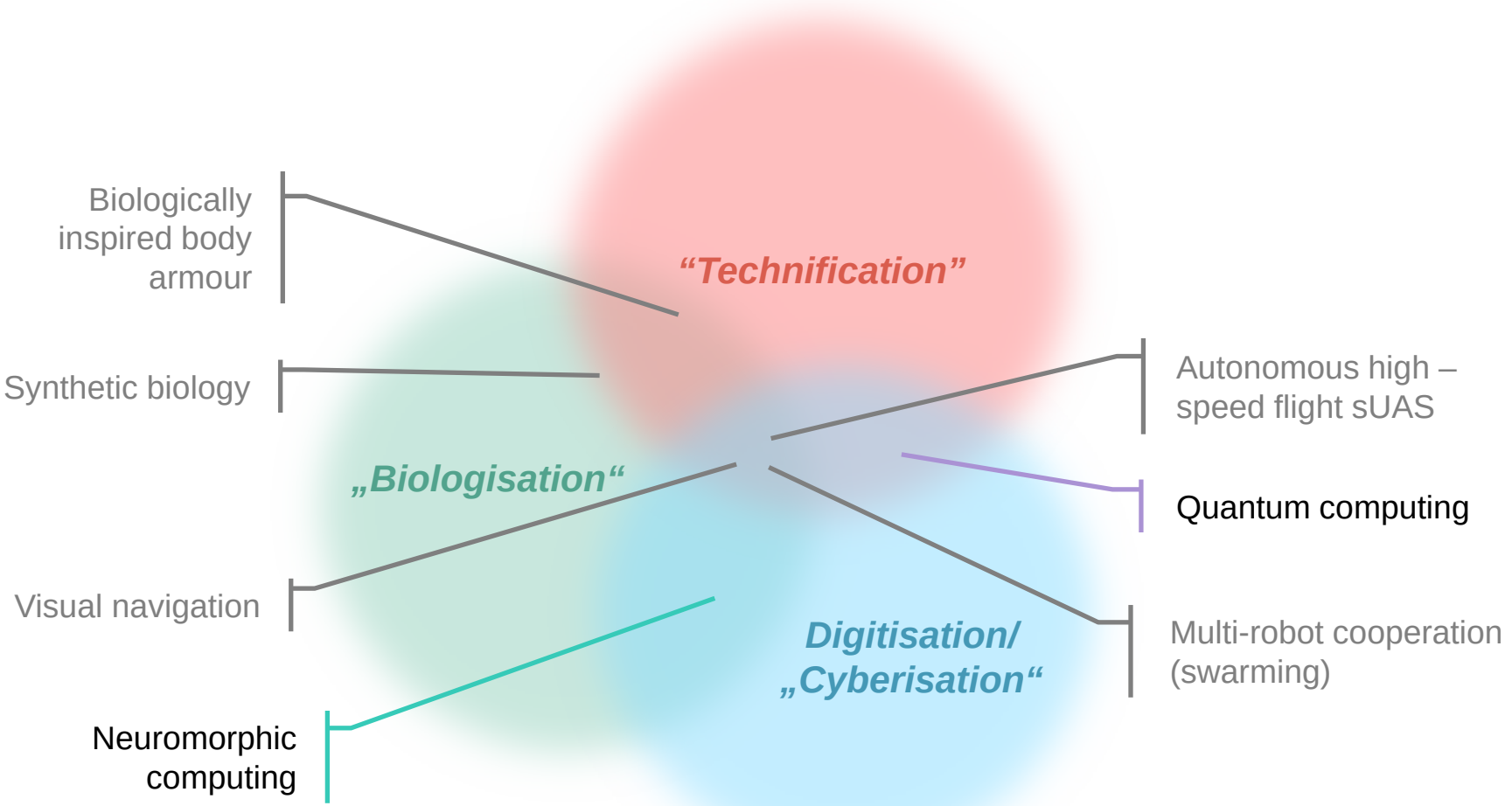
Some examples for emerging technologies “impacting defence”



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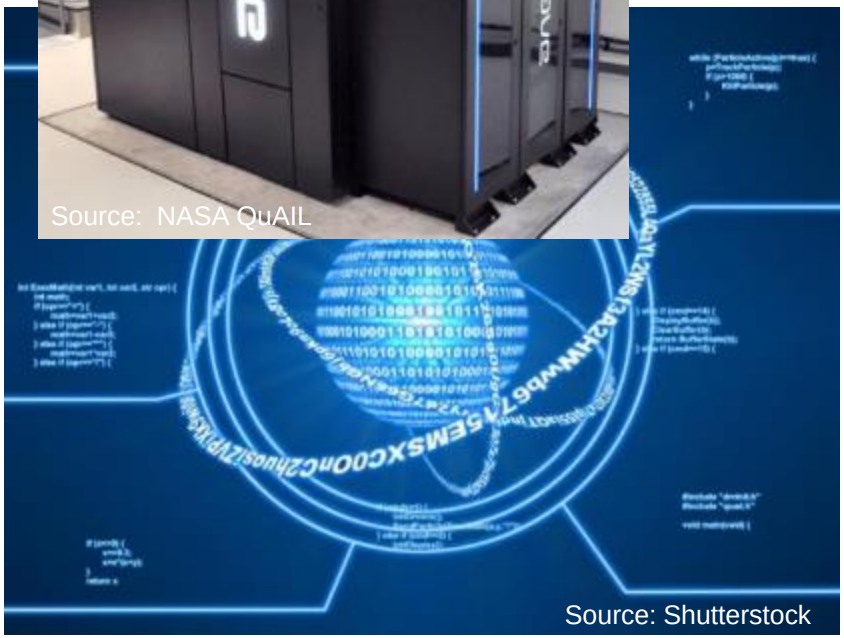
Quantum computing

Source: NASA QuAIL



Source: Shutterstock

State of the art:

- 1st systems seem to be operational

Expectation:

- Major improvement in computing power in specialised applications

Defence relevance:

- Cracking of currently used cryptography methods
- Improved computing of e.g. information management & supply
- Enhanced ISR data exploitation
- Modelling & Simulation

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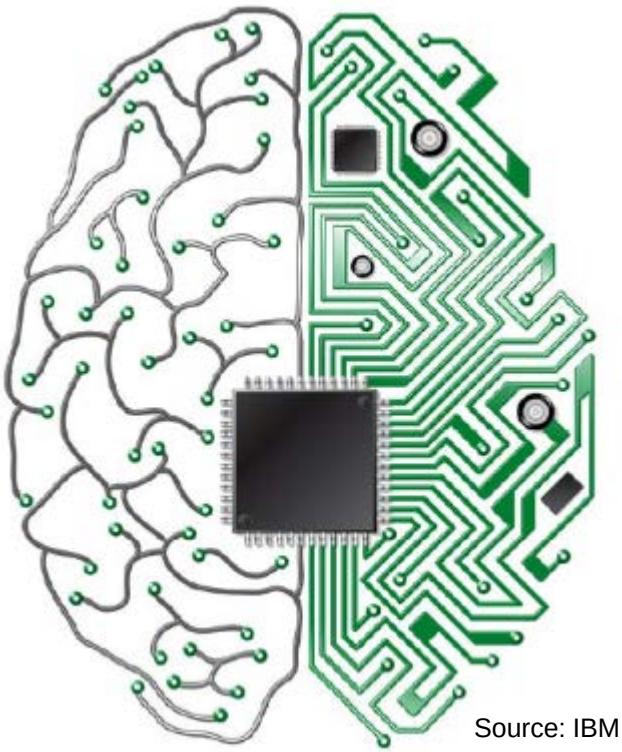
Neuromorphic computing



Source: IBM

State of the art:

- Basic research (e.g. “Human Brain Project”)

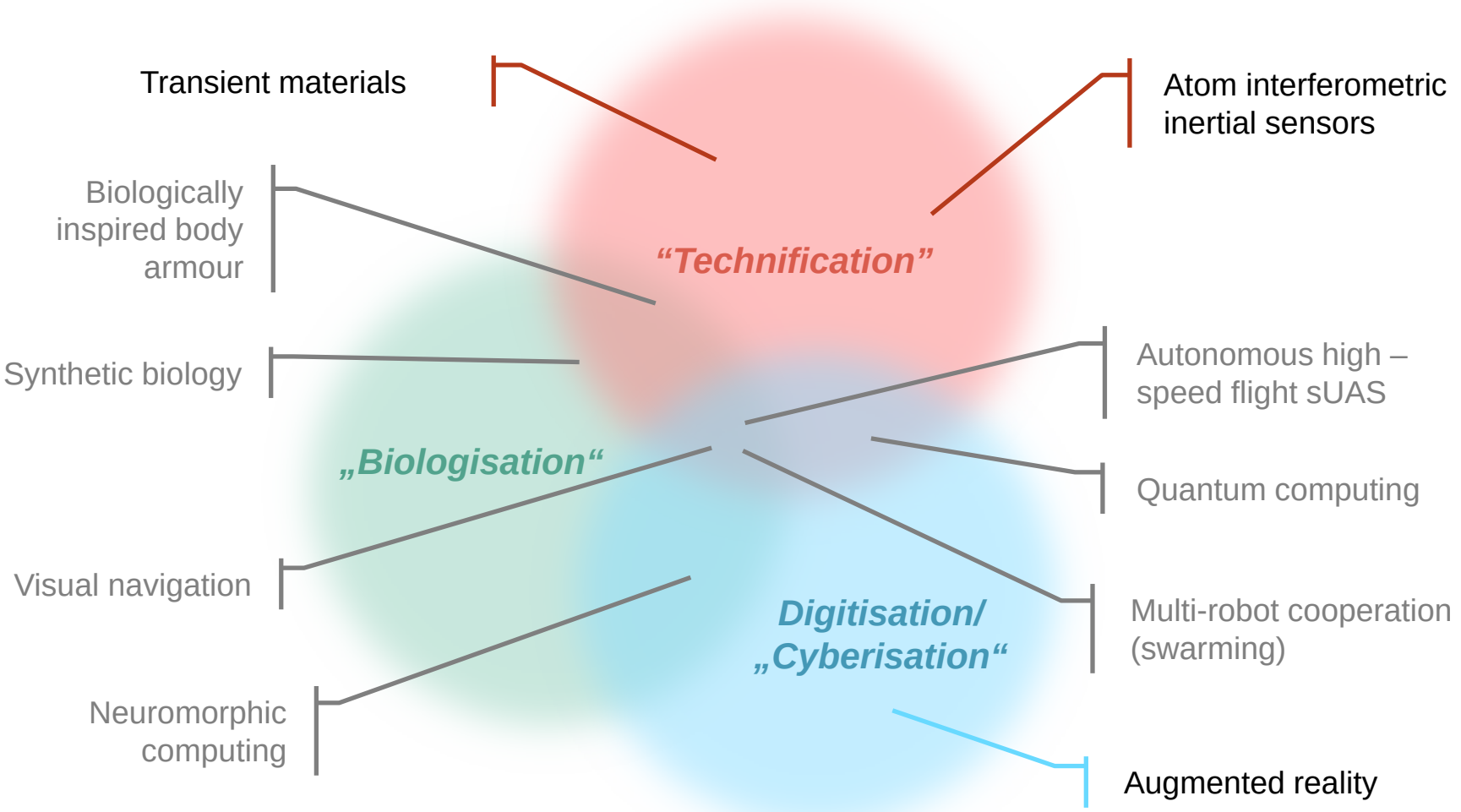
Expectation:

- Key technology for enabling demanding applications of AI

Defence relevance:

- Autonomous unmanned systems
- Improved command support and ISR
- Automatic target recognition
- Automatic language translation
- Improved M&S of human behaviour

Some examples for emerging technologies “impacting defence”



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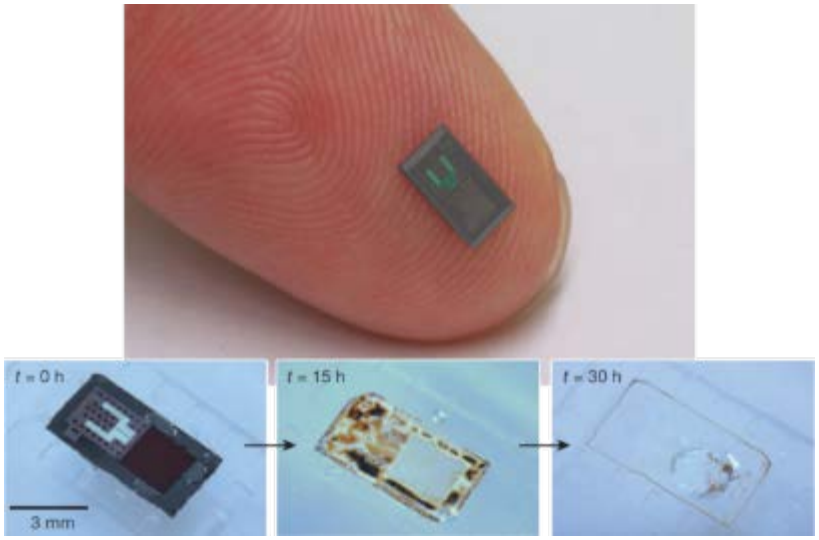
Transient materials



Sources: arstechnica, Kang et al.

State of the art:

- Lab studies

Expectation:

- New way of protecting “confidential know-how”

Defence relevance:

- Dissolution of e.g. “confidential sensor technology” after covert operations / when at risk to fall into “enemy’s hands”
- Prevention of unauthorised use of own weaponry / sabotage
- Medical diagnostics, …

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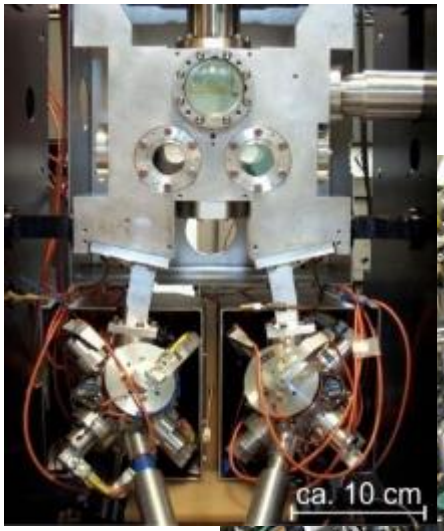
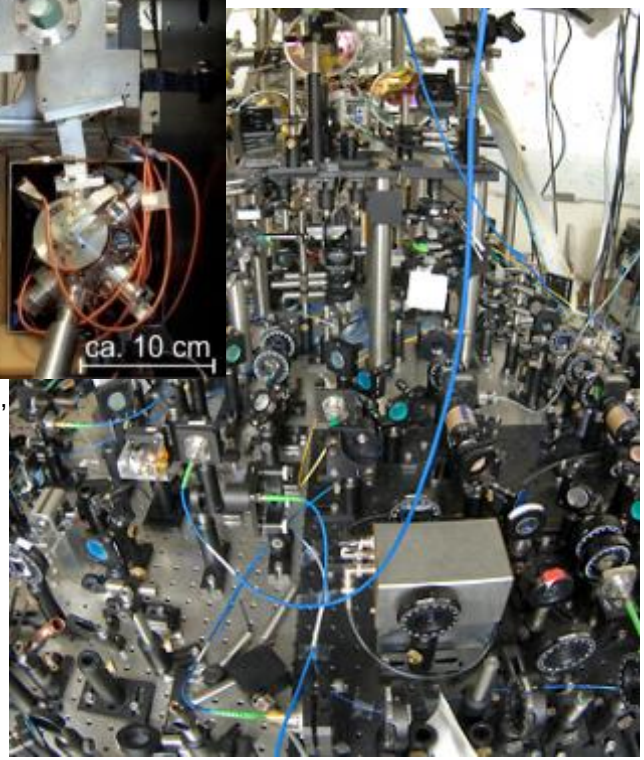
Atom interferometric inertial sensors





Sources: SYRTE, Phys.org

State of the art:

- Validated in lab environment

Expectation:

- Quantum leap in GNSS-independent navigation precision

Defence relevance:

- Long-enduring operations of mobile platforms & cruise missiles without GNSS signal
- If used as gravitation sensor:
  - Underwater collision avoidance
  - Through-the-wall sensing; detection of hidden tunnels, etc.

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Augmented reality

State of the art:

- First commercial applications

Expectation:

- Improved situation awareness of soldiers

Defence relevance:

- Identification Friend or Foe
- Support to MOUT
- Support to battlefield medicine, field maintenance, etc.
- Support to navigation
- Support to training & exercises, …

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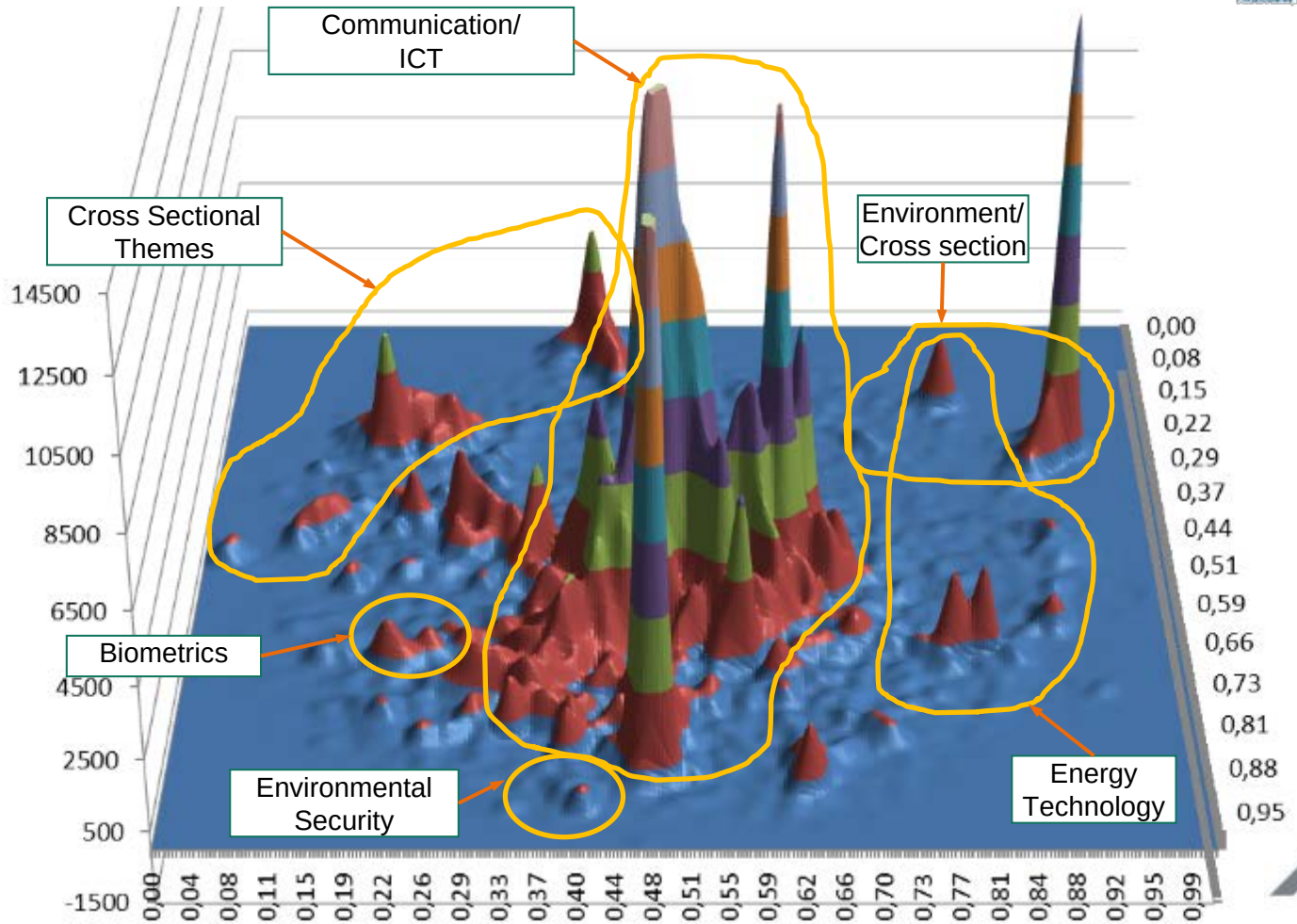
Phone +49 2251 18 224

ulrik.neupert@int.fraunhofer.de

Example – technology scanning using bibliometrics

- “weak *[early]* signals identification” -



Dedicated to innovation in aerospace

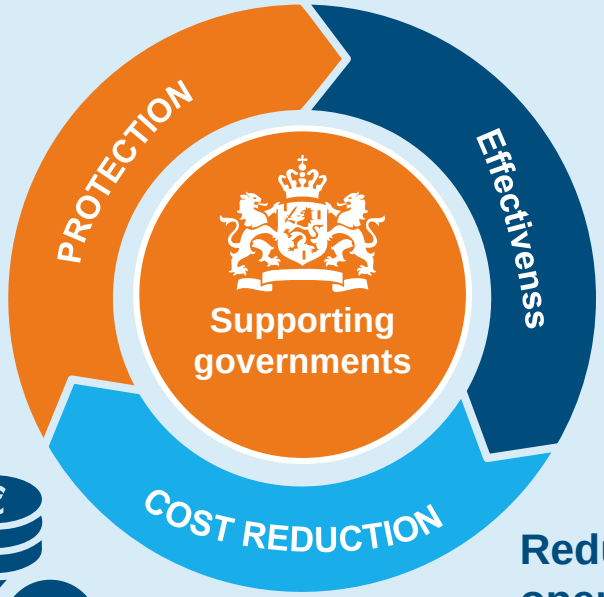
Cooperation = key to innovation

| Michel Peters, CEO NLR

Making operations safer, sustainable and more efficient

Our mission supporting governments in:

Maximal protection of military personnel and materials



Increasing effectiveness

Reducing operating, repair and maintenance cost

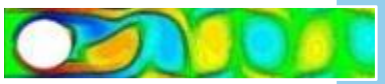
Triple helix in practice

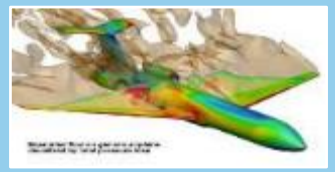
Research

Development & Integration technologies

Valorisation transfer to Industry

Production& commercialisation



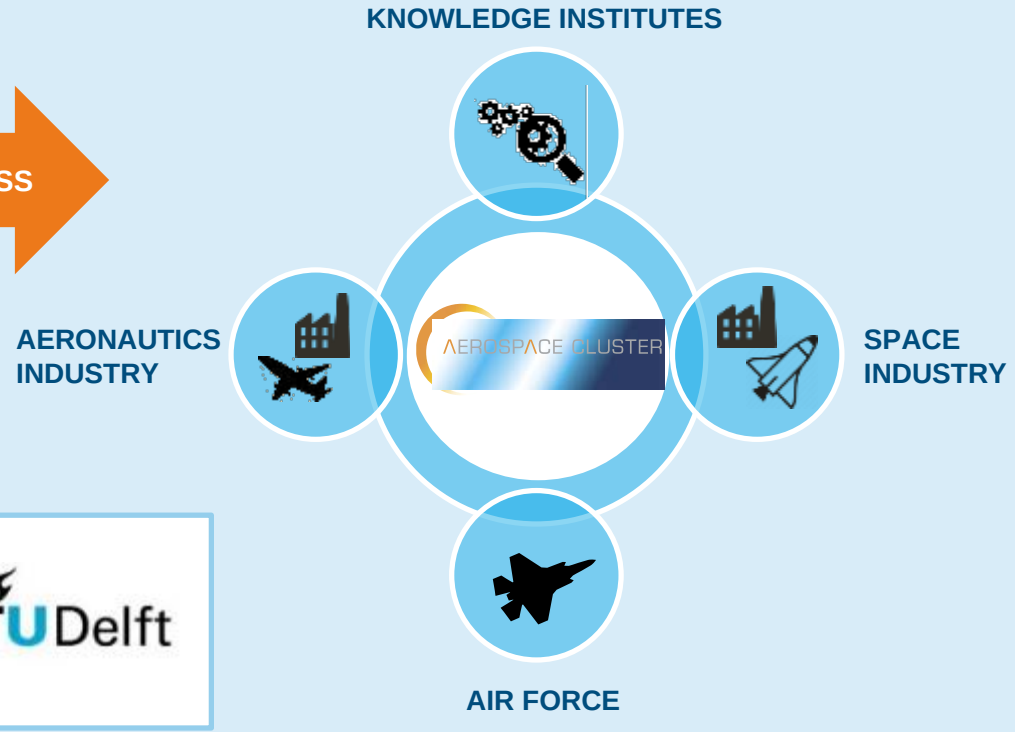


Universities

Industrial partners, Spin-offs, Start-ups

Aerospace Cluster

OPEN INNOVATION & COOPERATION KEY TO SUCCESS



Successful innovations

Competence Sharing

Development Center for Maintenance of Composites

3D Printing

ACM Pilot Plant

3D Printing NH90 Ladder bracket

Results:

- Redesigned
- Certified !
- 40% weight reduction component

Ready to fly during ‘luchtmacht dagen’ (RNLAF airshow)

Automated Composites Manufacturing Pilot Plant

- New manufacturing techniques
- ‘Robotification’ of fabrication process
- Overall design and production cycle improvement

Example: Landing gear component for F-35

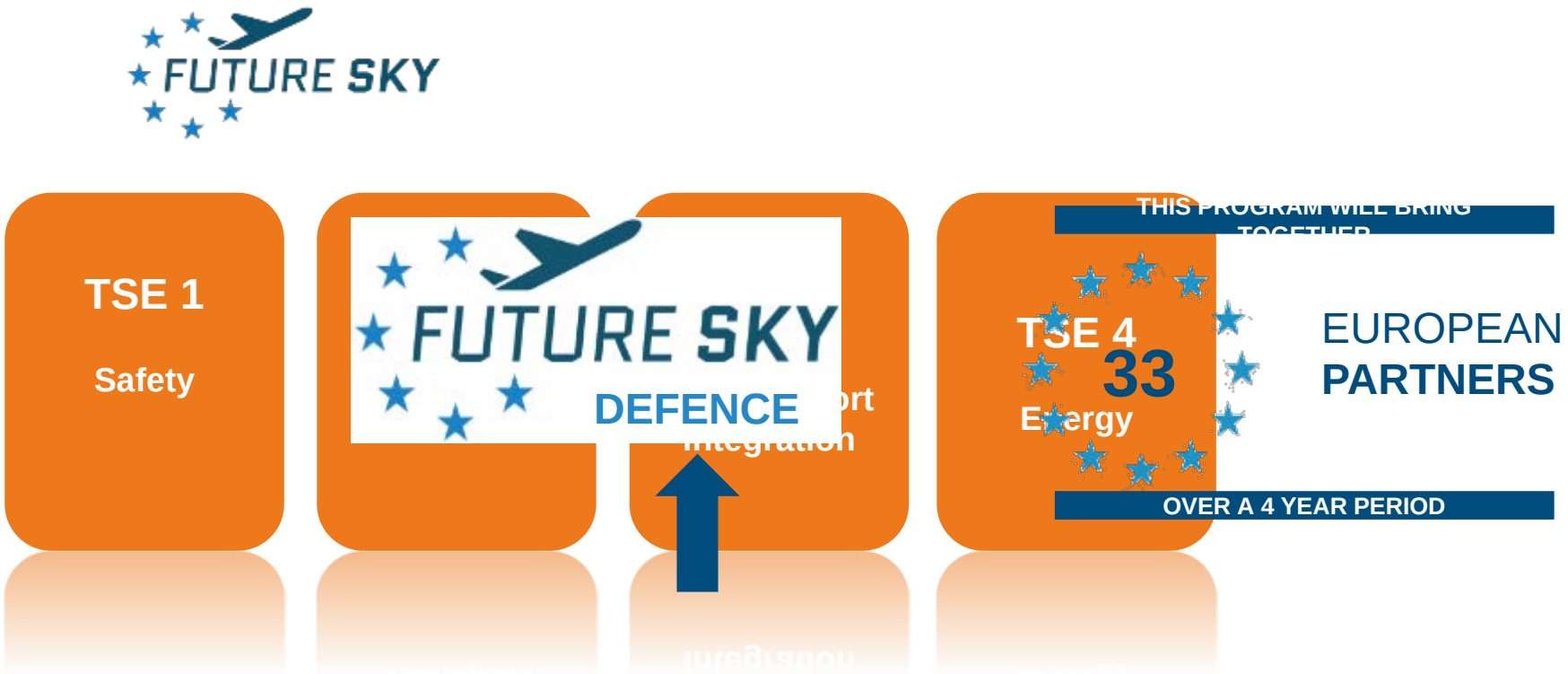
FOKKER LANDING GEAR

PROVINCIE FLEVOLAND

gemeente NOORDOOSTPOLDER

Ministry of Economic Affairs

Pushing the edge in R&D and cooperation



Food for thought!

FUTURE SKY DEFENCE

Theme 1: European military airworthiness harmonization

Theme 2: Electronic Warfare, EW interconnectivity and Cyber

Theme 3: Versatile and responsive training for joint, combined and interagency capabilities

Theme 4: Space & multi-platform sensor fusion / big data

Dedicated to innovation in aerospace

Fully engaged

Netherlands Aerospace Centre

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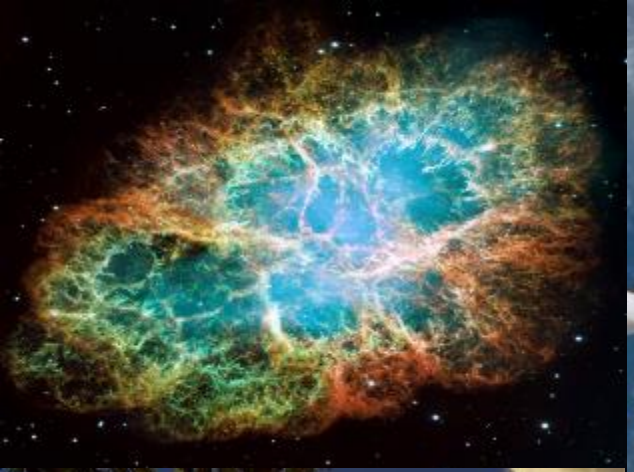
ESA funding innovation – a commercial approach

A. Ginati and R. Rinaldo

Integrated and Telecommunications-related Applications Department

European Space Agency

"Seminar on Research and Technology "*- EDA R&T conference 25th-26th April 2016– Amsterdam*



esoc

ESA Integrated Applications Promotion – IAP

The goal :

Foster new utilization of existing space capacity and capability, in close partnership with end-users, through the development of integrated (different space and non space technologies) applications projects which demonstrate a potential for sustainable services.

Incubator of Services

European Space Agency

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IAP scope

Sustainable services
based on

- SATCOM
- SATEO
- SATNAV
- SATAIS
- SATADS-B
- SSW
- HSF
- …..
- …..

in combination with terrestrial systems!

Security-related themes

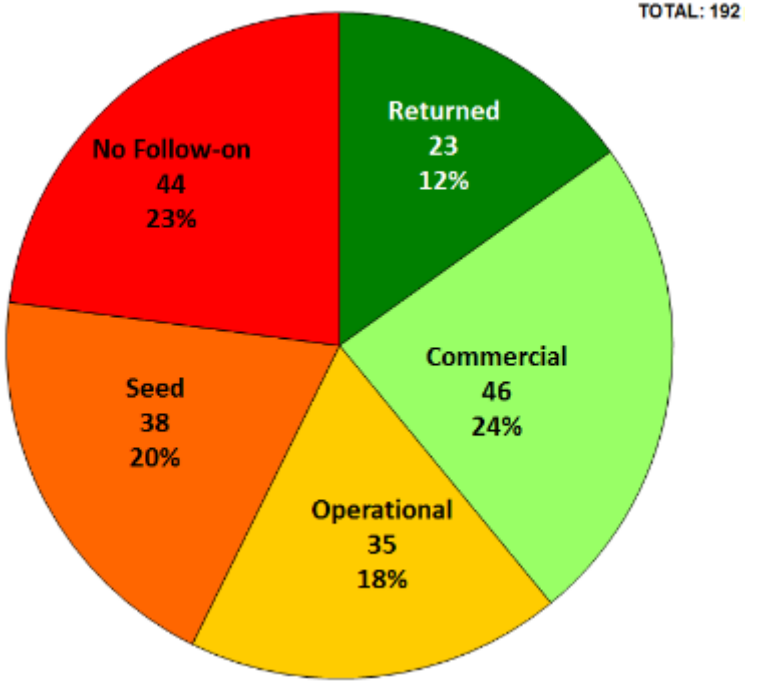
The offer

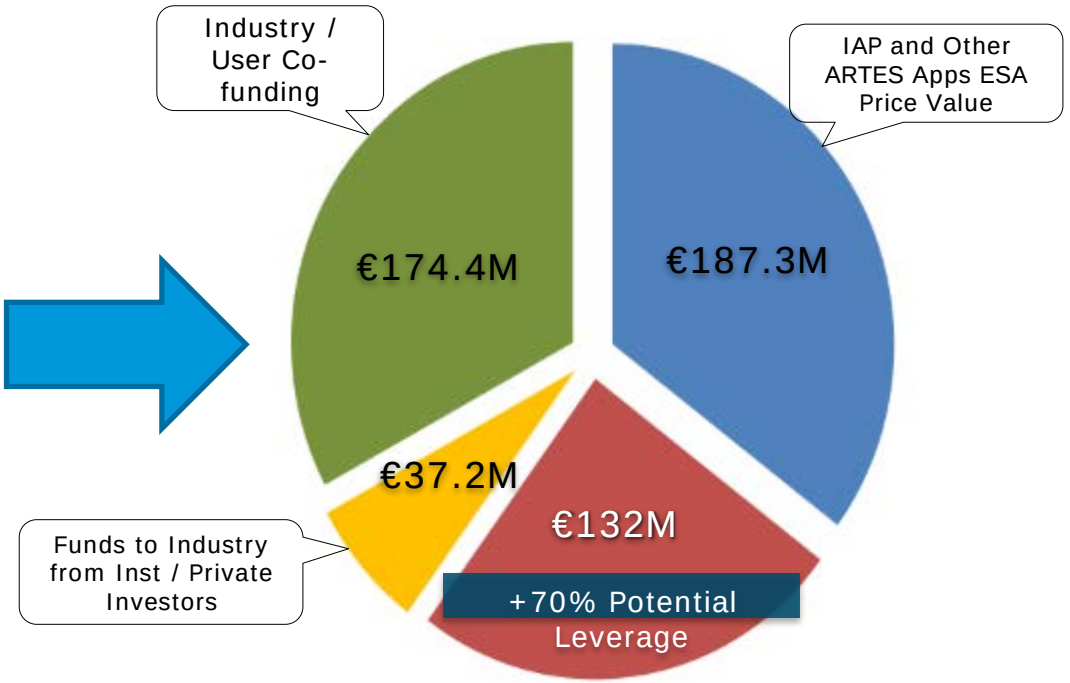
- Financial support
- Technical & Business expertise
- Promotion
- ESA "branding"
- Networking
- Access to 3rd party funding

ace Agency
al Use

IAP financial structure

The data collection initiates from the **192** completed and appraised projects from ARTES Integrated applications and service programmes.





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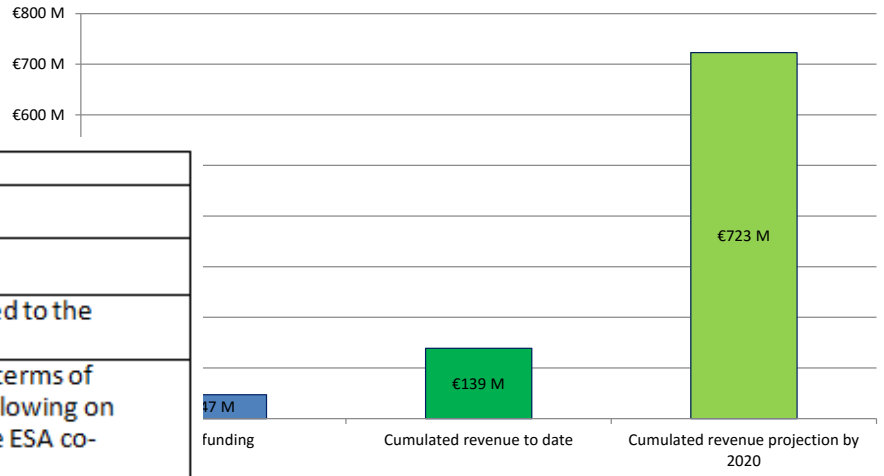
IAP Socio-Economic Impact (SEI)

43 project's impact appraised against 10 Societal -Economic indicators

#	Description	Measure
1	Revenue	Euro
2	Exports	% of revenue going to export
3	Jobs	no. of employees created or sustained linked to the project
4	Investment leverage	Euro, includes total 3rd party investment in terms of equity, debt, grant, public funds or M&A following on from the ARTES project, as compared to the ESA co-funding
5	R&D spend uplift	Increase in the ratio of R&D expenditure/revenue
6	Extent of the value chain	Number of business relationships. This includes consortium partners, suppliers, distributors etc.
7	Addressable market size	Potential financial value without possibility to compare or aggregated
8	Value creation	May be linked to a financial measure without possibility to aggregate figures
9	Societal benefits	E.g. improvement in emergency distress, better education in rural schools, saved lives due to telemedicine
10	Innovation impacts	E.g. market disruption and patents

1. Cumulated revenue to Date, 3 : 1
Cumulated revenue projection 2020, 15 : 1



2. >70 % of revenue goes to export

3. 280.5 Jobs were created

European Space Agency
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IAP Strategic Partnerships

EMSA
FRONTEX
efca

Maritime Activities

EUROPEAN DEFENCE AGENCY
EUROCONTROL

RPAS Activities

LUX DEV

eHealth for Sub-Saharan Africa

European Railway Agency

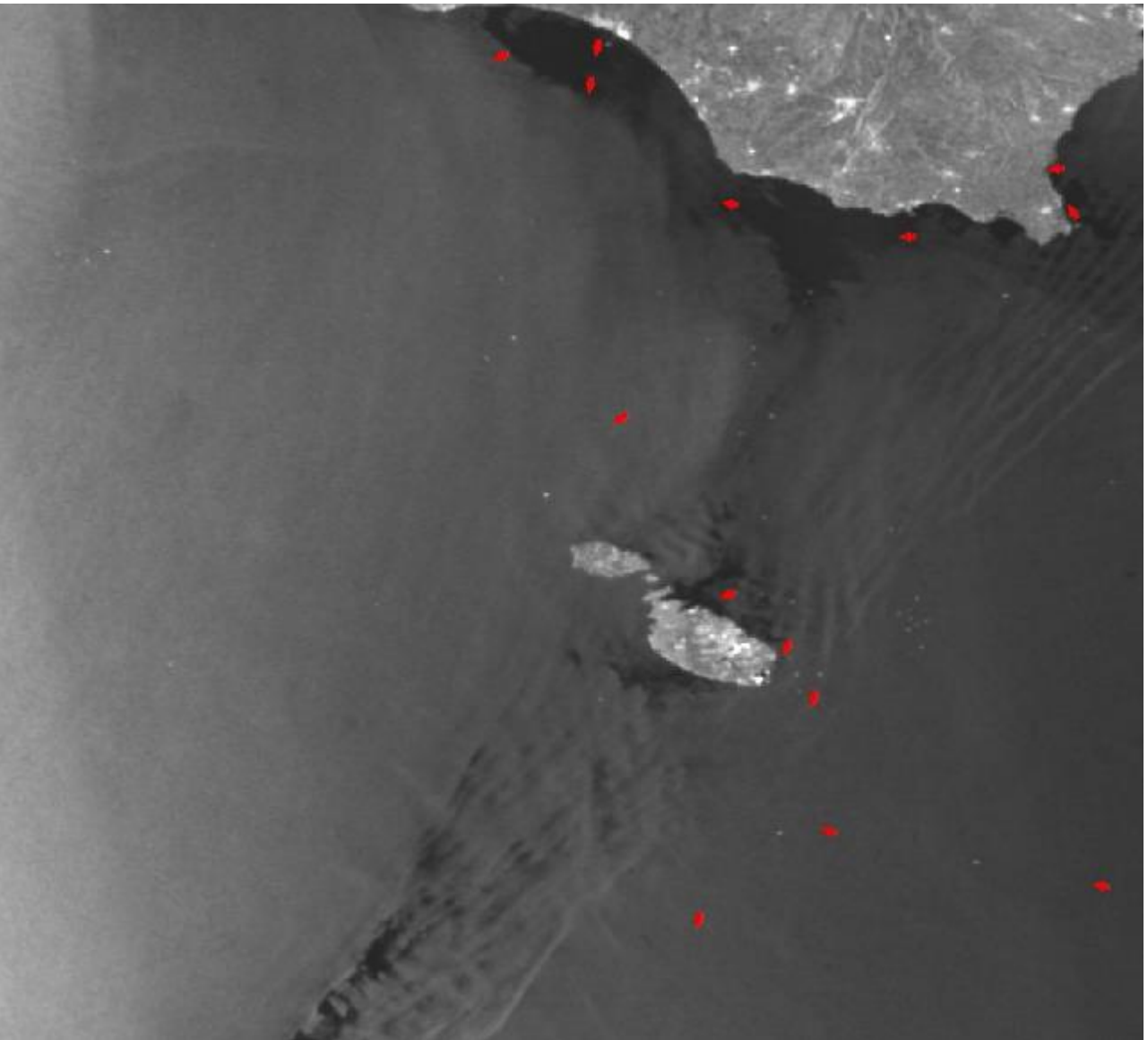
Space for Rail

European Investment Bank

"SMAP Fund"

Space for Mediterranean Acceleration Programme

The value of Space: Satcom, Nav, EO & RPAS



AIS tracks from ships

SAR detected ships

Correlation SAR & AIS

Remaining uncorrelated ships & UAS for identification

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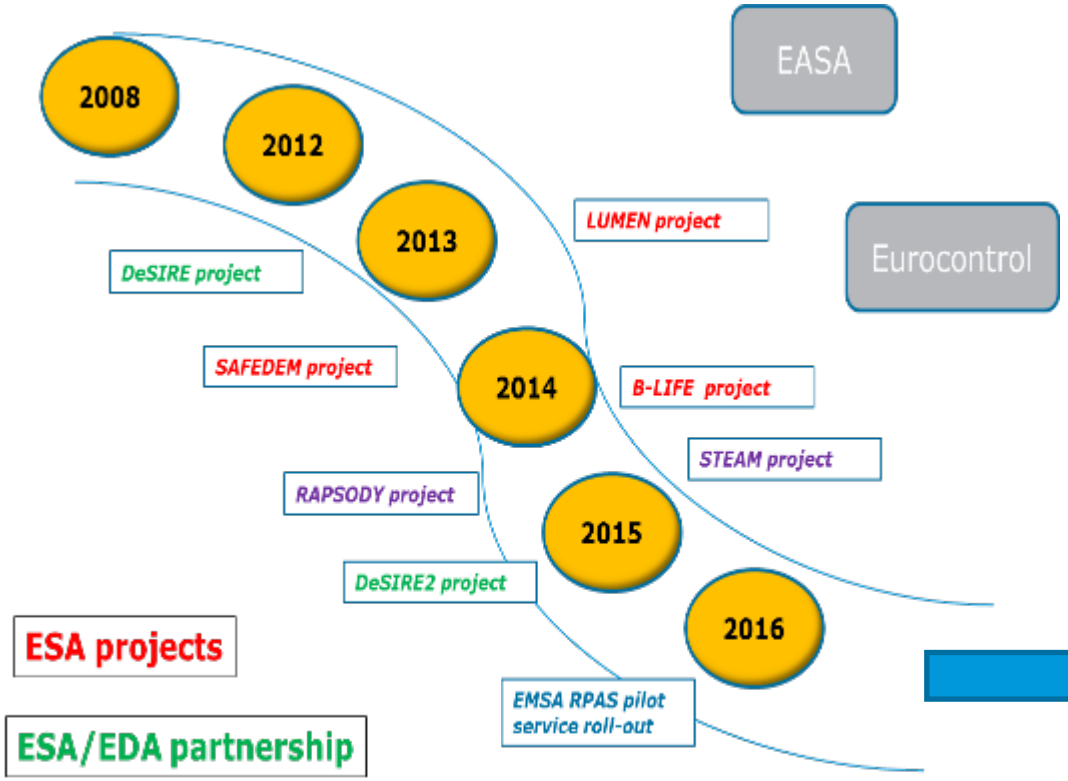
UAs / RPAs

Since 2008 EDA and ESA have established a collaboration in the domain of RPAs with the objectie of integrating RPAs in the general air space, paving the way for sustainable services



EDA-ESA projects have contributed/are contributing to the establishment of EU regulations and standards for RPAs operations, in partnership with Eurocontrol and EASA

Market take-up

European Space Agency

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IAP activities related to Remotely Piloted Aircraft Systems - RPAS

Feasibility

- Unmanned Postal Delivery
- BIOSCOPE crop mgmt service for potato farmers
- STEAM ship emission aerial measure-ments
- UASatcom exploration & pipeline monitoring
- PalmOil-Vision carbon footprint in palmoil sector
- SAFEDEM enhanced and safe demining
- SINUE Integrating RPAS into non-segregated airspace

Demonstration

- B-LiFE biological crisis field laboratory
- RAPSODY UAV based S&R (1) and Pollution Monitoring (2) Services
- KORE crop precision farming
- SAFEDEM enhanced and safe demining
- DESIRE 2 Integrating RPAs into non-segregated airspace
- DeSIRE Integrating RPAs into non-segregated airspace

Operational

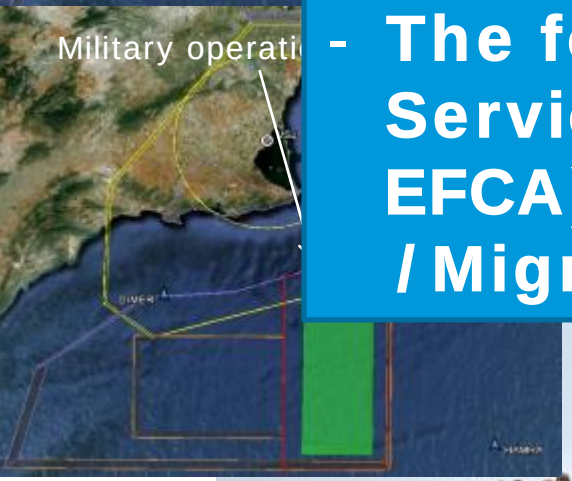
- SURMON (UASatcom) exploration & pipeline monitoring

RPAS range: Micro to MALE RPAS

Space assets: Satcom, SatNav integration with sat EO data

User / Customer Engagement

1st RPAS (UAV) Demo Day 24.4.14 in Murcia (DeSIRE)



- SAT-AIS initiative. The EC/EMSA are investing 10.2 M€
- 1st RPAS service 10 € for EMSA
- The following one, RPAS Pilot Services (with FRONTEX and EFCA) to Monitor fishery /Migration etc (~60M€/ 2017)

Demonstration of Satellites enabling the Insertion of RPAS in Europe – 2 (DeSIRE 2)

Objectives

To develop and to demonstrate a service based on a Remotely Piloted Aircraft (RPA) flying in Beyond Radio Line of Sight (BRLOS) using a dual satcom link supporting C2 and ATC functions.

To demonstrate to the users the potential of RPAS complemented by satellite applications (Satcom , Satnav and Earth Observation) for developing new services for operations.

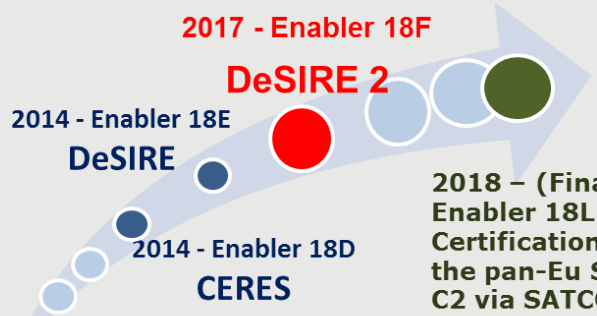
User(s):
Maritime and Environmental agencies, Civil protection, Police, Public authorities, Coast-Guards, National Air Forces, FRONTEX, MoDs
Status: On-going

Maritime Surveillance and Border Control

Law enforcement

Environmental Surveillance

EU REGULATORY ROADMAP FOR RPAS
Regulatory Improvement 18*
ICAO TARGET 2018
"Restricted RPAS operations BVLOS/BRLOS/IFR supported by SATCOM"



Enabler 18F: Comprehensive C2 requirements validation from 2nd demonstration of C2 operation via satcom European Space Agency

Budget: 2.625 kEUR cost, 600 kEUR funded by EDA, 1.185 kEUR by ESA and 840 kEUR by Industry

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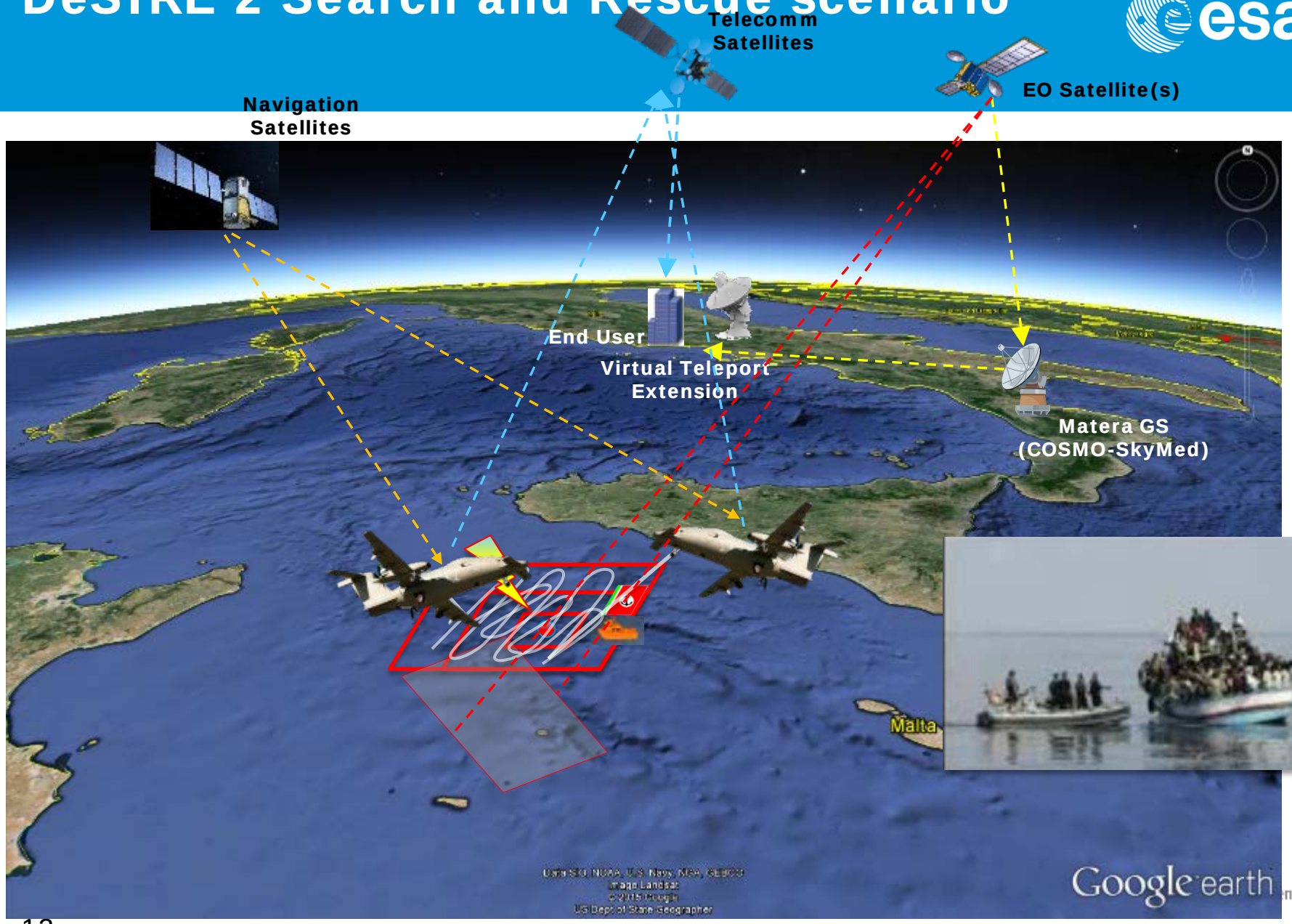
DeSIRE 2 Search and Rescue scenario



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Birds and Flight Safety

GAF (1997-2004): 360 collisions strikes/year
FAF (1998-2005): 320 collisions strikes/year
RAF(<2004): 110 documented serious accidents

Estimated conservative cost due to damage and delays of commercial aircraft worldwide
1.2 billion USD per year

ARMÉE DE L'AIR

DEFENCE
PEACE OUR PRIORITY

FlySafe Objectives

FlySafe activities:

- ✓ Started in June 2007
- ✓ In partnership with : RNLAF, BAF, FAF, GAF

FlySafe objectives: To develop a bird warning system of systems to improve flight safety & increase flight operation time in northwest Europe by:

- ✓ Improving existing en route bird detection systems
- ✓ Reducing human dependency
- ✓ Developing bird forecast models
- ✓ Developing tools for bird flight activity detection at and near airports
- ✓ BIRDTAM Cross border harmonization

FlySafe project team

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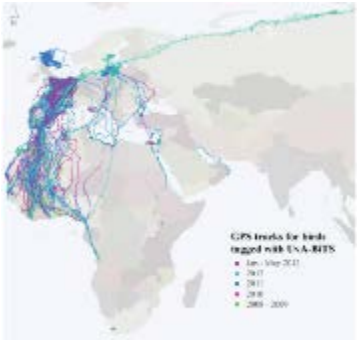
FlySafe outcome

the bird migration model & bird tracking system:

- ✓ RNAF has funded two additional ***FlySafe follow-up projects, FlySafe II and FlySafe III,*** respectively aimed at extending the geographic coverage of FlySafe services through co-operation with new European weather institutes (OPERA network) & users: 16 countries (> 60 radars), and to build bird migration models based on bird weather radar algorithm developed in FlySafe.



- ✓ led to a new e-COST action ***European Network for the Radar Surveillance of Animal Movement (*ENRAM)**, with a NL and UK lead, to increase and strengthen the international research network (e.g. insect migration, bird migration, meteorology)

- ✓ UvA-BiTS: **more than 50 projects all over the world** (South Africa, Australia, Siberia, Oman, Europe), >50 research institutes/companies involved, >1,200 birds (39 species) tagged

Avian Radar: **ROBIN Radar Systems** got contracts in 10+ countries (e.g. the Netherlands, Belgium, UK, Turkey, Estonia, Bulgaria, Poland, France, Norway, Spain, Israel). Tens of systems are operational in Europe and is planned a business expansion towards the Middle East, Asia & Australia. To support its international roll-out and innovation agenda, ROBIN Radar Systems has obtained additional investment from Inkef Capital (ABP) and the Mainport Innovation Fund (KLM, Schiphol Airport a.o.)

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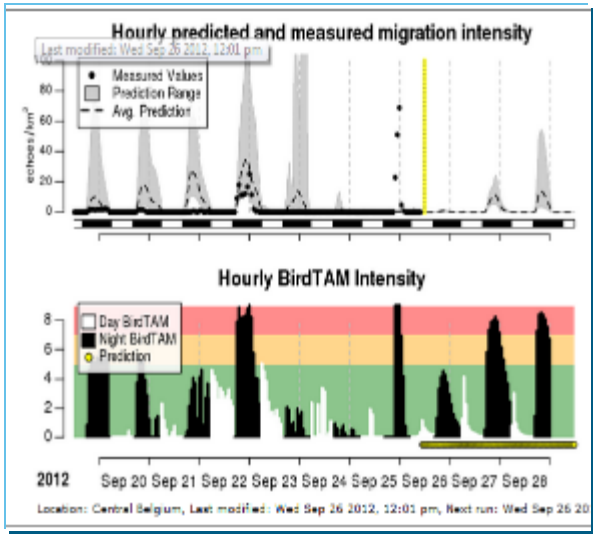
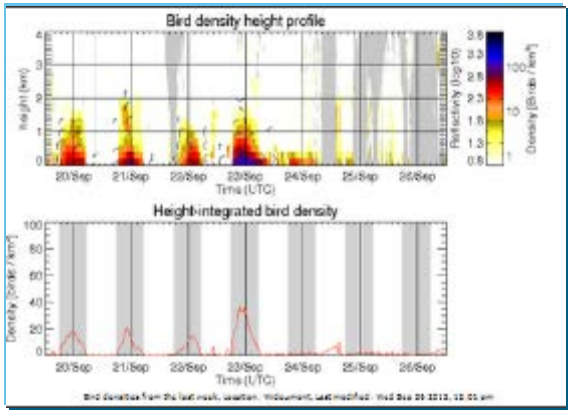
FlySafe web service



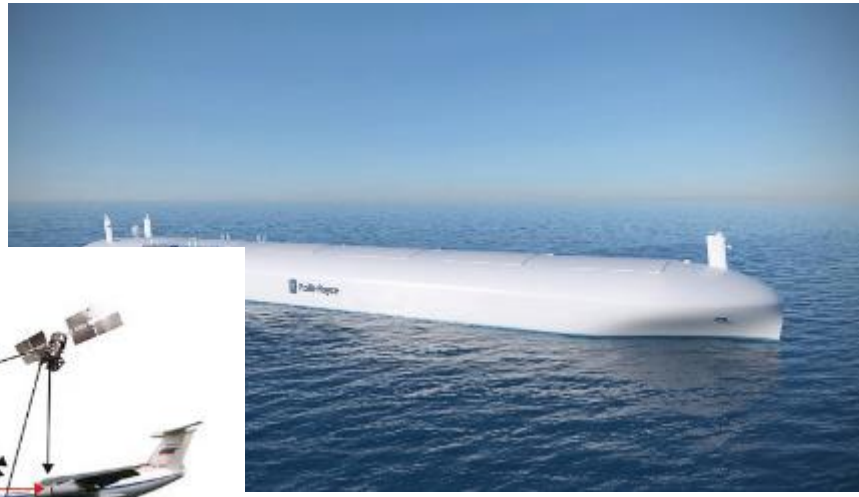


http://www.flysafe-birdtam.eu/

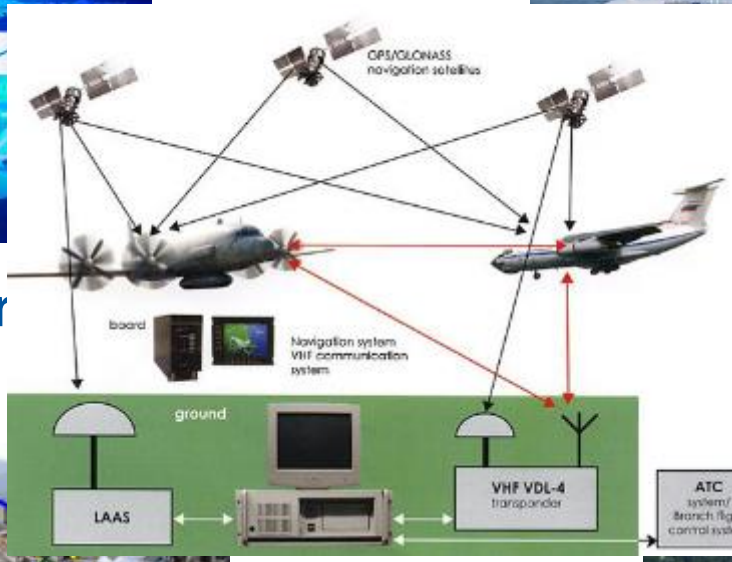
What is next?

Cyber-security

Unmanned Maritime Vehicles



ADS-B



Emergency respor

CBRN

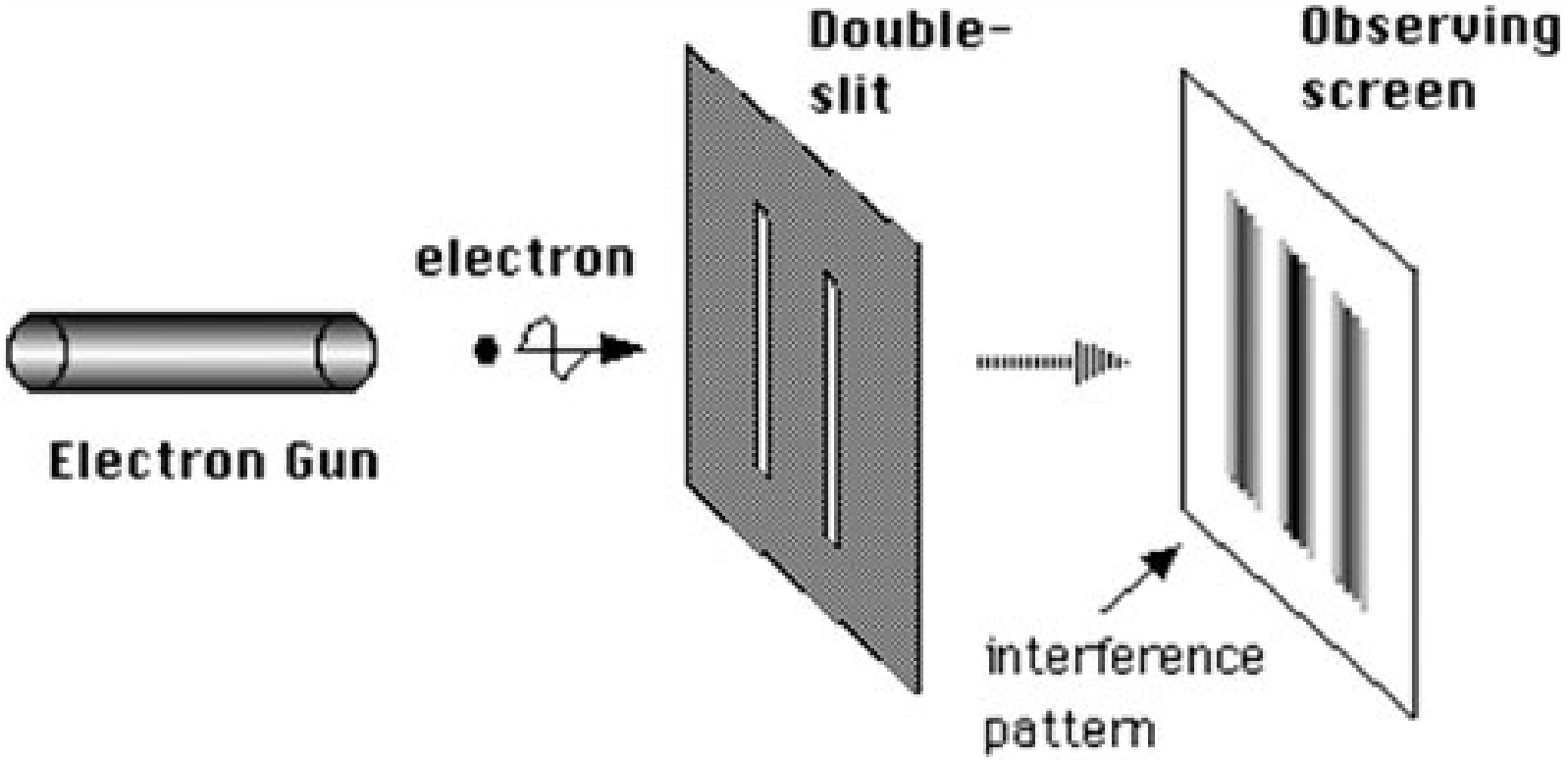
Others???

esa
"Space is the Limit"
Thank You!
European Space Agency

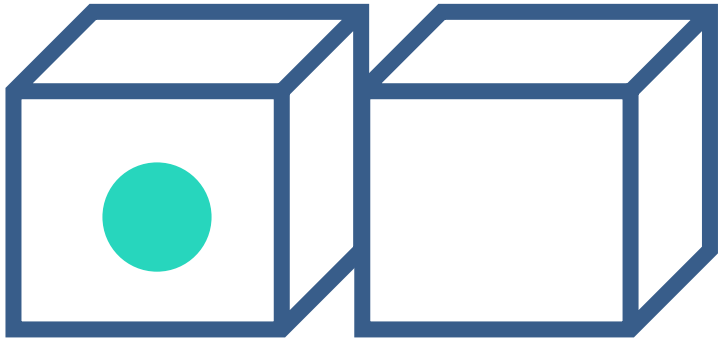
Quantum technologies and their impact

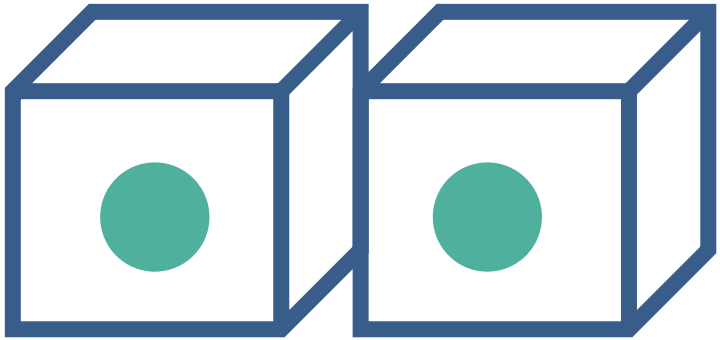
Dr. R. (Rogier) Verberk
April 25, 2016

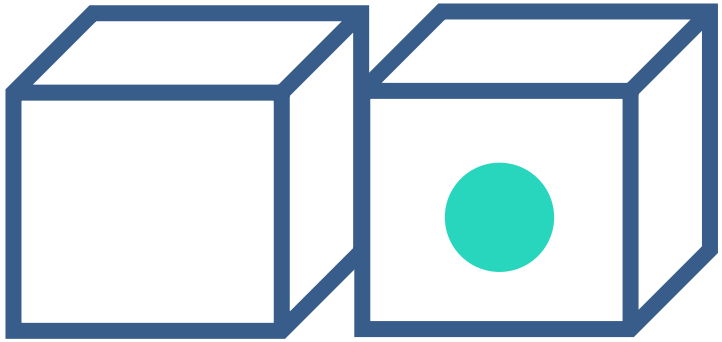
Superposition



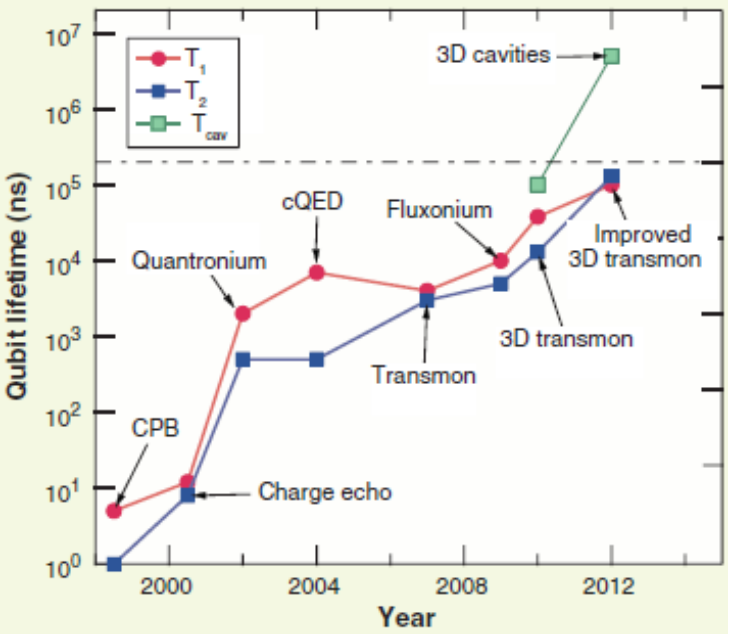
Conventional versus quantum computing

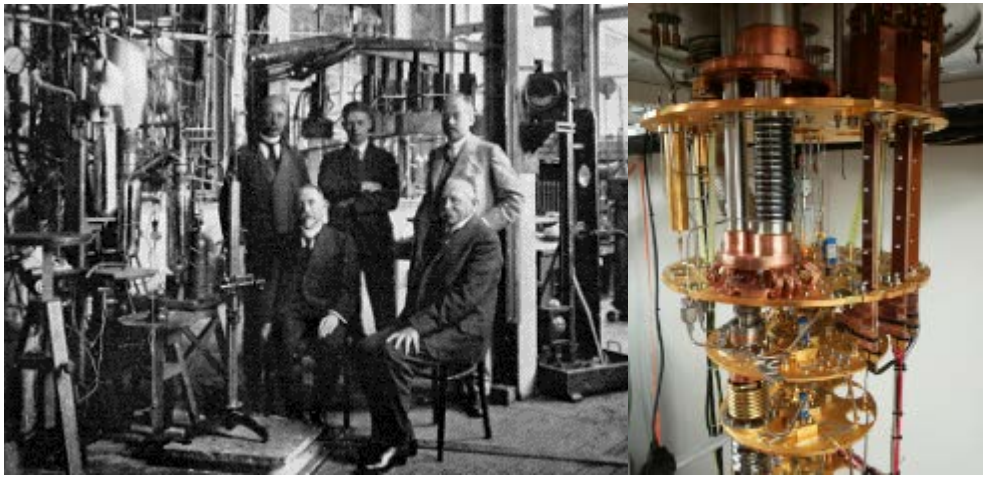


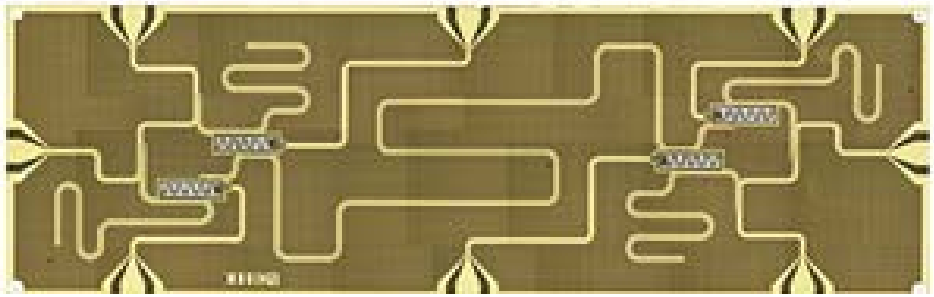


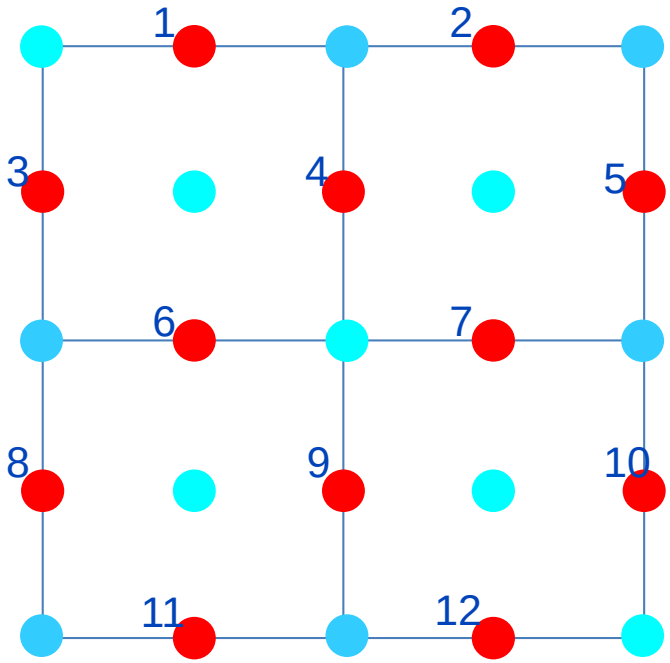


Recent developments

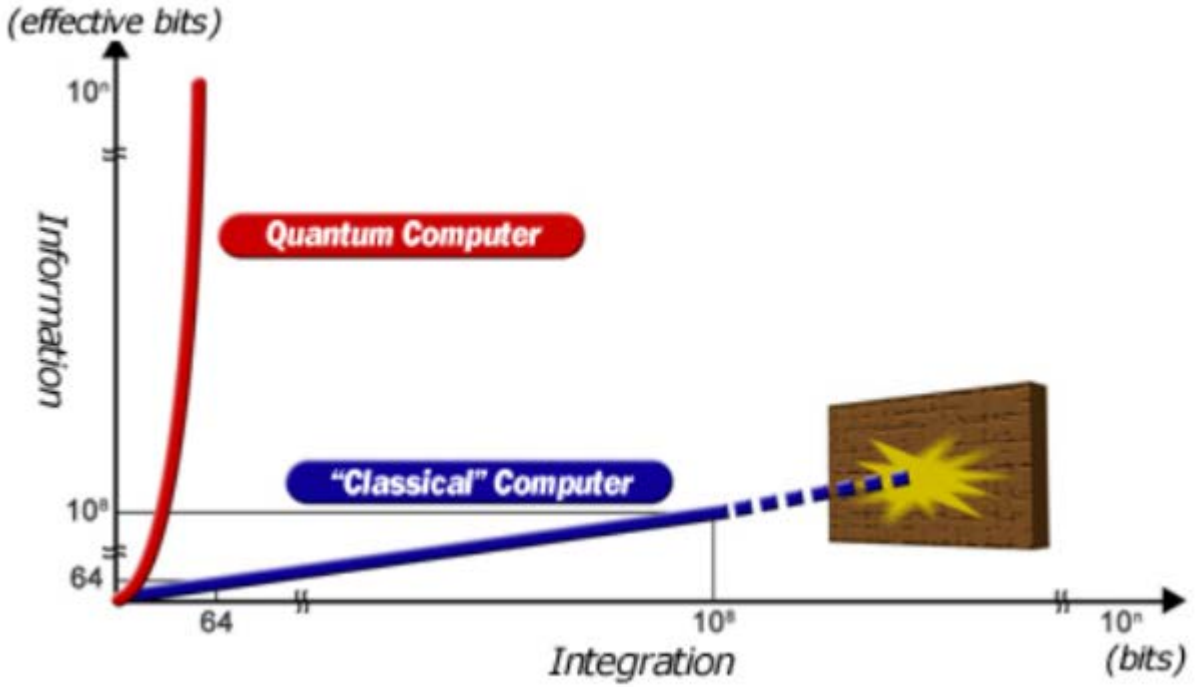




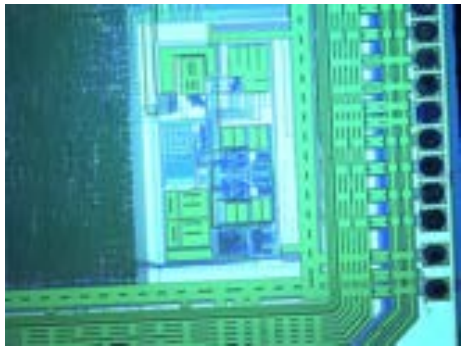


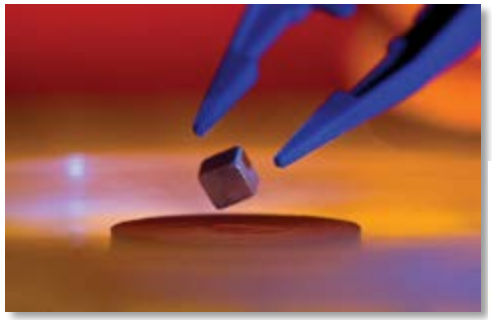


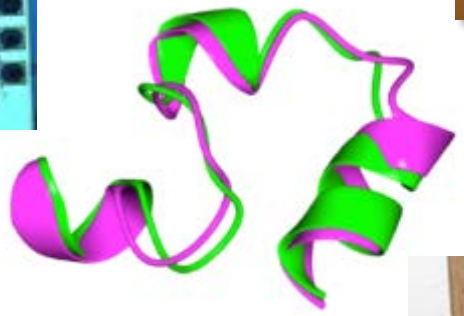
Scaling of computing power



QC applications

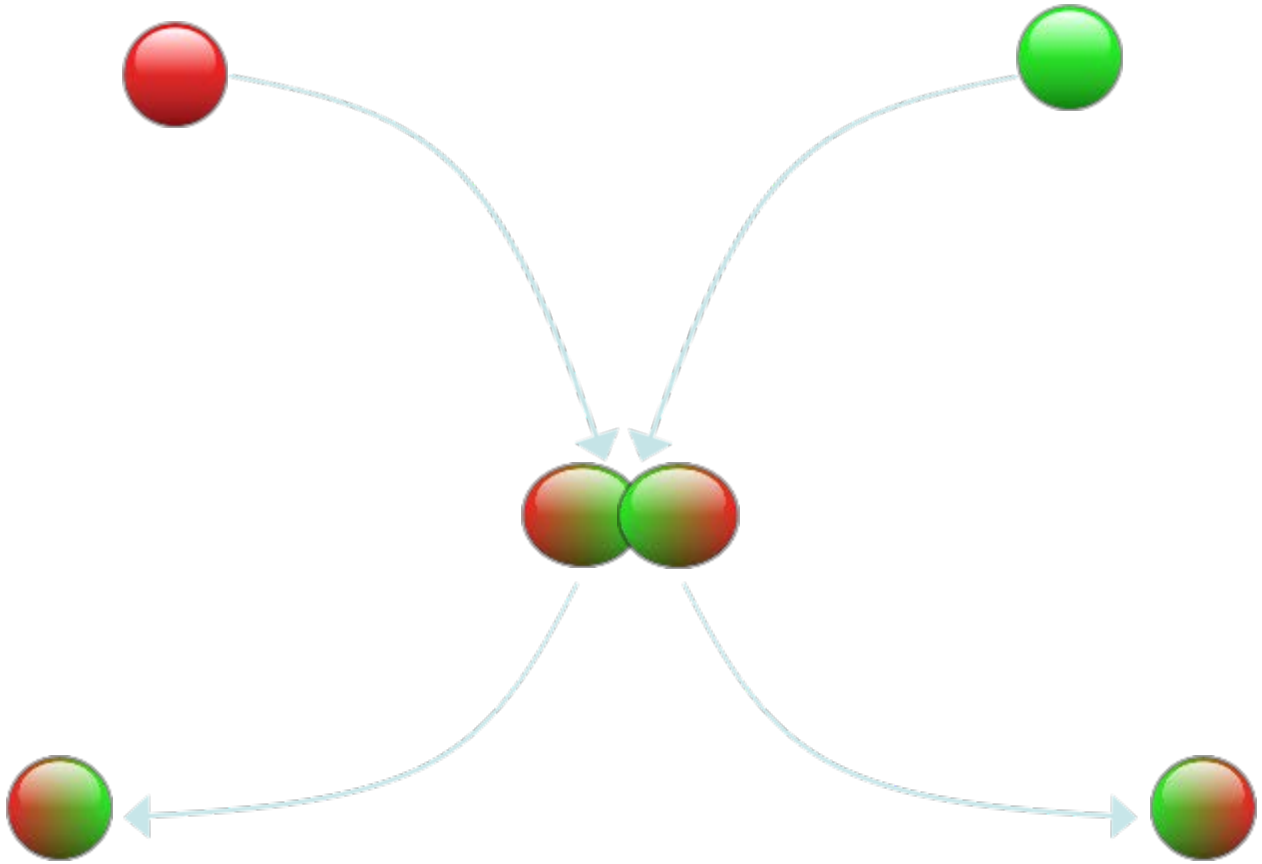






1000 qubits: factorize 232 decimal number
10000 qubits: factorization beyond HPC

Quantum entanglement

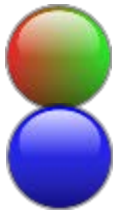


Also at huge distances…

A measurement at
left-hand side,
affects right-hand side

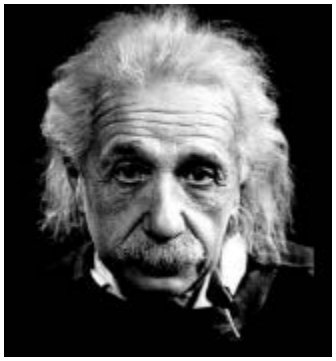
… instantly!

Teleportation



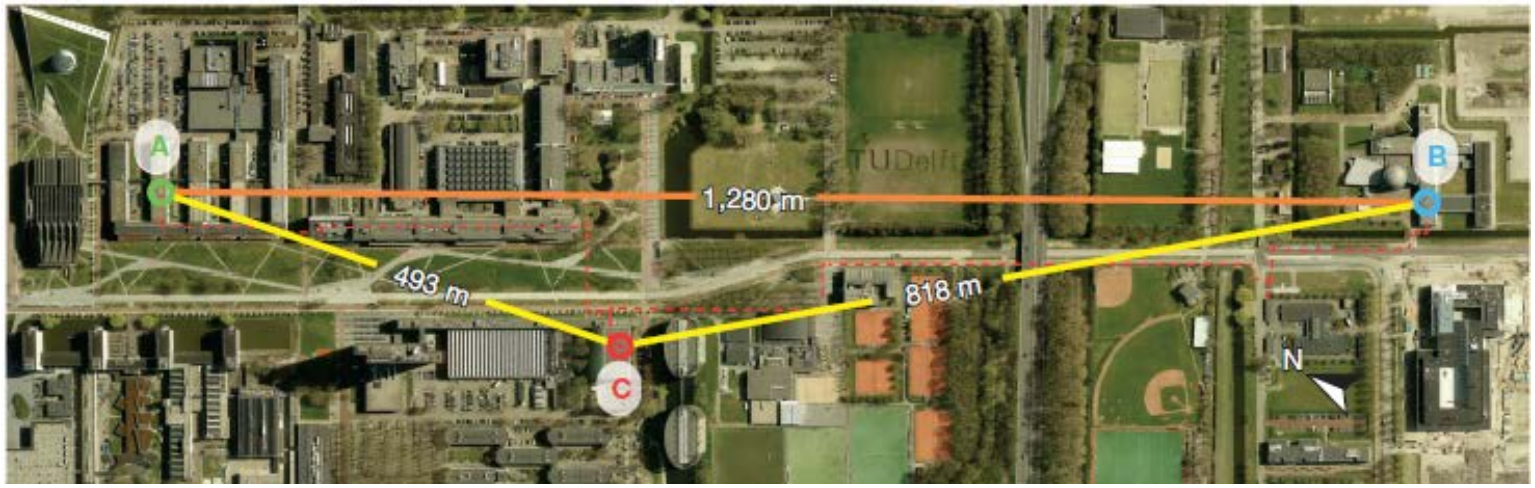
Teleportation

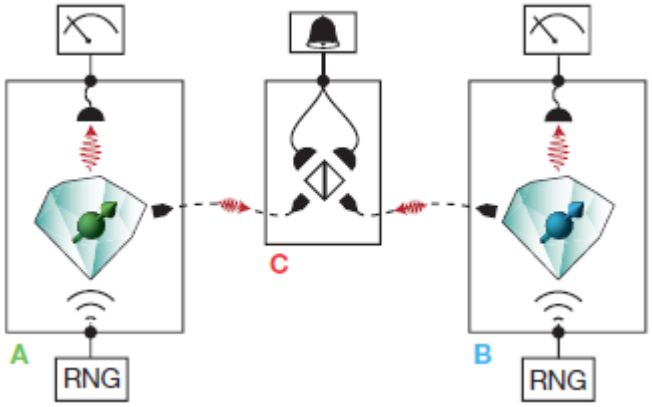
Teleportation



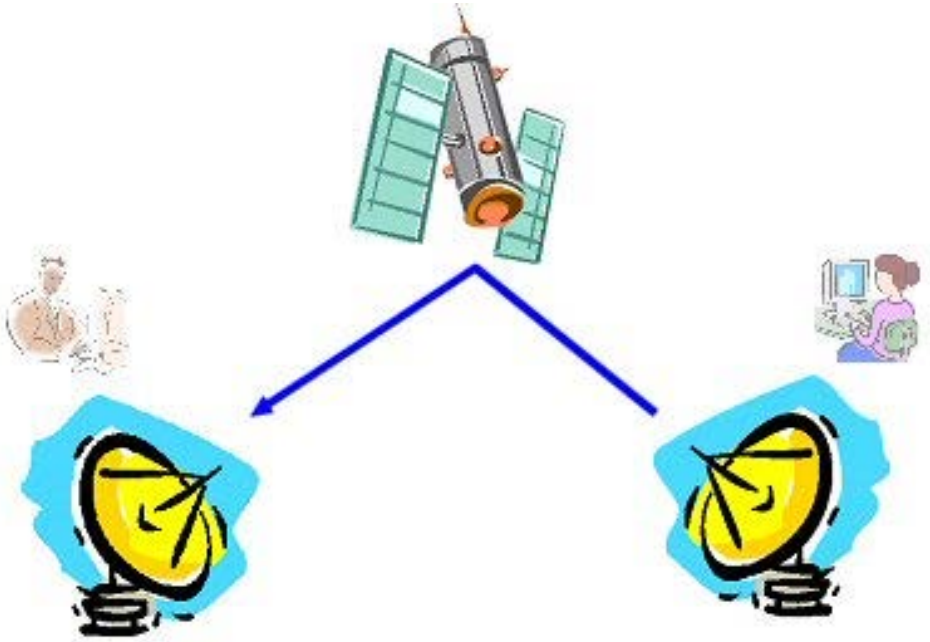
“Spooky action at a distance”

First Loophole-Free Bell Test (QuTech, Delft, 2015)

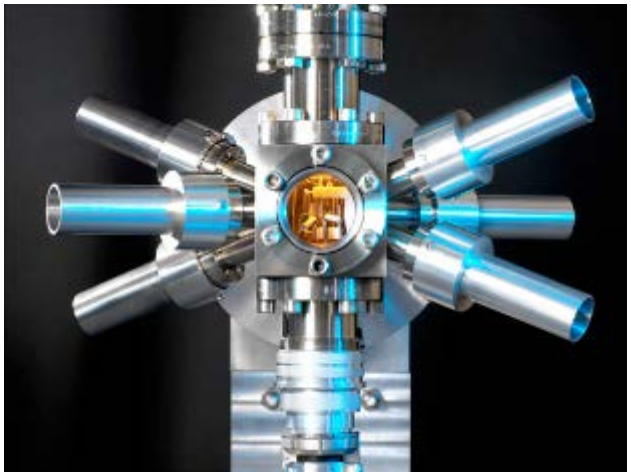




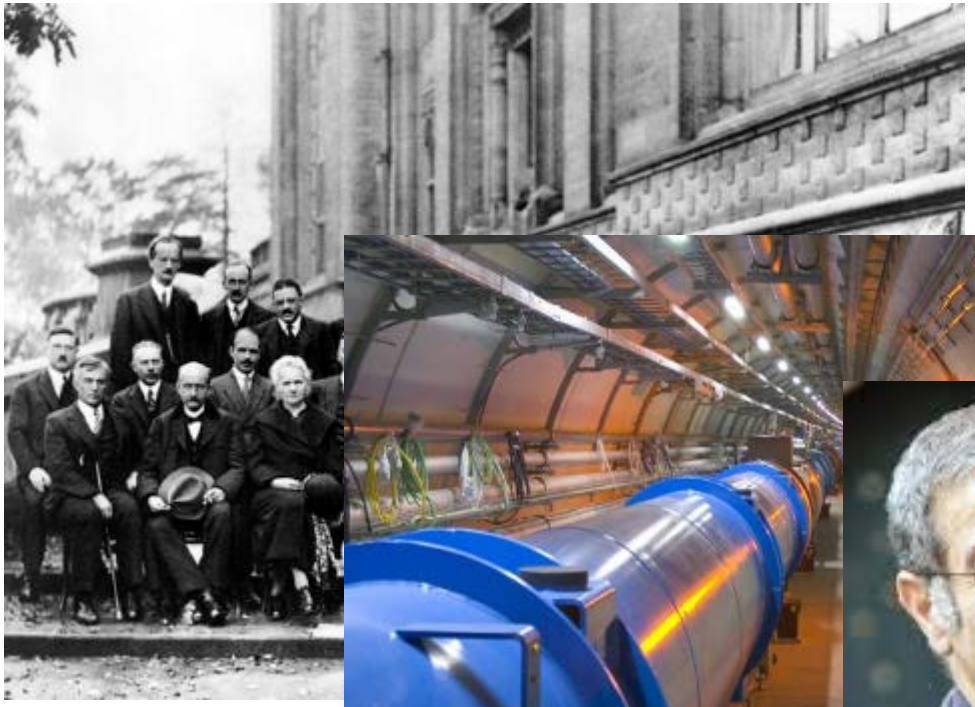
Quantum Internet



Quantum metrology



Position of Europe



Flagship Quantum Technologies

QuTech

Partners:

Microsoft

intel

Leiden University
Univ. Copenhagen

An initiative by: TU Delft Delft University of Technology and TNO

Supported by:
Dept. of Economic Affairs & Innovation, Dept. of OCW
Dutch industry / Topsector HTS&M, ERC

NWO FOM STW

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DELIVERING INNOVATIVE DEFENCE RESEARCH AND TECHNOLOGY

Dr Bryan Wells
Defence Science and Technology, UKMOD

Chair, EDA R&T Steering Board

Amsterdam, 25 April 2016

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Coverage

The technology landscape challenge: getting the best S&T for innovative game-changing advances

UK thinking on Innovation

Role for International S&T Leaders

http://upload.wikimedia.org/wikipedia/commons/a/a0/Social-media-for-public-relations1.jpg

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Why Innovation?

“Dieu n’est pas pour les gros bataillons, mais pour ceux qui tirent les mieux”

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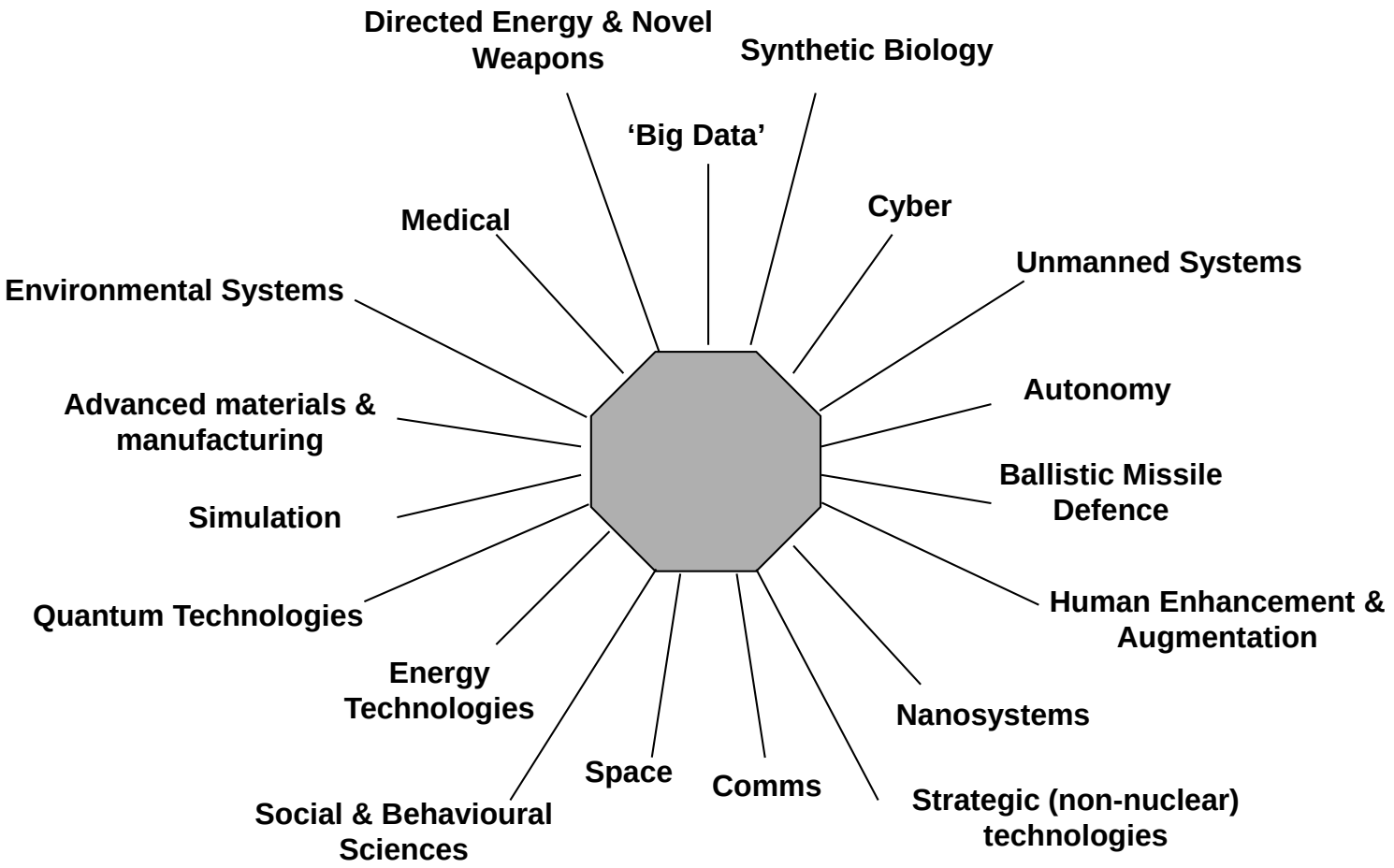
Thinking to the Future



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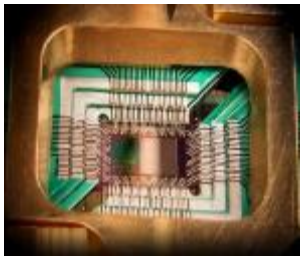
Implications of Technology Trends

- Few Technologies are the preserve of the defence sector
- Rate and direction of change cannot be controlled by defence
- Technology trends are both opportunities and threats
- Combinations of technologies may lead to real innovations
- Innovative use of existing capabilities could be game-changing



http://commons.wikimedia.org/wiki/File:DWave_128chip.jpg

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S&T Themes

Data and Information

- Our dependence on information will grow
- Growing info-structure…Growing inter-connectedness
- More data & smarter analytics…Better control & optimisation
- Increased dependence…Greater vulnerability

www.defenceimagery.mod.uk File: 45155077.jpg

Humans and Autonomy

- The humans' role will remain central; but change
- Human – and – military productivity increases
- Decision-making shifts towards machines
- Span of human control increases

Decentralised Critical Infrastructure and Innovation

- Distributed infrastructure will build the 21st Century
- New trade, geo-political models etc built – mostly bottom-up
- Distributed grids/ networks for info, communications, energy etc replacing 20th C heavy, centralised, capital-intensive, infrastructure

Shocks and Surprises

- Novel, contentious, potentially disruptive developments may surprise and disrupt us.

S&T as a Potential "Leveller"

- Historic advantages that 'Western Nations' once enjoyed by default in defence will reduce..

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UK Strategic Defence and Security Review – 2015
Innovation Announcements

- Horizon Scanning for Innovation: Emerging Technology and Innovation Analysis Cell

- Defence and Security Accelerator for Innovative capabilities

- Workforce initiatives: entrepreneurial skills

- 1.2% of defence budget on S&T

- *Around £800M over 10 years specifically on Innovation*

- *20% of S&T budget currently on Disruptive Capabilities*

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The International Dimension

INNOVATION IS INTERNATIONAL

Co-operation must add value

cutting-edge research
Industrial capacity
Operational advantage

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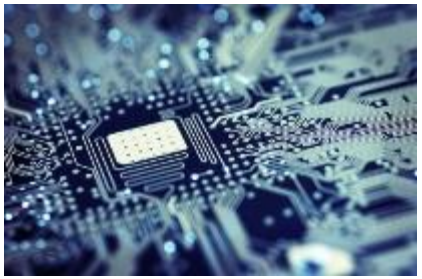
Innovation – The Challenges

- Defence does not have exclusive access to high technology

- There is a rapid spread of know-how

- Defence does not invent the technology future



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Innovation – Our Strengths

- Cutting-edge research
- Cutting-edge capabilities
- Our people

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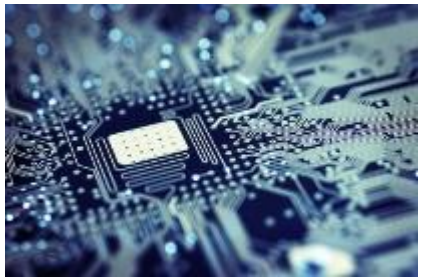
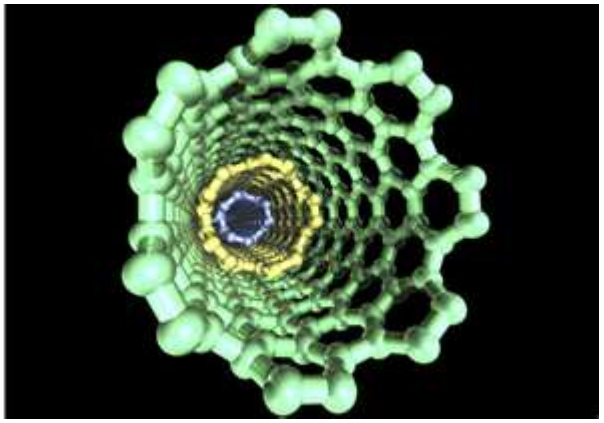
Opportunities and Challenges





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“My dear, here we must run as fast as we can, just to stay in place.“