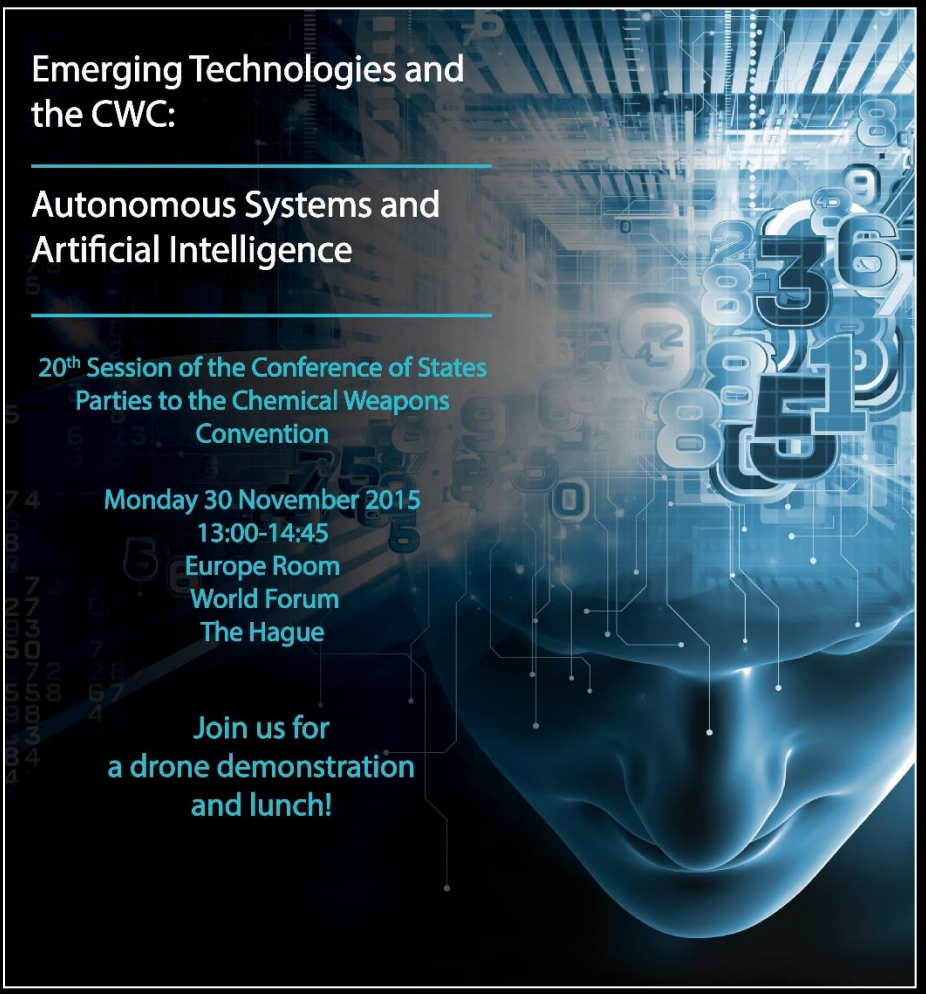
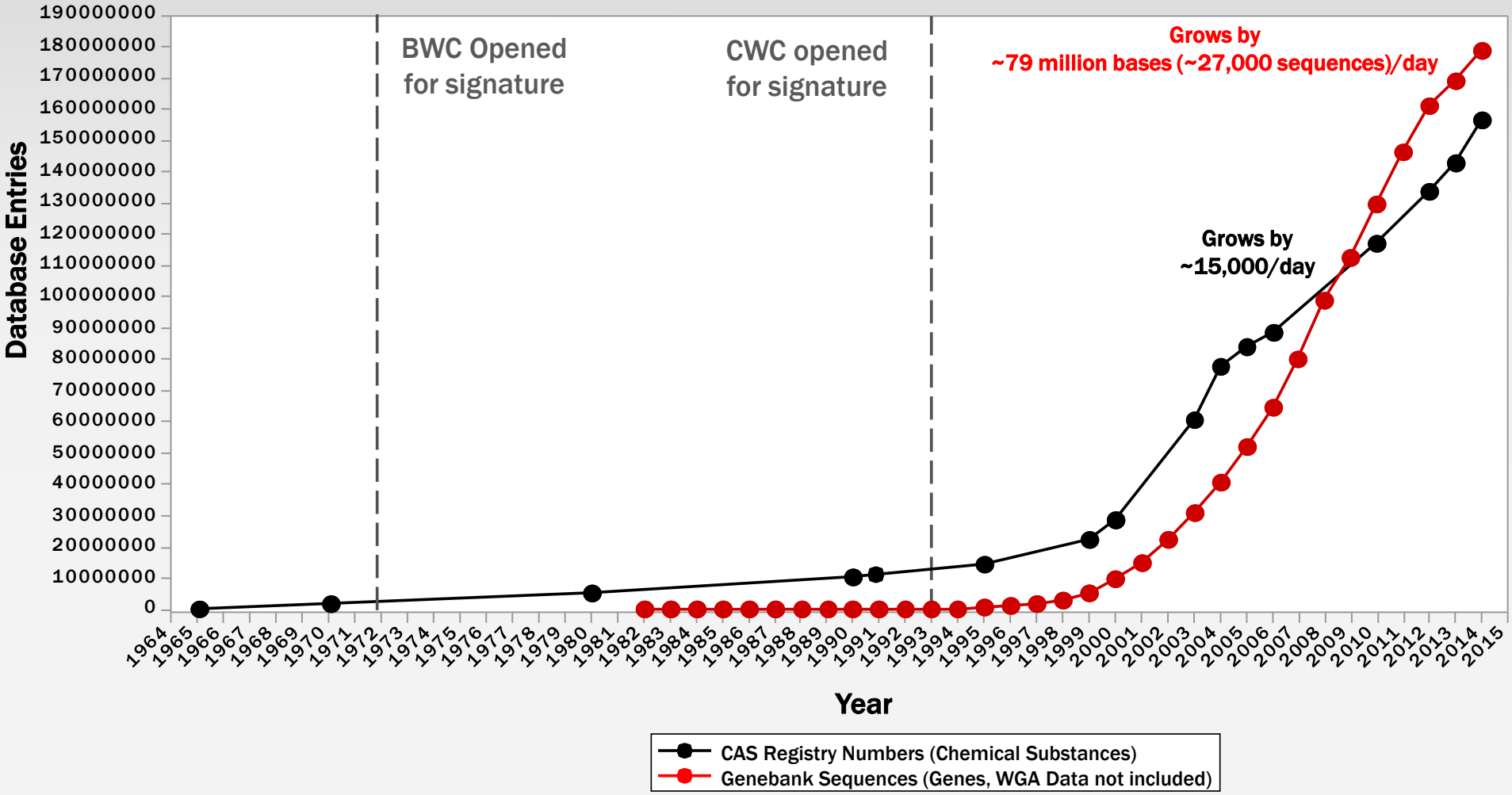


Developments in Science and Technology: Autonomous Systems and Artificial Intelligence in Chemistry

Jonathan E. Forman, Ph.D.
OPCW Science Policy Adviser
Jonathan.forman@opcw.org

Science and Technology at OPCW
www.opcw.org/special-sections/science-technology/

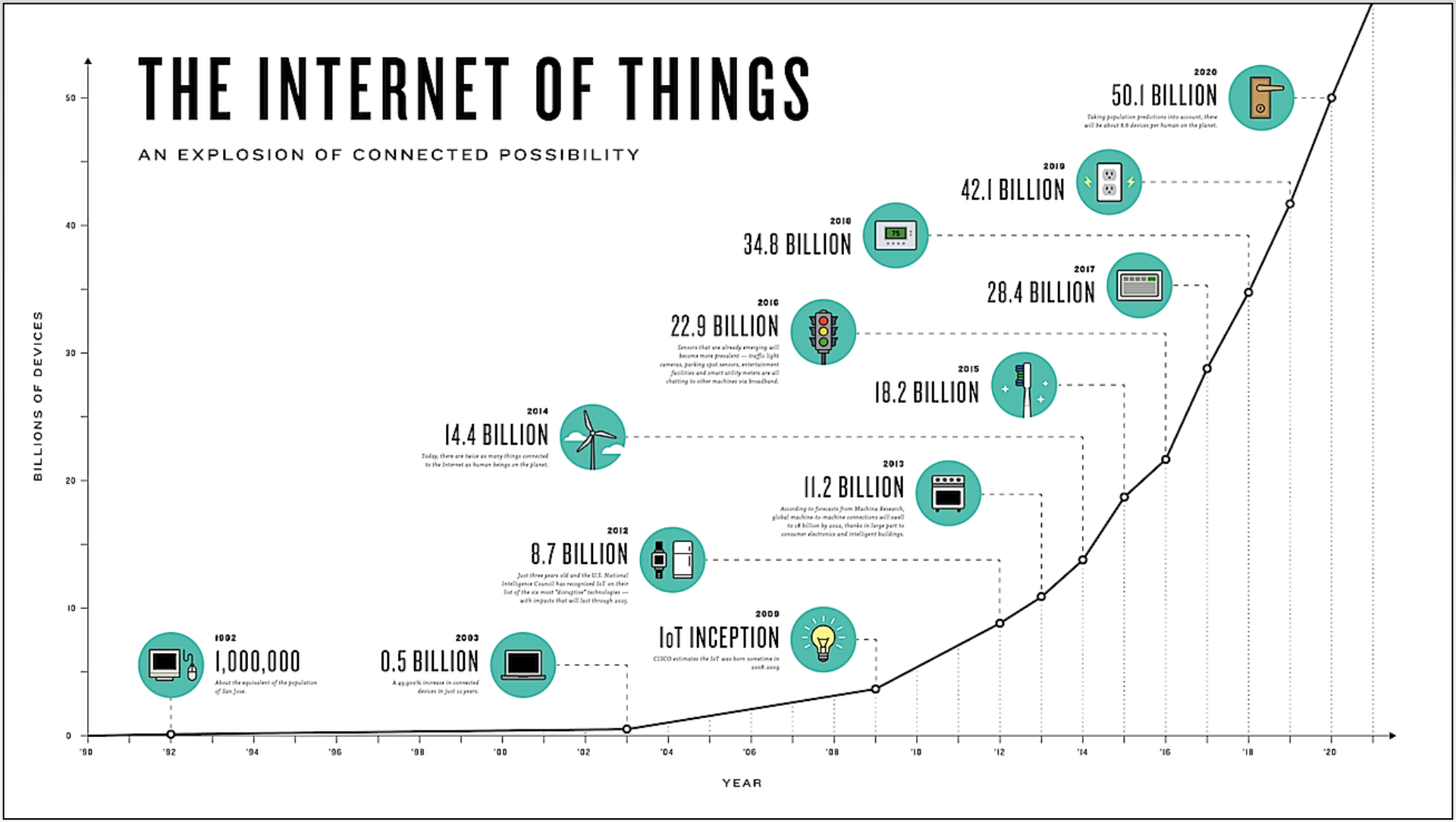
Scientific Developments



Technology is Built Upon Scientific Convergence

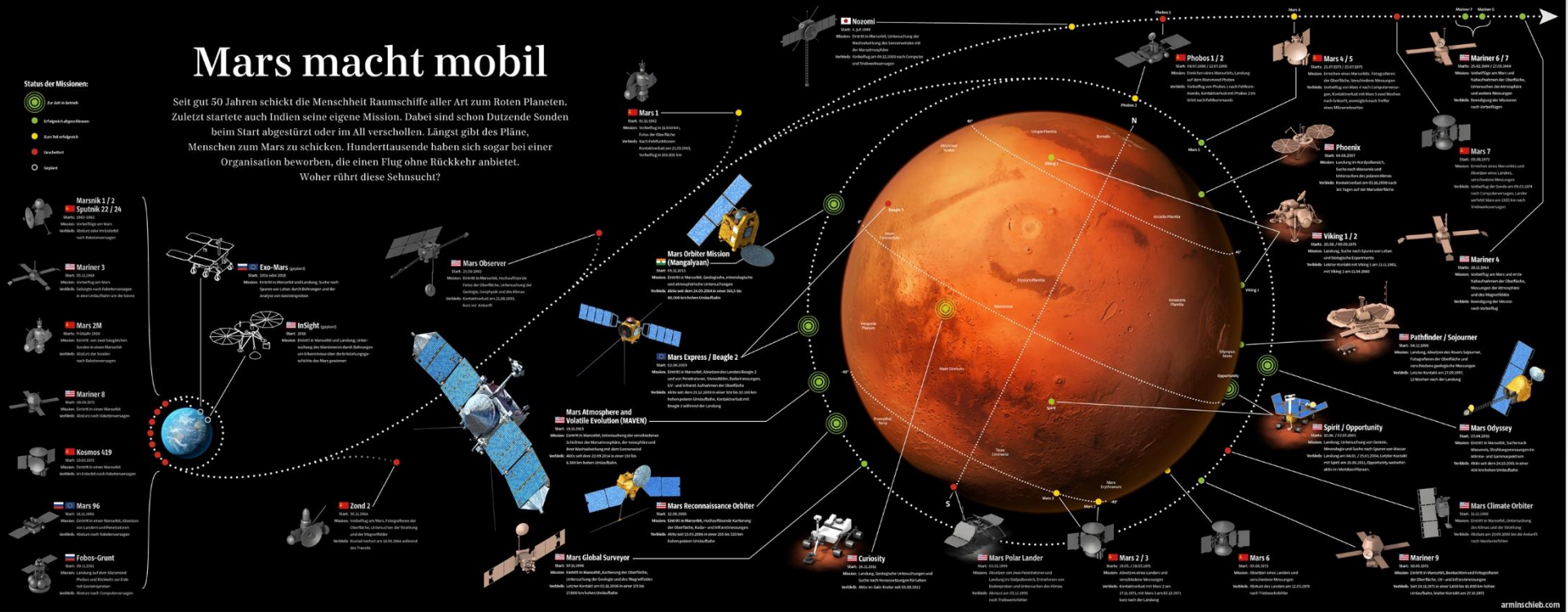
- Chemistry – Biology – Physics – Engineering – and more!

A World of Connected Devices



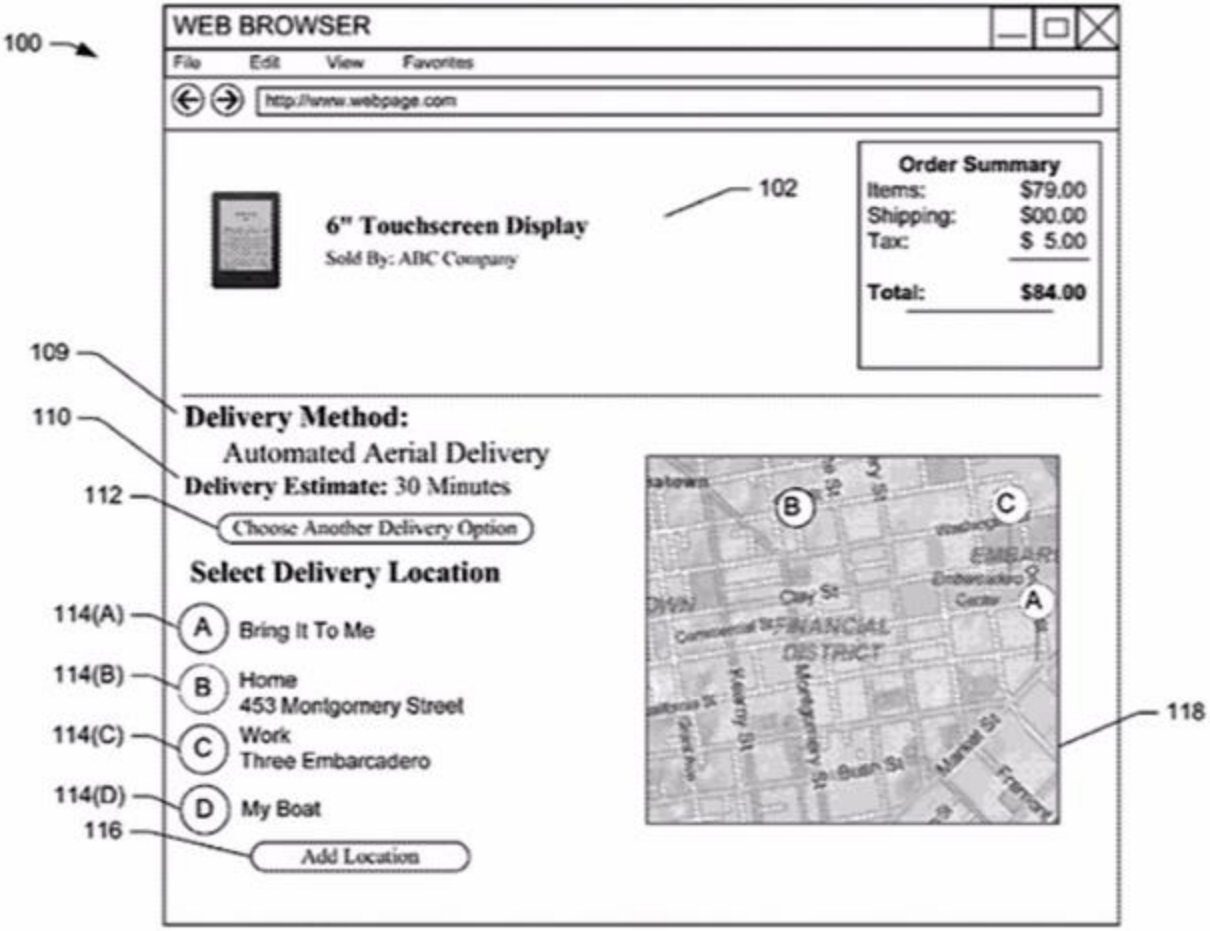
Autonomous Systems

Autonomous Systems



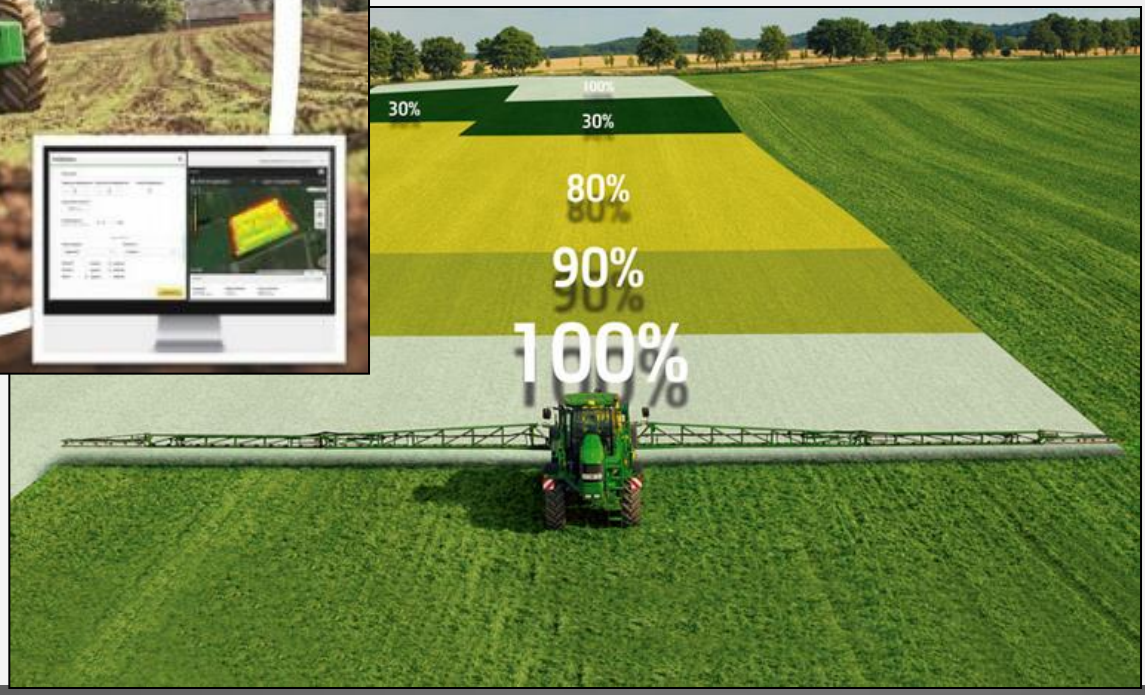
Autonomous Systems

Autonomous Systems

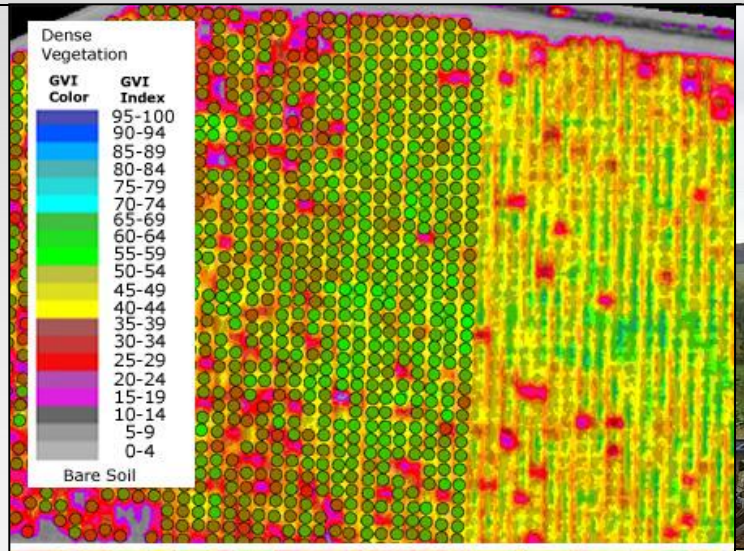


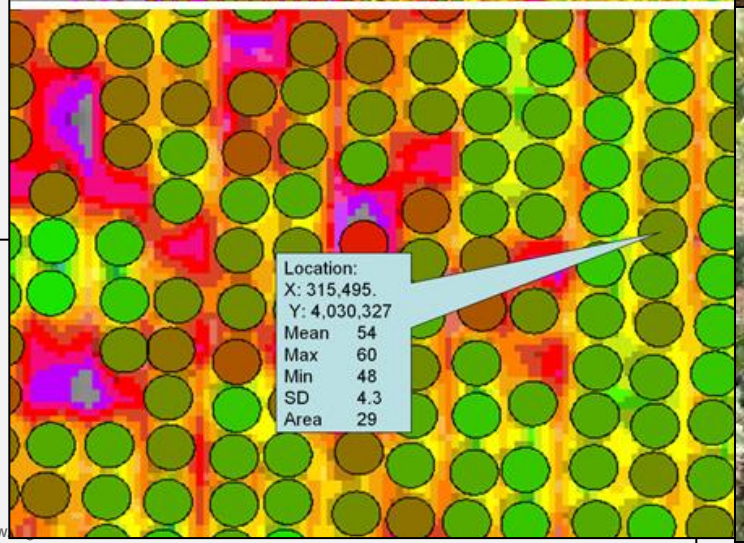
US Patent: 20150120094A1, 30 April 2015

Enabling Technologies for Chemistry Applications

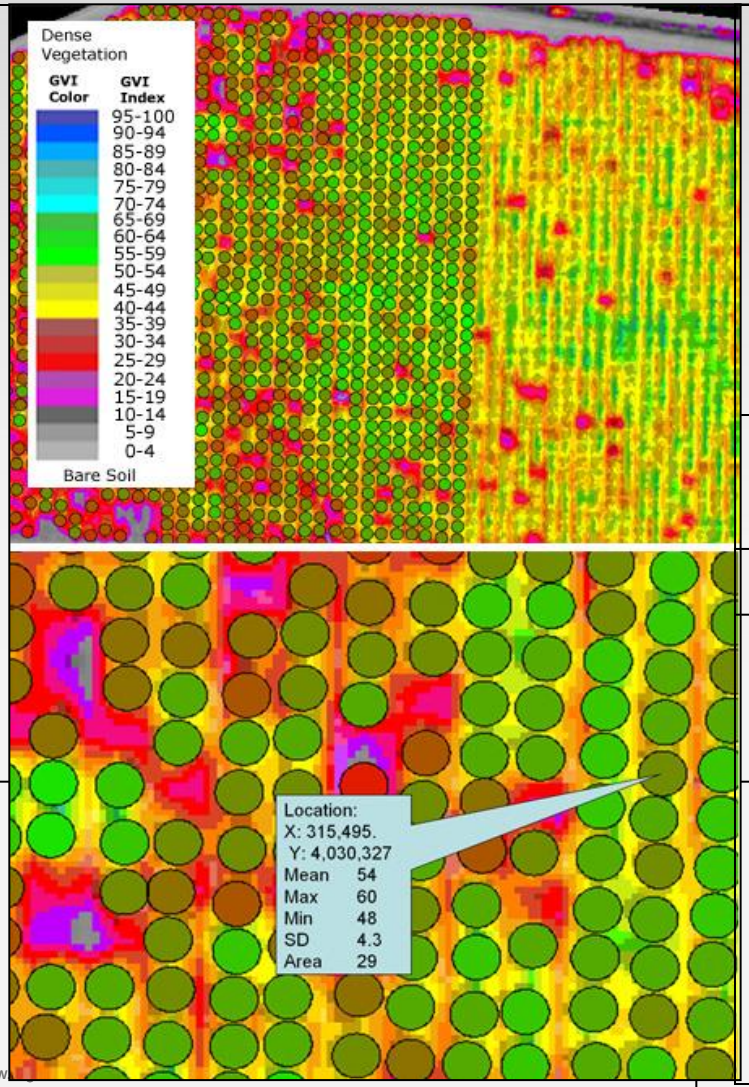


Enabling Technologies for Chemistry Applications

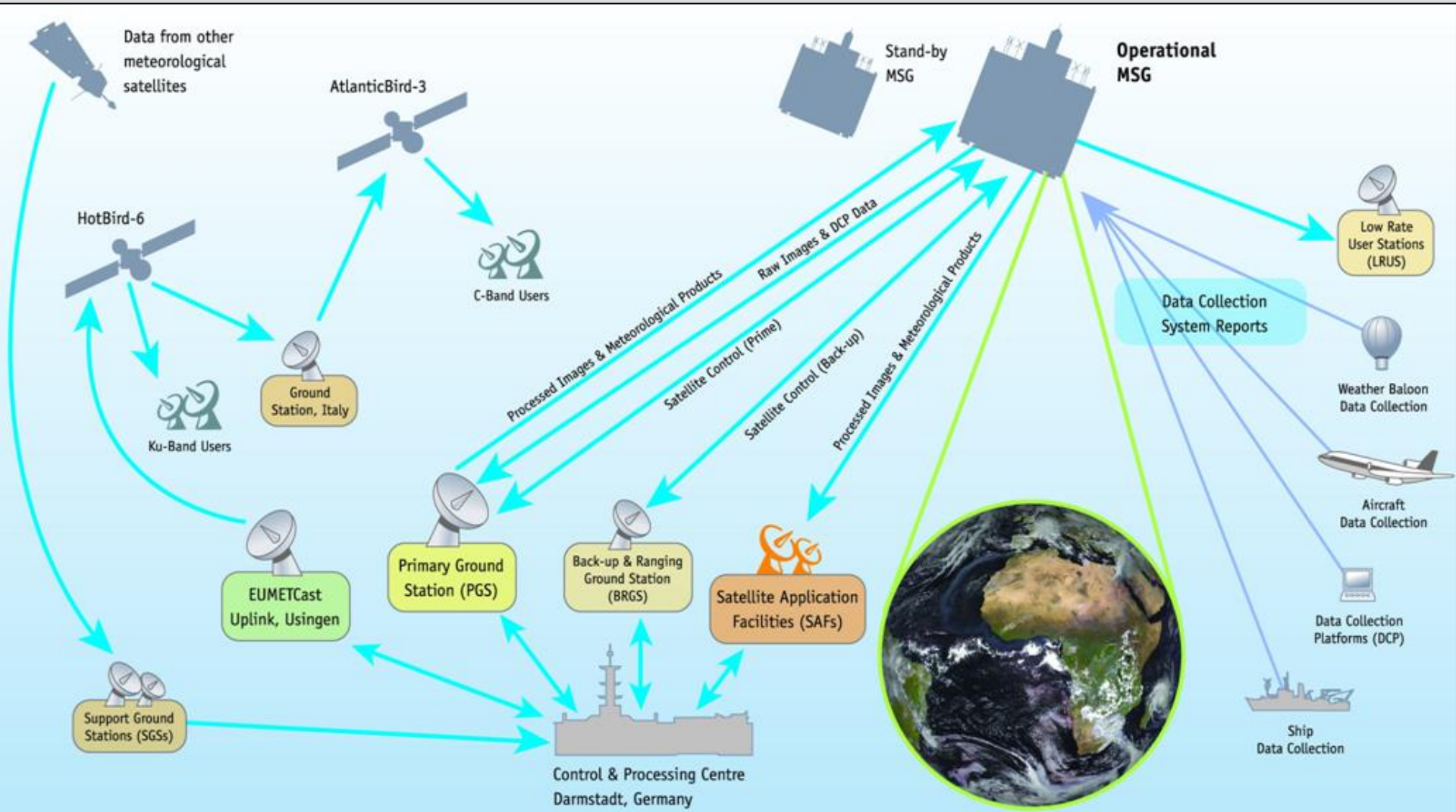




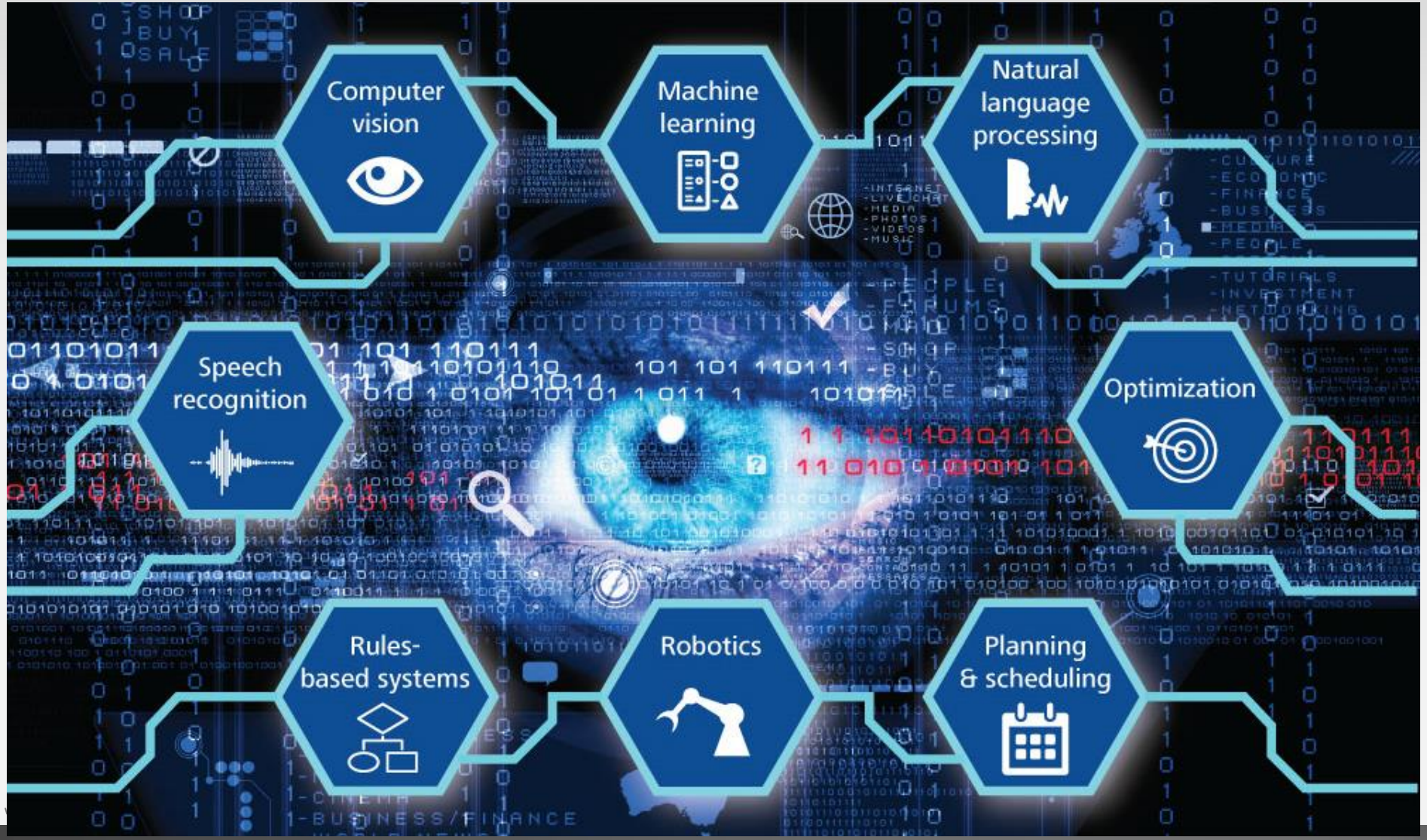
Enabling Technologies for Chemistry Applications



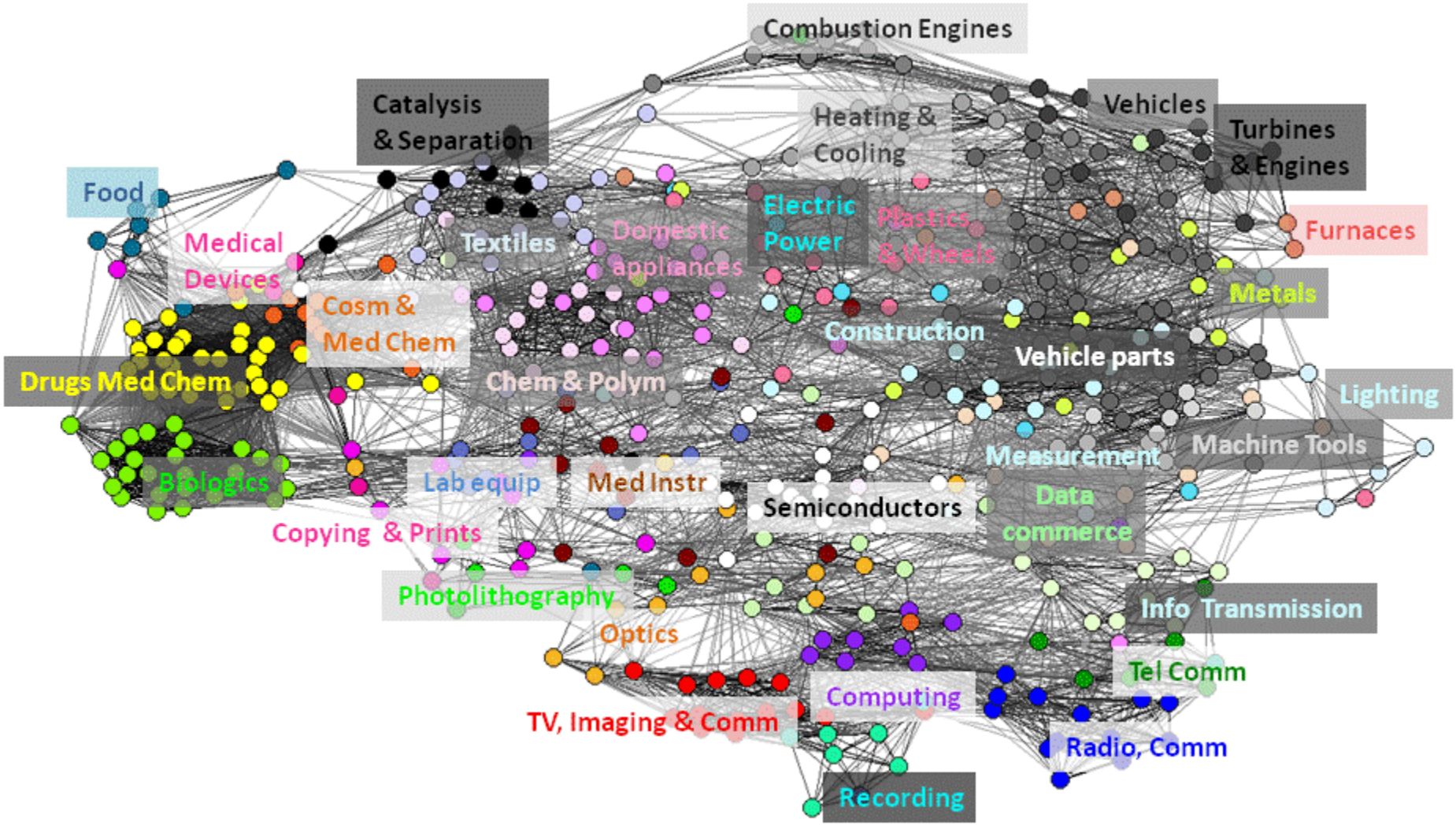
Global Data Collection and Sharing



Artificial Intelligence



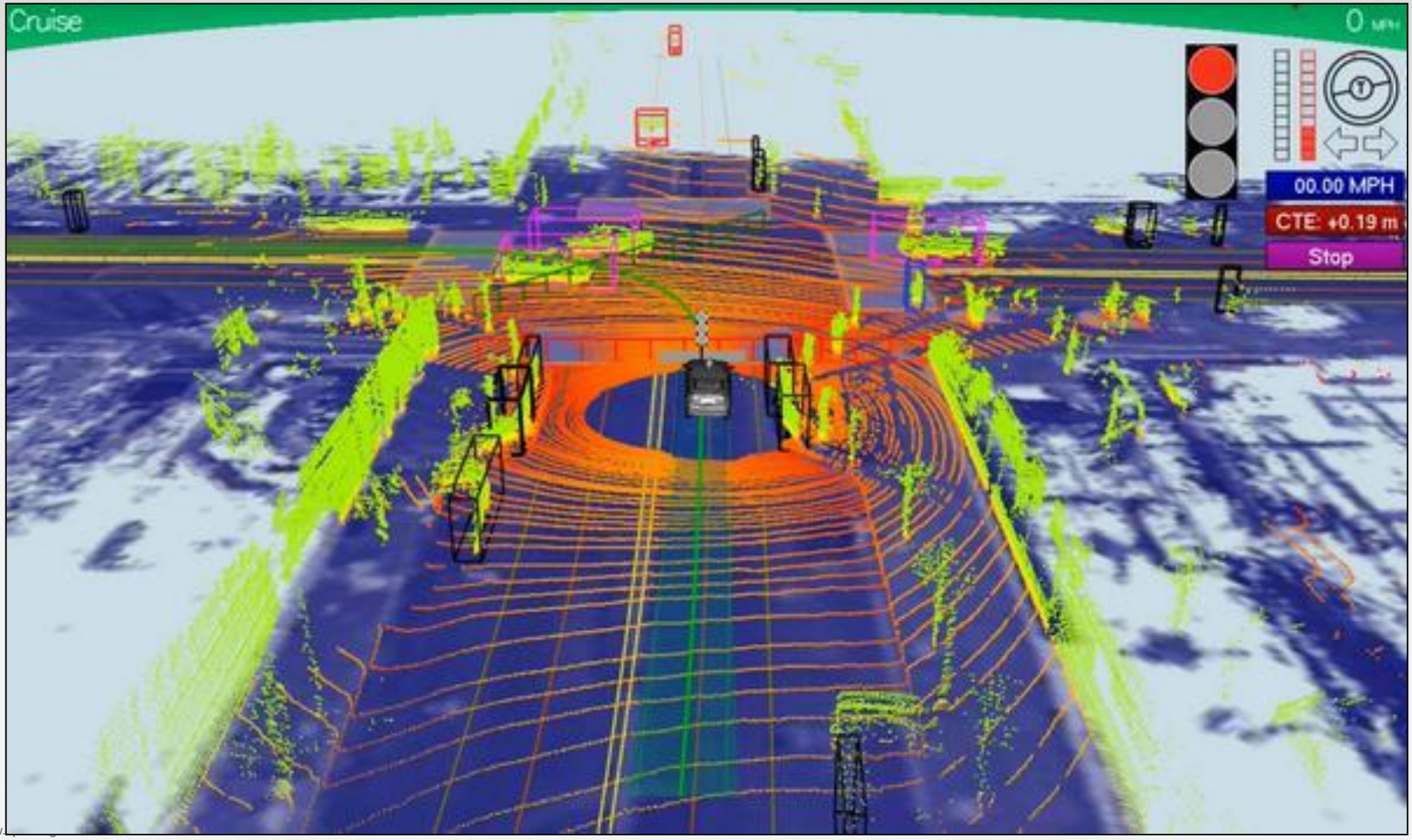
Synthesis of Information



http://www.news.ucsb.edu/2014/013890/new-tool-exploits-unique-structure-links-between-patents

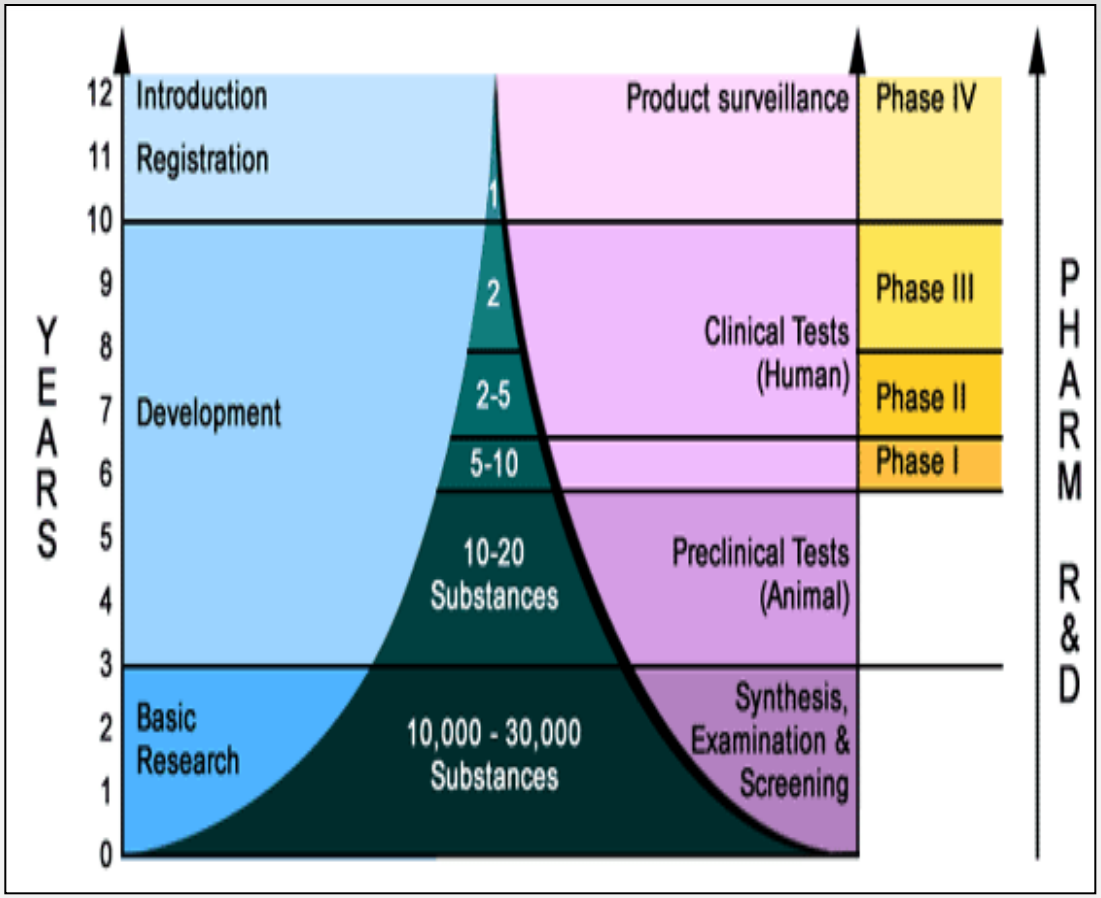
Synthesis of Information

Autonomous Decision Making: The Self-Driving Car



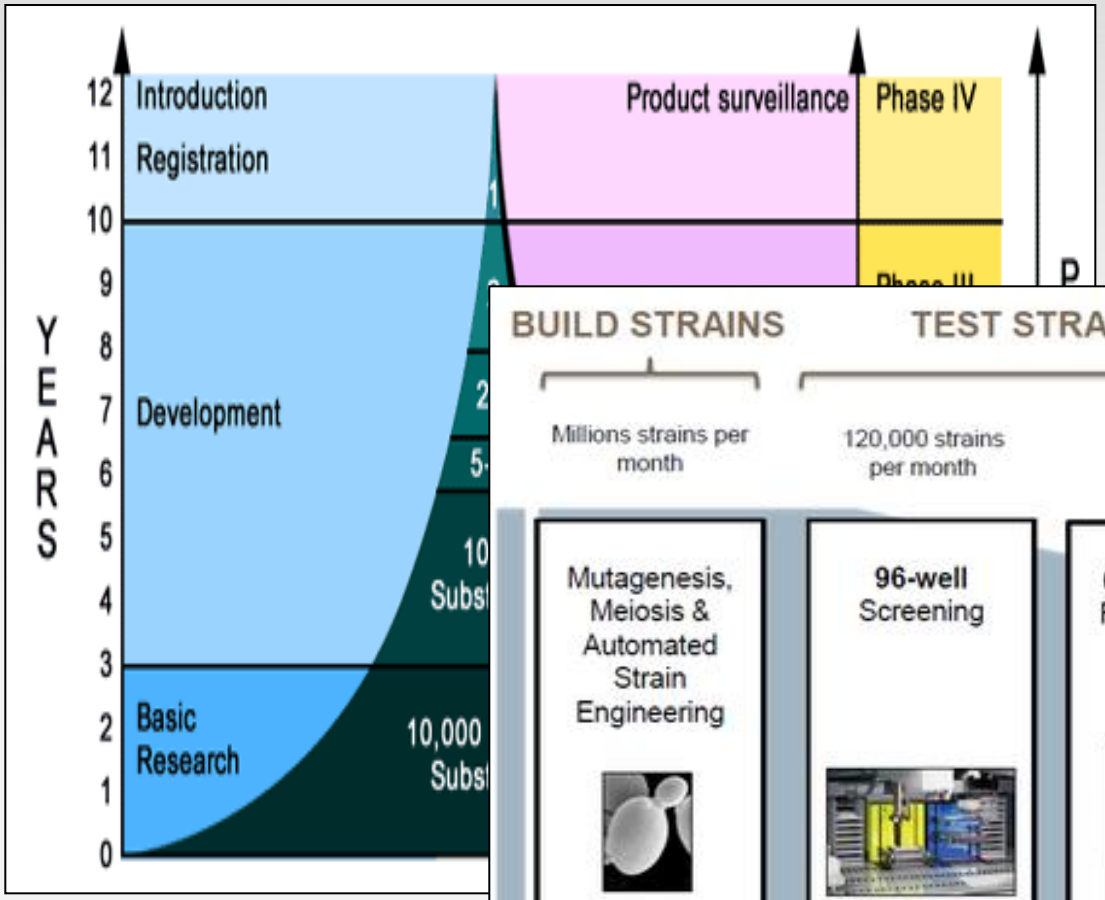
Some Chemistry Relevant Applications:

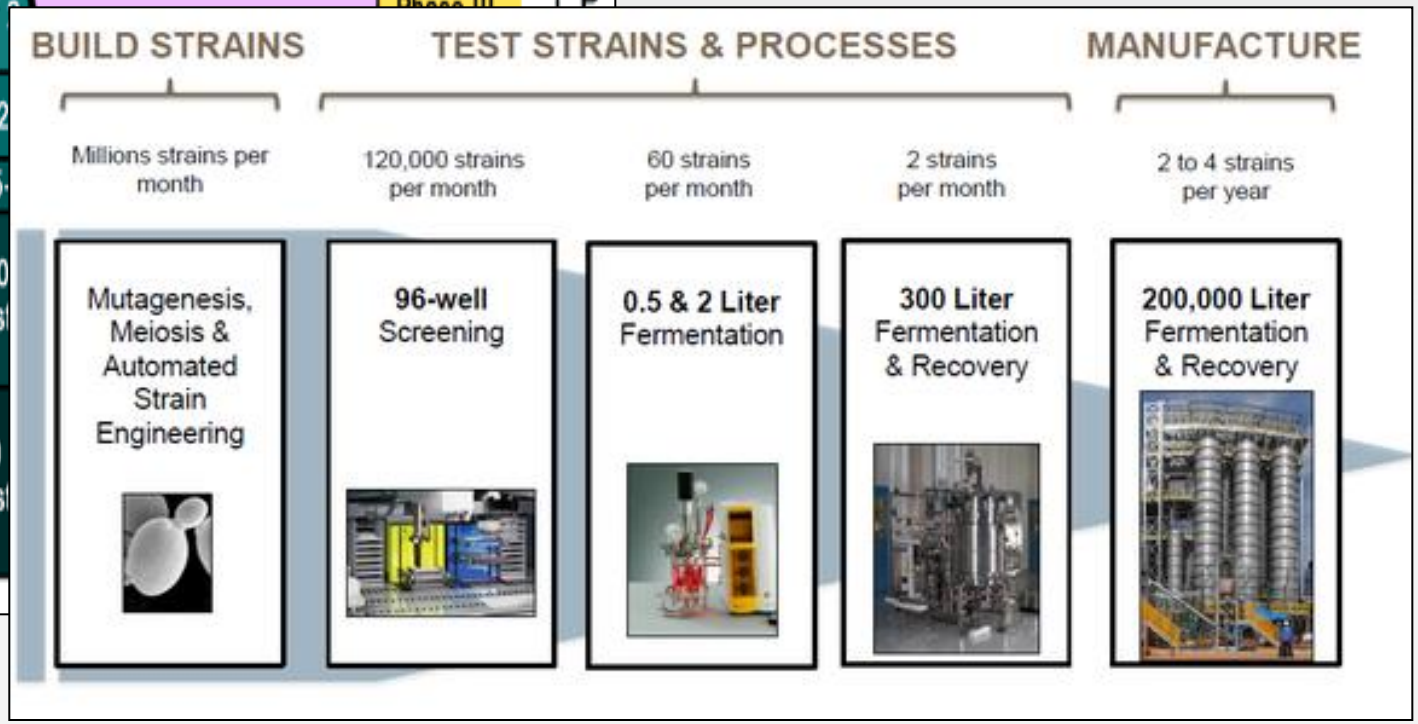
Clinical trials



Some Chemistry Relevant Applications:

Clinical trials, Metabolic Engineering

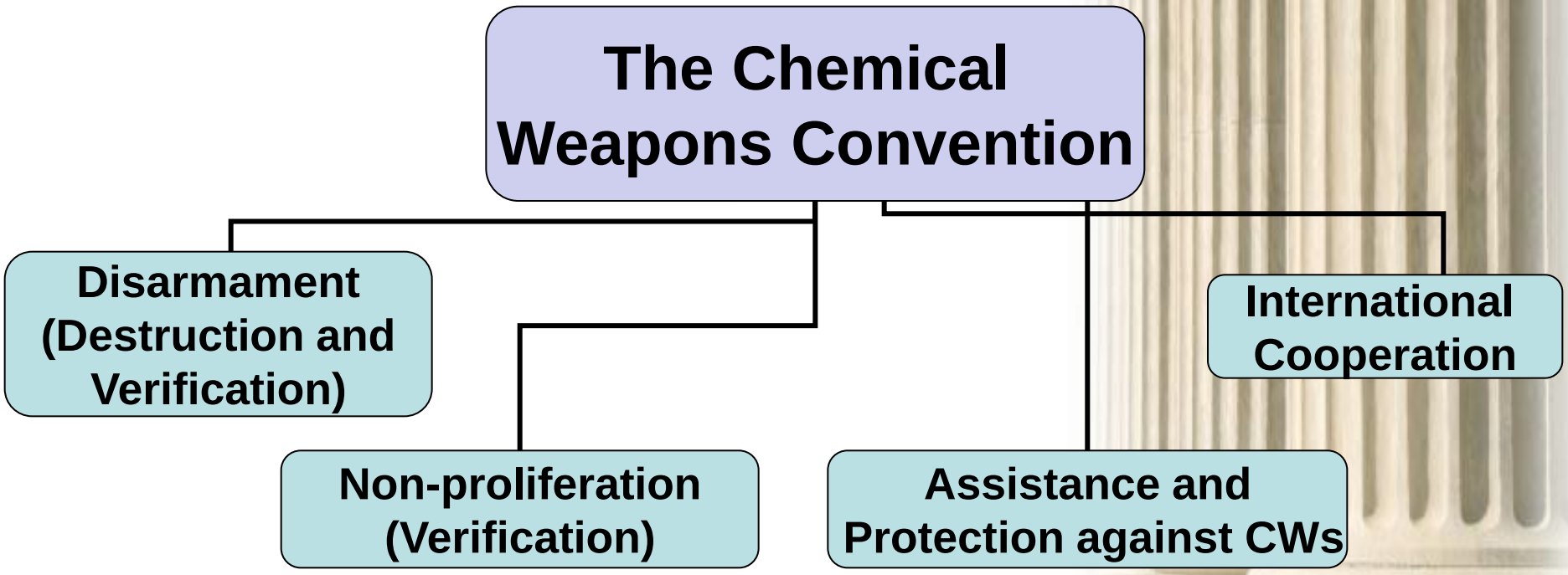




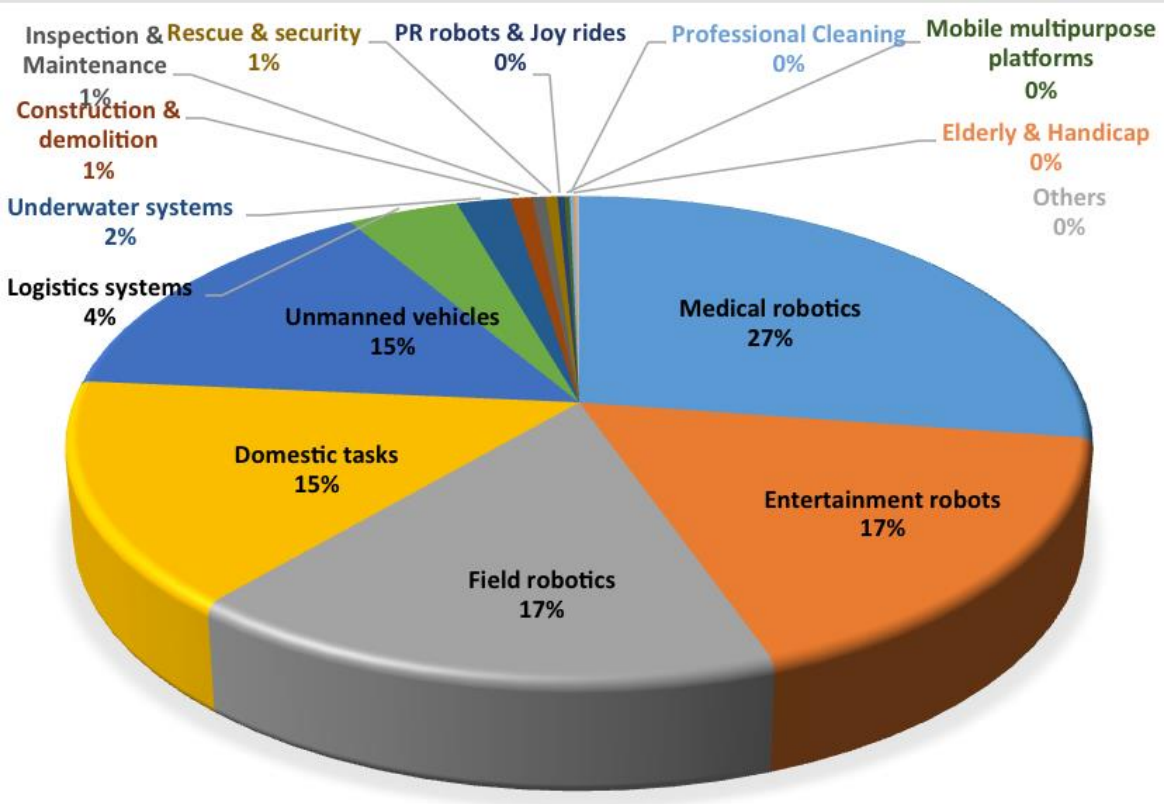
Some Chemistry Relevant Applications:

Clinical trials, Metabolic Engineering, Medical Diagnosis and Treatment

Opportunities for the CWC

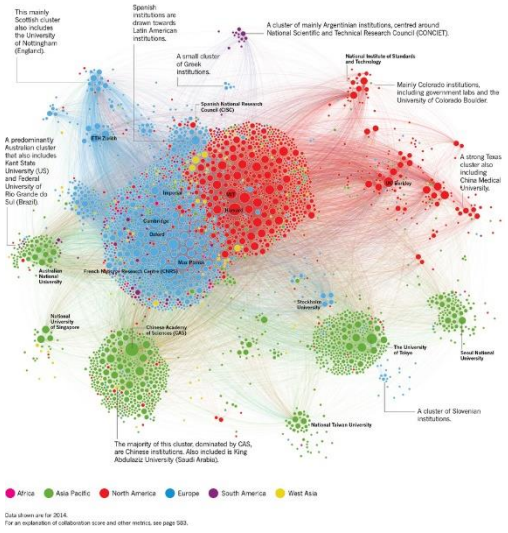


Opportunities for the CWC

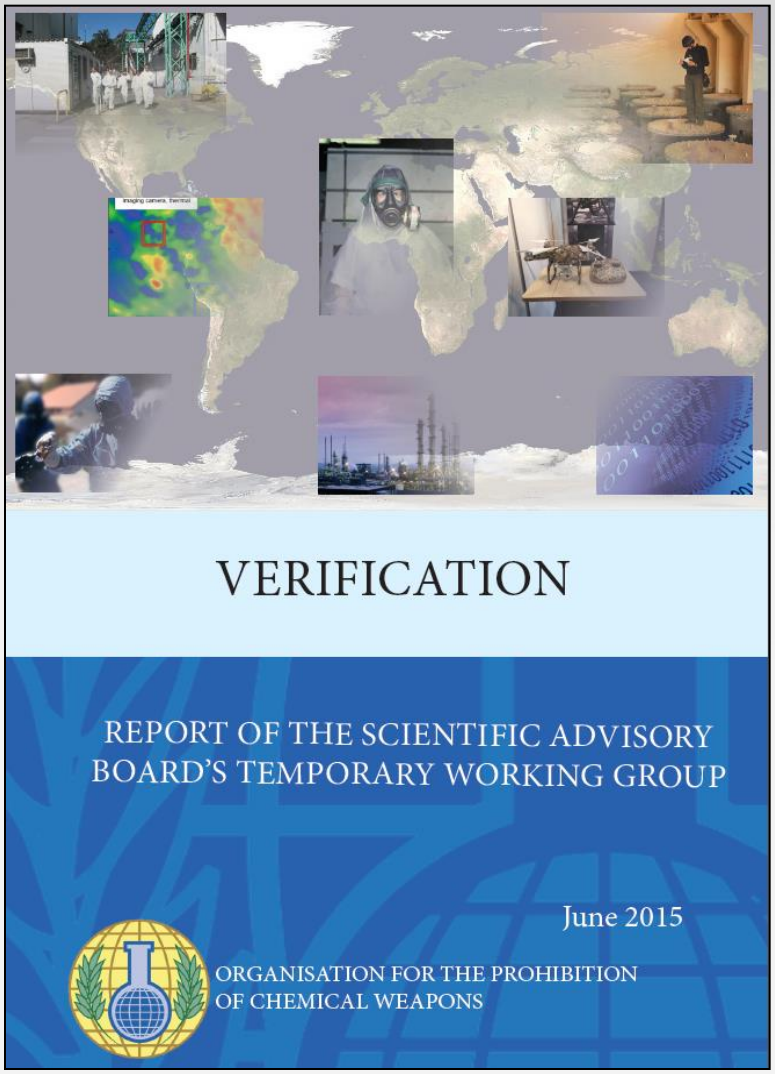


Field Robotics Market in 2013 = $817M (Innorobo.com)

"Data Collection" Collaborations



Report of the Scientific Advisory Board's Temporary Working Group on Verification



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ORGANISATION FOR THE PROHIBITION OF CHEMICAL WEAPONS

Working together for a world free of chemical weapons

Report of the Scientific Advisory Board's Temporary Working Group on Verification

Recommendation 1

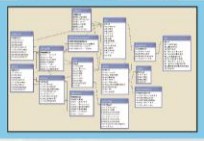
The Secretariat should consider adopting a comprehensive, more analytical approach to verification utilising all available and verifiable information.

Recommendation 2

The Secretariat should acquire the capability to use open-source information on a routine basis.

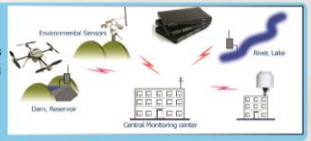
Recommendation 3

The Secretariat should put in place an information management structure that can provide the support required for the verification process.



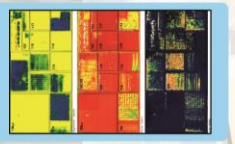
Recommendation 4

Remote/automated monitoring technologies should be added to the list of approved inspecti on equipment.



Recommendation 5

The Secretariat should look into the option of using satellite imagery for the planning of non-routine missions, in particular for IAU and CI.



Recommendation 6

The Secretariat should visit the National Authorities to obtain assurance on the accuracy and completeness of declarations. The outcome of such visits may impact on the inspection frequency.

Recommendation 7

The Secretariat must commission an independent review of all activities pertaining to the missions carried out in the Syrian Arab Republic.

Recommendation 8

The list of declarable OCPFs submitted by States Parties should include all facilities which fall under the definition/requirement of paragraph 1 of Part IX of the Verification Annex, regardless of the purity level of a DOC or DOC mixtures produced.

Recommendation 9

Not all facilities that fall under Part IX of the Verification Annex should be considered of the same relevance to the object and purpose of the Convention. The TWG recommends a practical approach for enhancing the utilisation of verification resources for OCPF declaration and on-site inspection processes.

Recommendation 10

The verification thresholds for OCPFs producing highly relevant chemicals, and the possibility of revision of the product group codes, should be addressed by the SAB as well as the industry cluster.

Recommendation 11

The OPCW should increase the staff of the OPCW Laboratory to cope with various aspects of IAU, biomedical samples, trace environmental analysis, toxins, and on-site analysis. Establishing a network of DLs for biomedical sample analysis should be a high priority.

Recommendation 12

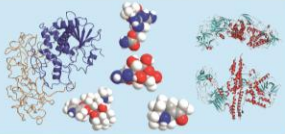
Lessons on chemical sampling and analysis from the OPCW's support to the 2013 United Nations Mission to Investigate the Use of Chemical Weapons in the Syrian Arab Republic, and all subsequent OPCW activities in relation to the Syrian Arab Republic must be identified and implemented.

Recommendation 13

PTs should incorporate a broader range of chemicals, and at a wider range of concentrations, to prepare laboratories for IAU-type scenarios.

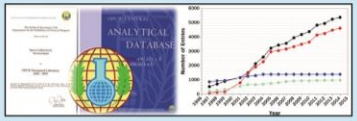
Recommendation 14

The Secretariat should expedite toxin identification exercises.



Recommendation 15

Continuous additions to the OPCW Central Analytical Database (OCAD) are recommended to allow the OPCW to meet all its mandated inspection aims, including IAU.

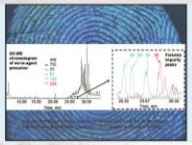


Recommendation 16

Developments in analytical instrument portability, miniaturisation and disposable biosensors should be periodically reviewed by the Secretariat and the SAB for potential applicability to on-site analysis.

Recommendation 17

The Secretariat should monitor developments in attribution analysis/chemical forensics.



Recommendation 18

The Secretariat should augment its capability to monitor and forecast developments in science and technology of relevance to the Convention and its verification regime.

https://www.opcw.org/special-sections/science-technology/science-technology-monitor/

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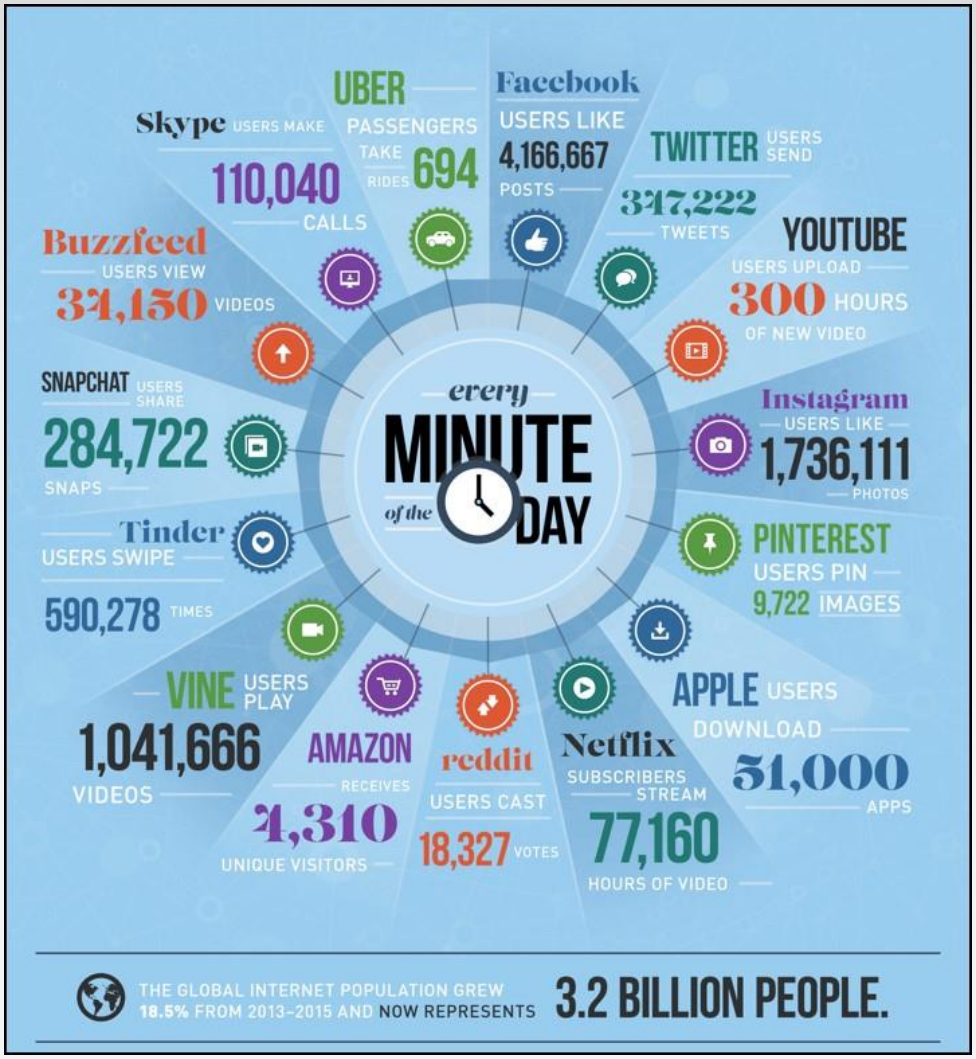
Report available at: https://www.opcw.org/fileadmin/OPCW/SAB/en/Final_Report_of_SAB_TWG_on_Verification_-_as_presented_to_SAB.pdf

Challenges of Data Collection



Challenges of Data Collection

THE CATCH WITH GADGETS

Data concerns could thwart the vast expansion of wearable electronics. The number of devices is rising quickly, putting strain on the already clogged mobile network. There are also worries about security and privacy.

GLOBAL MOBILE DATA TRAFFIC

2010 90

2014 2,500

Petabytes (10^{15} bytes) per month

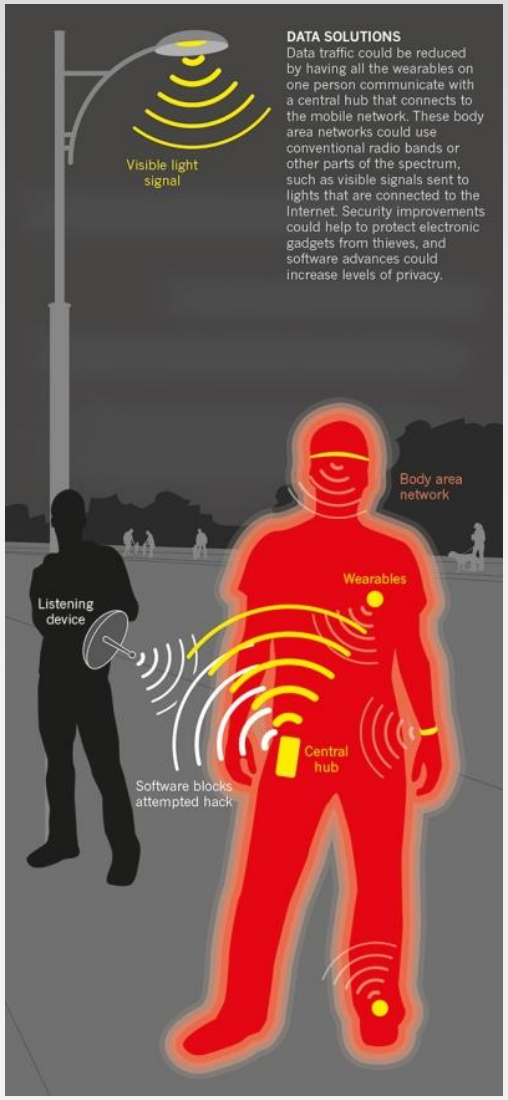
NUMBER OF WEARABLES

2015
100 million

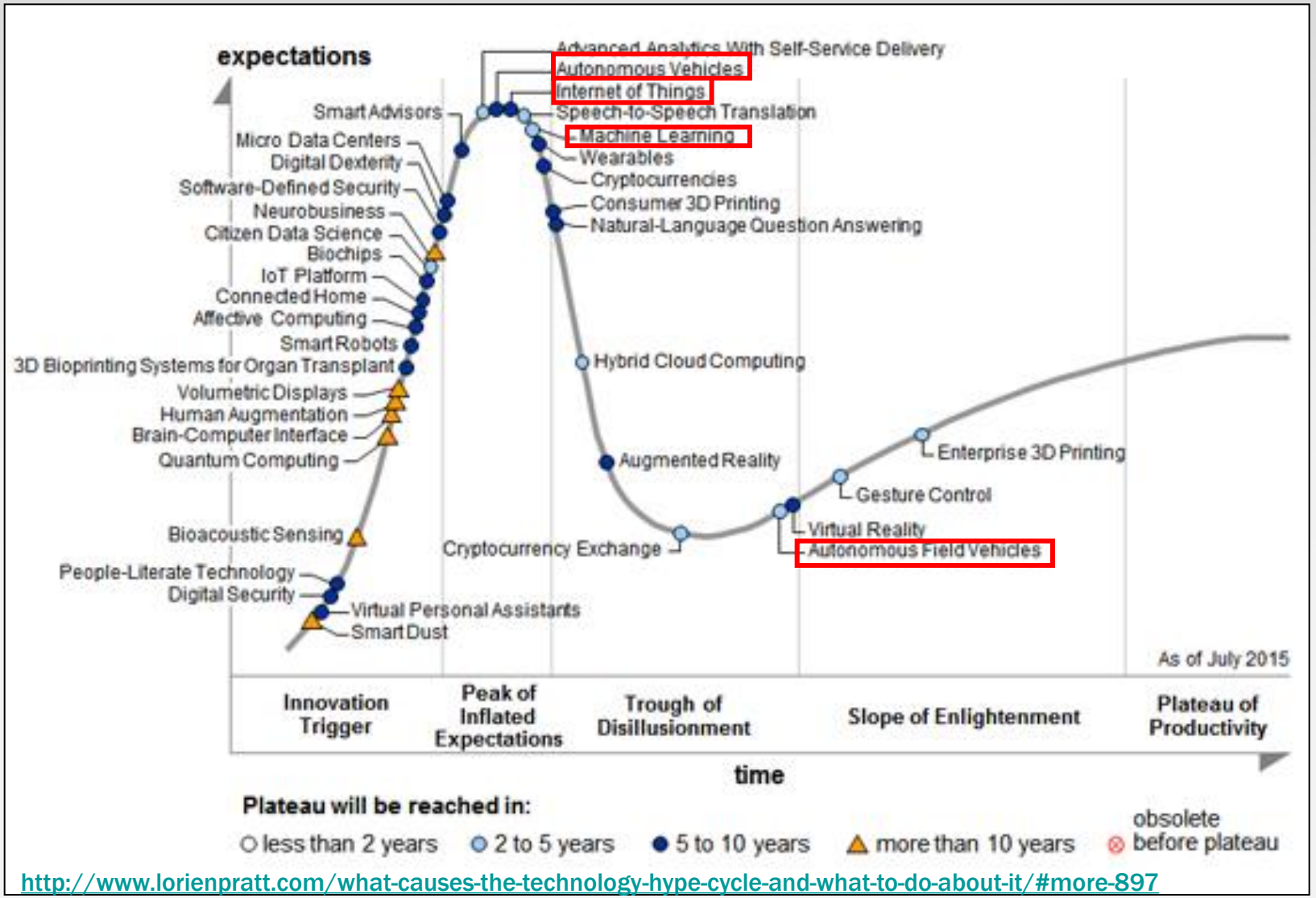
2019
500 million

+400%

Nature 525, 22–24 (2015); doi:10.1038/525022a

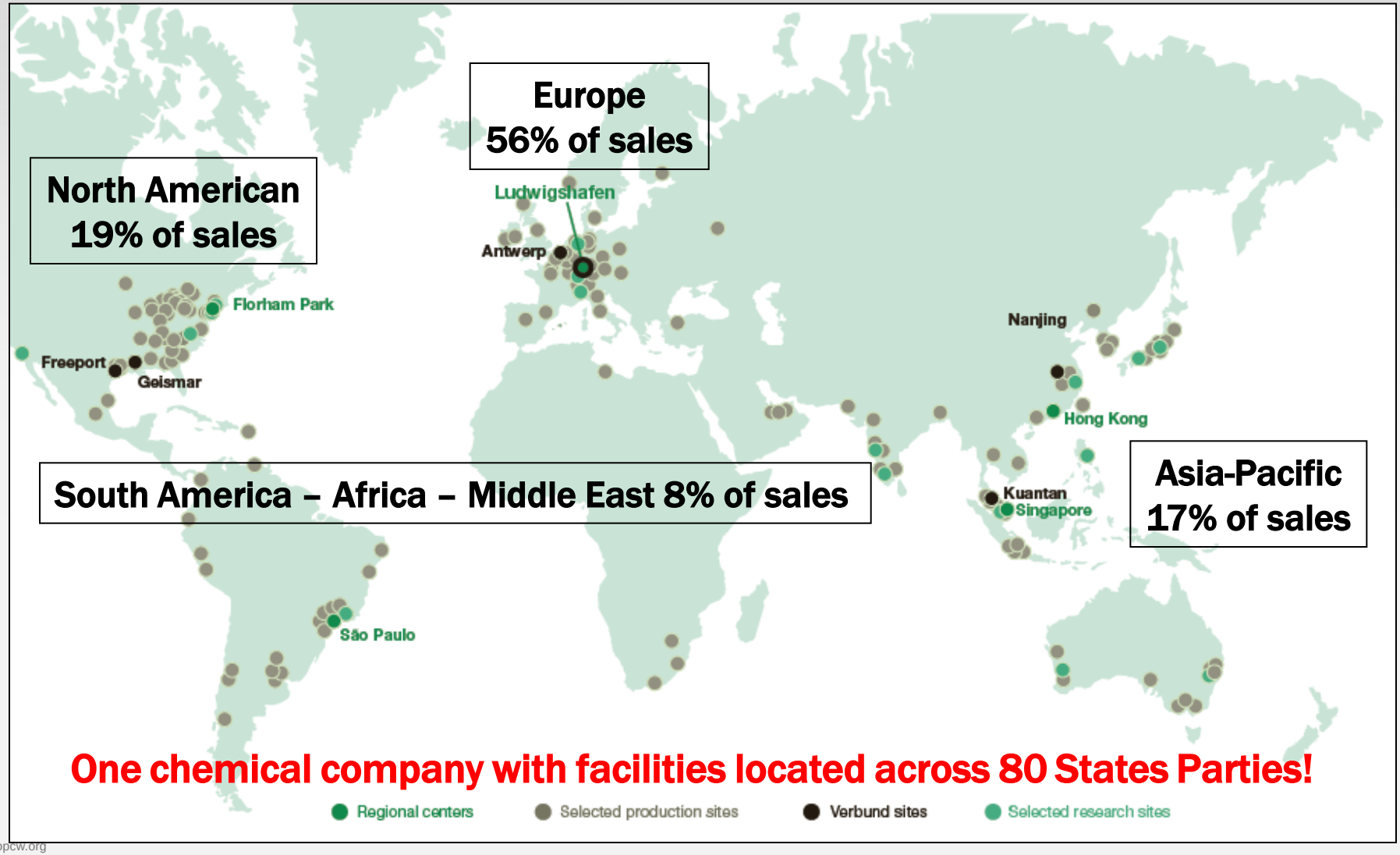


The Future or Now?

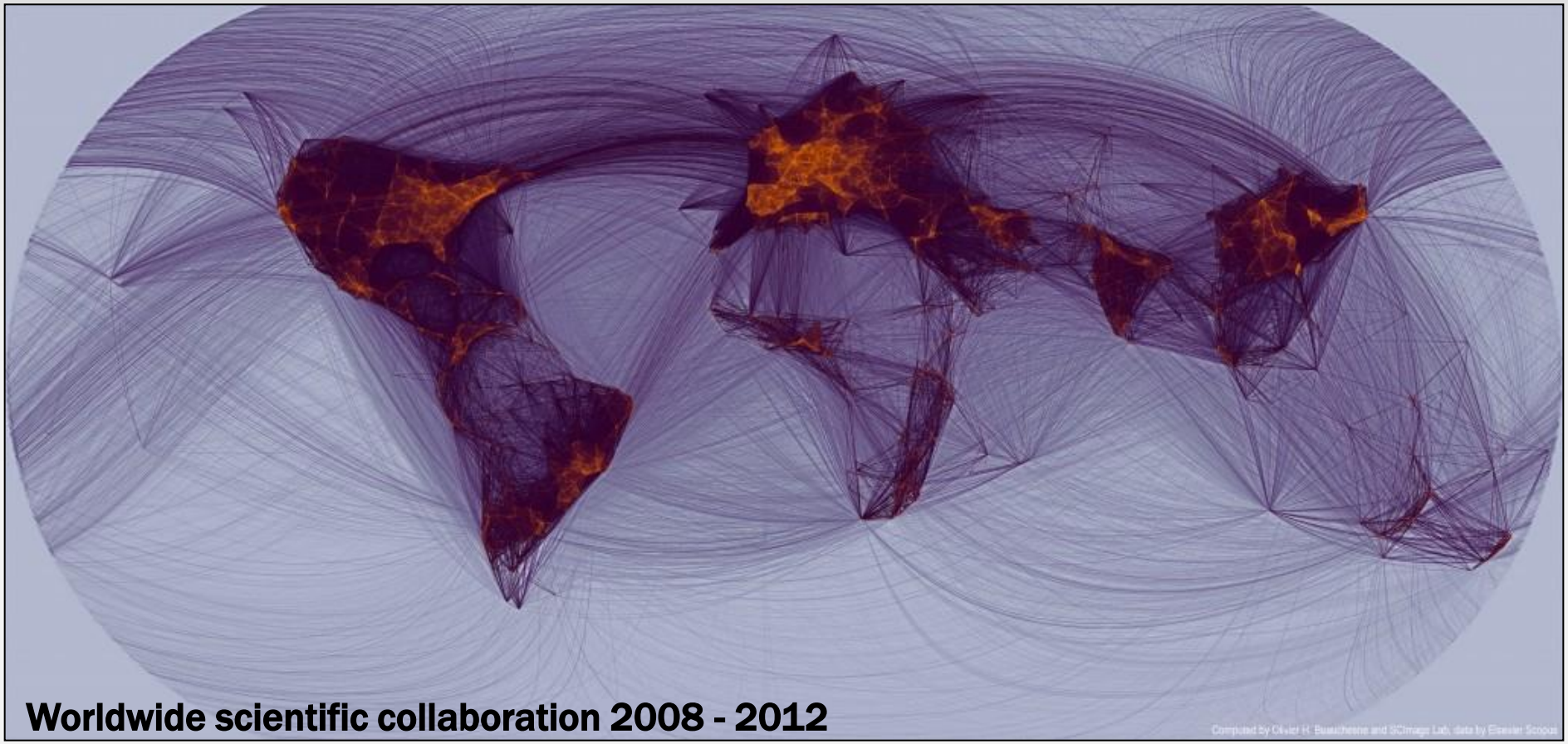


http://www.lorienpratt.com/what-causes-the-technology-hype-cycle-and-what-to-do-about-it/#more-897

Economic Drivers of Technology Diffusion



Technology Diffusion Through Scientific Collaboration



Worldwide scientific collaboration 2008 - 2012

http://olihb.com/2014/08/11/map-of-scientific-collaboration-redux/

Preparing for the Future

- Continued integration of data and devices
  - Decision making – human or automated?
  - Enabler for communication and collaboration
- CWC Implementation
  - If it can be imagined – it can probably be built!
  - Opportunities (customised solutions)
- Chemical safety and security
  - Recognise chemical applications from emerging technological applications across broad sectors
- The Future is Now