Regional Forum on Emergent Technologies

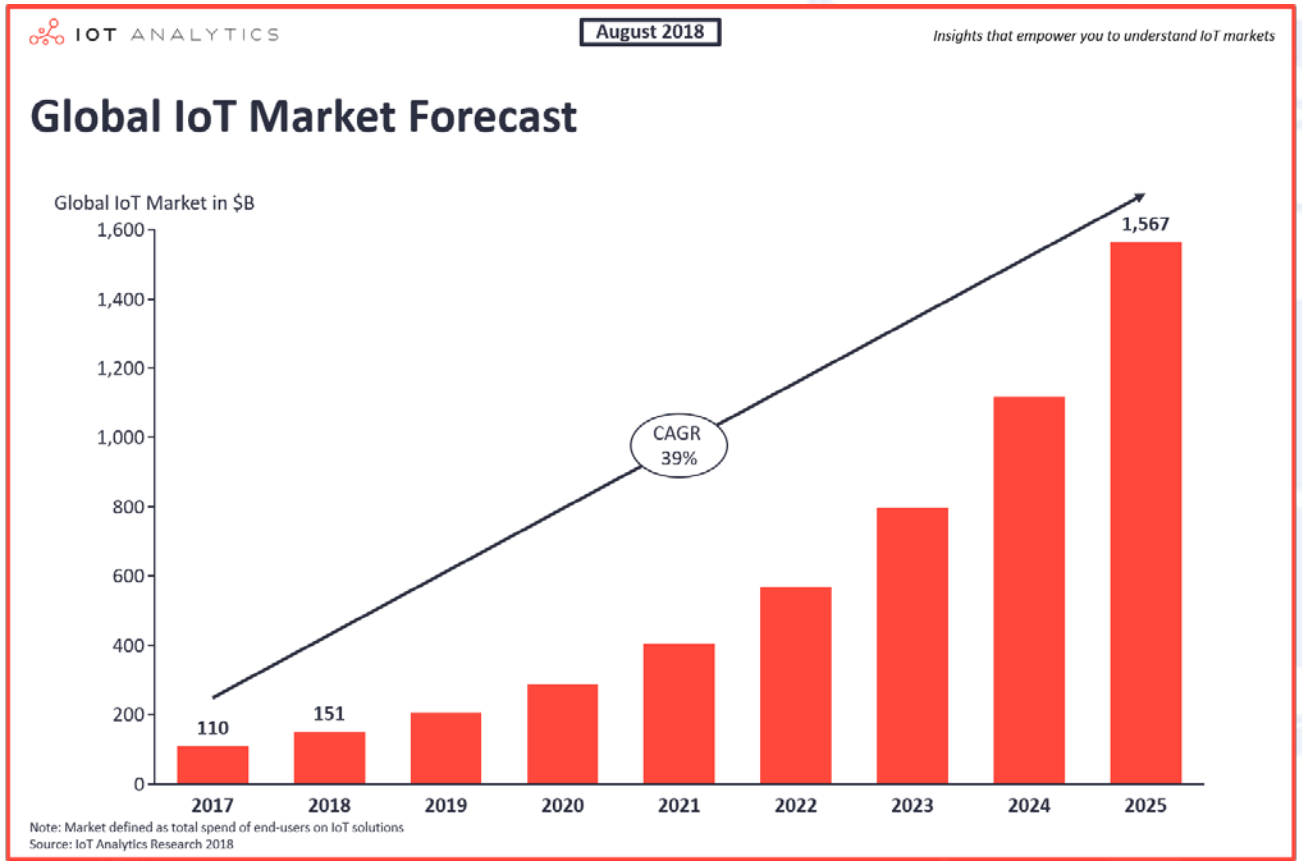
IOT Opportunities and Challenges

Tunis - Tunisia

23-24 April 2019

Pedro Seixas ITU Expert

Internet of Things is a big opportunity



- By any measure the Internet of Things is a huge opportunity
- IOT Analytics estimate a strong and accelerating growth of end-user spending on IoT solutions up to 2025
- The global market predicted to reach $1 567B USD

Source: IOT Analytics

A significant growth of connected devices

Connected devices evolution (Billions)

IoT	2017	2023	CAGR
Wide-area IoT	0.8	4.1	30%
Of which Cellular IoT	0.7	3.5	30%
Short-range IoT	6.2	15.7	17%
Other devices			
PC/laptop/tablet	1.6	1.7	0%
Mobile phones	7. 5	8.6	2%
Fixed phones	1.4	1.3	0%
Total devices	**17. 5**	**31.4**	**11%**

Source: Ericsson, (2018)

Source: Ericsson Mobility Report, IoT connections outlook, June 2018

What looks more promising

- Ovum, a research and consultancy firm, recently surveyed 1350 organizations in 14 countries which are deploying IOT solutions.
- The main IOT drivers for organizations are: reducing costs and improve business processes.
- But a third of respondents also placed high priority on IOT in order to improve competitiveness and customer experience.

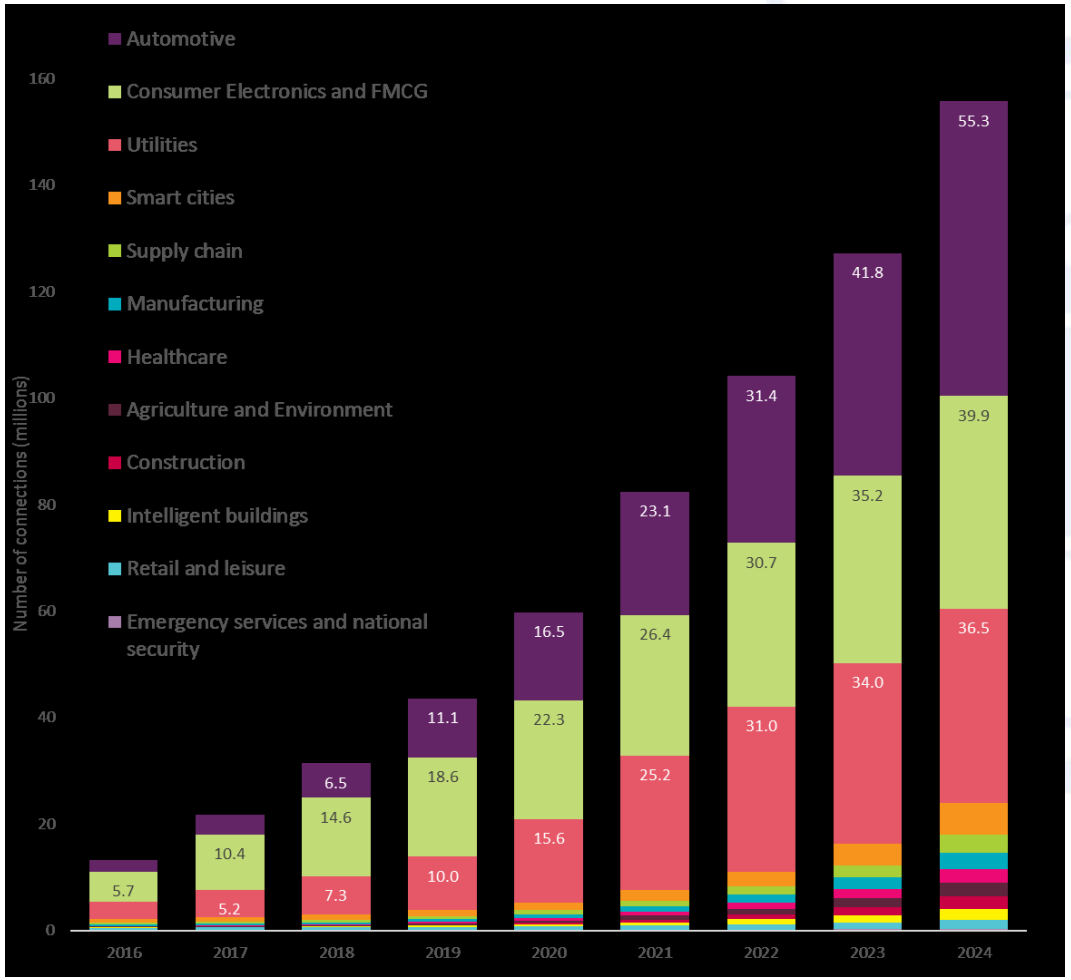
Source: https://ovum.informa.com/resources/product-content/iot-infographic

Where is more opportunity?

- Most IOT projects are concentrated in industrial manufacturing and that's probably in the short term the most promising sector
- According to Growth Enabler* the global IoT market share will be dominated by three sub-sectors; Smart Cities (26%), Industrial IoT (24%) and Connected Health (20%). Followed by Smart Homes (14%), Connected Cars (7%), Smart Utilities (4%) and Wearables (3%).

* Source: MARKET PULSE REPORT, INTERNET OF THINGS (IoT) UK, Growth Enabler, 2017

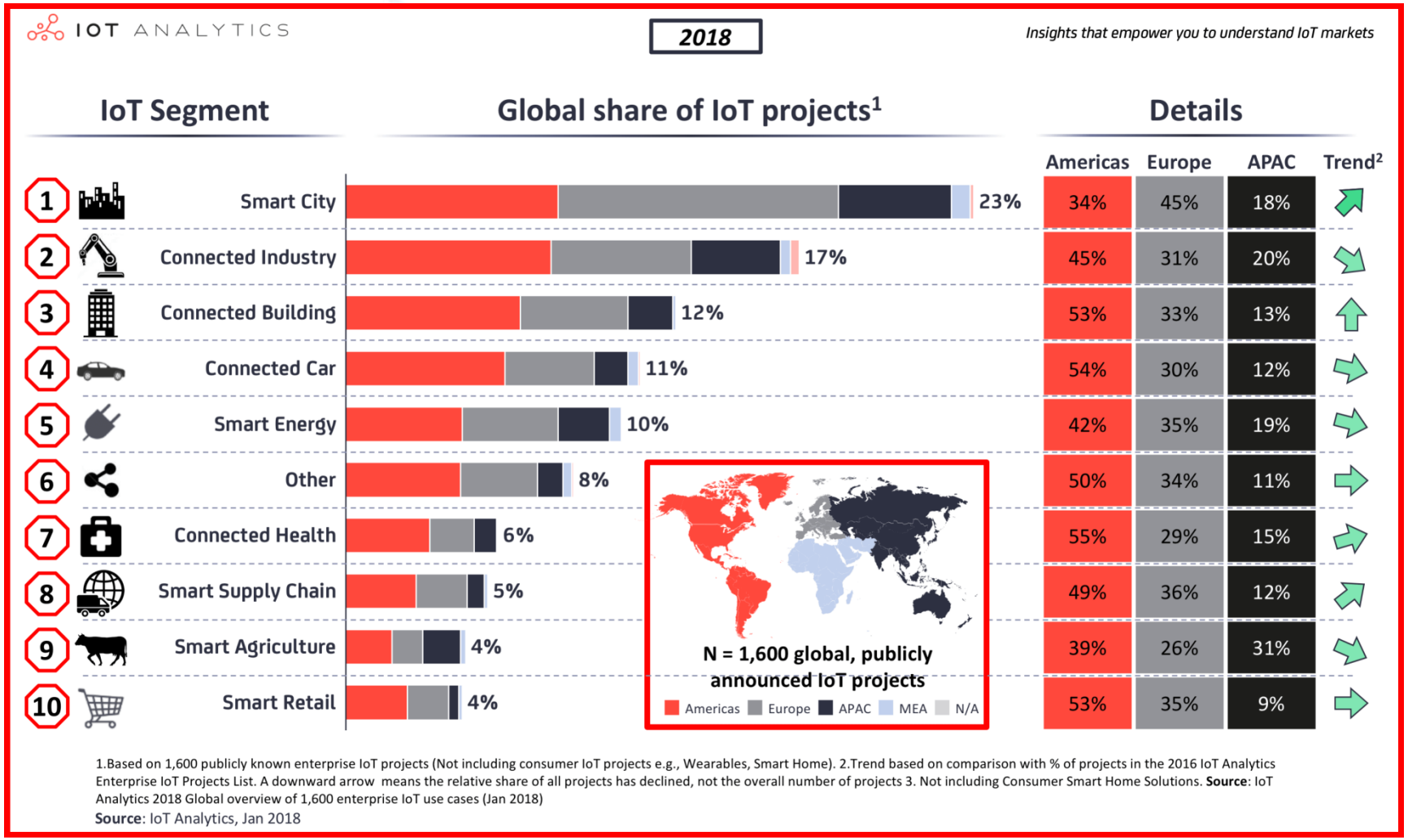
Where is more opportunity?



- According to OFCOM, in the UK, growth in the IoT sector (number of connections) was being led by the consumer wearables and white goods market, which accounted for over 40% of all IoT connections.
- But in the future most of the growth in IoT is predicted to be in the automotive, consumer electronics and utilities sectors

Source*: Cambridge Consultants IoT forecast for Ofcom*

Geographical distribution of IOT



Source: https://iot-analytics.com/top-10-iot-segments-2018-real-iot-projects/

Market structure of IOT

Market development key characteristics

Large players	Large international players are entering the IoT market, offering both generic and industry specific solutions, with ongoing acquisitions of companies that hold a strong position in the hardware more mature segment (e.g. semiconductors) or in specialised software niches.
Sector specialisation	The IoT market is evolving towards the development of specific software and integrated solution development and consulting. Solutions are being developed and tailored to specific industries.
Integrated solutions	increasingly clients demand for ‘plug-and-play’ solutions. Integrated solutions (of hardware and software) are much easier and less risky to implement.

Many challenges

	National	Cross-border
Social/Economical Technical	▪ Limited Standardisation ▪ Connectivity ▪ Spectrum ▪ Network security ▪ Skills	▪ Standardisation ▪ Numbering and Adressing ▪ Spectrum
Legal	▪ Existing national legal framework ▪ Spectrum licensing/ pricing and numbering ▪ Trust: Data and privacy ▪ Liability	▪ Extra-territorial use of numbering resources ▪ Permanent roaming ▪ Data flow

Fragmentation

- Since its beginning, IoT services and applications have been developed to be adapted in a vertical service model, i.e., in which every layer has been designed by a specific organization.
- Inter-operability and fragmentation are therefore a major challenge. This means that integration between applications, services and platforms is more difficult and often involves tailor made development.
- This, coupled with low volumes of enabling technologies, increases costs, making an IoT business case more challenging to proof.

Build trust in IOT

- A fundamental role of companies and regulators is to ensure consumer trust in IoT, so as to achieve its potential and curb its threats
- There are four main areas of intervention:
  - Ensuring data protection and privacy
  - Informing consumers and giving them control over data
  - Limiting the use if probabilistic predictions
  - Keeping data markets fluid
- A key concern is how to deal with personal data, starting with the problem of defining it and separate it from the bulk of data.

IOT National Plans

- An example is The “Action Plan for Brazil”, a study later turned into an action plan was commissioned by the Ministry of Science, Technology, Innovation, and Communications (MCTIC).
- It concludes that the widespread adoption of IoT technologies throughout the country could add up to $200 billion to the Brazilian economy by 2025.
- The aspiration of the national strategy is to “accelerate the implementation of the Internet of Things as a tool for sustainable development of Brazilian society. One that is capable of making the economy more competitive, strengthen the nation's productive chains, and promote improved quality of life.”
- Four main priorities identified with the greatest growth potential for the Brazilian economy are Smart Cities, Healthcare, Agribusiness and Manufacturing..

Conclusion

- The current situation indicates that the implementation of IOT applications is still limited and that progress has been slower than expected.
- Weak aspects of the offering, such as high costs due to fragmentation, unclear business case coupled with lack of adequate skills/human resources on the customers side have contributed to a still underdeveloped market. This is even stronger in the case of Small and Medium size companies.
- Public intervention is sometimes necessary to push demand. A current topic of debate is 5G sharing in order to improve the business case

Thank you

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Big Data: a Competition Perspective

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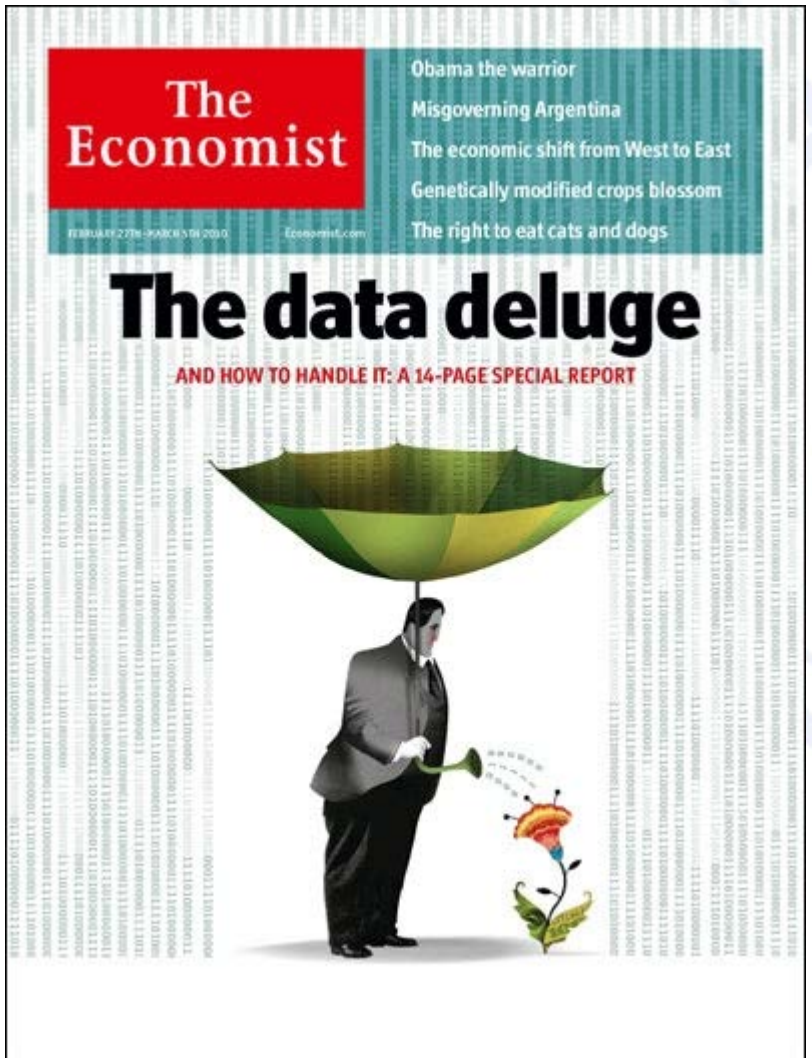
Increasing “datafication”* of activity



The Economist, Feb 25th 2010

"Where is the Life we have lost in living?
Where is the Wisdom we have lost in knowledge?
Where is the Knowledge we have lost in information?"
T. S. Eliot, The Rock

*Datafication: a term coined by By Kenneth Neil Cukier and Viktor Mayer-Schoenberger back in 2013

Big Data

"Big data starts with the fact that there is a lot more information floating around these days than ever before, and it is being put to extraordinary new uses. **Big data is distinct from the Internet, although the Web makes it much easier to collect and share data.** Big data is about more than just communication: the idea is that we can learn from a large body of information things that we could not comprehend when we used only smaller amounts."

Source: Kenneth Neil Cukier and Viktor Mayer-Schoenberger, "The Rise of Big Data". Foreign Affairs (May/June): 28–40, 2013

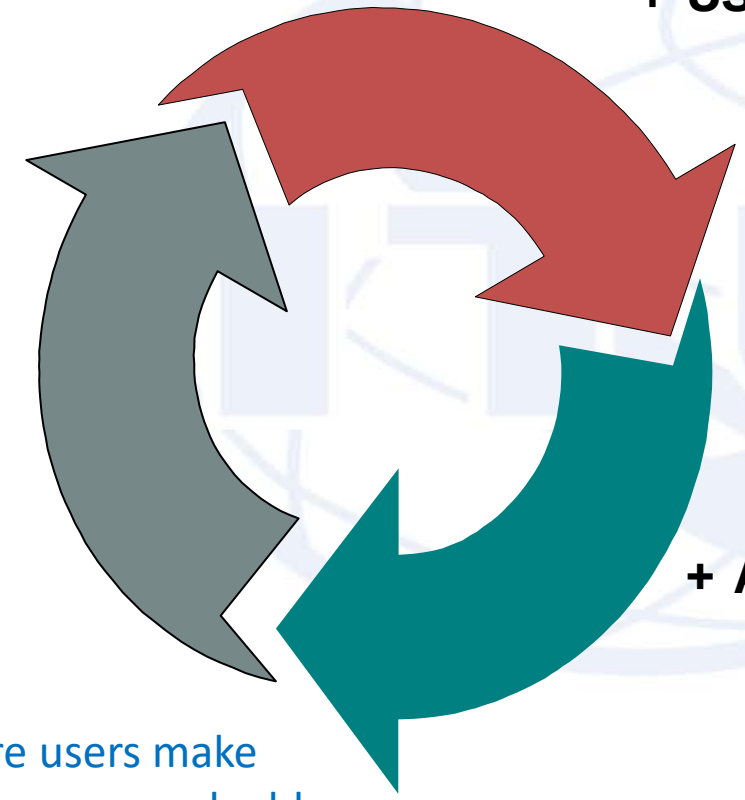
Online platforms

- Online platforms are at the heart of Big Data, but so Walmart is. So why are we speaking about Google, Facebook or Amazon?
- Among other players, online digital platforms play a disruptive role in the economy:
  - transforming the economics of many business and reshaping markets by exploiting indirect network effects,
  - reducing transaction costs, and
  - harnessing technological innovations such as **Big Data** analytics and self-learning algorithms.
- For certain types of platforms consumers can get services “for free” and in return allow their data to be sold to advertisers.

Network effects

	Positive	Negative
Cross-group effects	**Users experience a higher value if there are more participants on the other side of the platform** (e.g. to allow them to use a payment mechanism)	**Users experience a lower value if there are more participants on the other side of the platform** (e.g. they may dislike advertising)
Within-group effects	**Users experience a higher value if there are more participants on the same side of the platform** (e.g. they like all their friends to be on the same social media platform)	**Users experience a lower value if there are more participants on the other side of the platform** (e.g. bidders for these goods on internet auction websites experience more competition)

The more data they get, the better



an increase in the amount of users of a platform results in more data to be collected and, consequently, in improved service quality, which in turn attracts new users

These cross-group effects make platforms with more customers on both sides more valuable to both sets of customers.

More users make platforms more valuable to advertisers

Market concentration has caught attention

	Global market share April 2018 (%)	Business activity
Google	90	Search
Facebook	66	Social media
Apple	45	Smartphone web traffic
Amazon	37	Online retail

This feedback loop, associated with network effects promotes larger and fewer competing platforms

Source: The Economist 30th June 2018, "Fixing the Internet", based on data from Global Stats Counter

Contestability

- Online platforms typified by economies of scale and strong network effects (whether direct or indirect) can make it particularly difficult for rivals to enter and challenge the position of the platform effectively.
- As a consequence, such markets tend towards concentration and can even “tip” in favour of one platform in the sense that the winner takes all.
- In theory monopolies are ok if they can be contested

Big Data and Competition

- Is Big Data creating an insurmountable competitive advantage? When can we say that a “BIG DATA” advantage is at play?
- Is the access to data a barrier to entry? To what extent can companies monopolise data and use it to exclude rivals?
- Is it about the data or rather the ability to analyse it?
- Is the data replicable or available from other sources? Does it experience decreasing returns?
- How quickly does the data become outdated?

Barriers to entry

- This tendency towards monopoly stimulates intense rivalry in the form of dynamic competition for the market as distinct from static competition within it.
- But entry usually concerns a market segment: Amazon began as an online bookseller, Facebook challenged Myspace in the social network segment and Google replaced Alta Vista in the search engine market
- At the time of entry none had probably a lot of data

Big Data will not create market power

- Network effects may be also beneficial to new market entrants if they are able to enter and attract a high number of users for other reasons e. g. because of an innovative feature.
- They also argue that data is cheap and non-rivalrous (because users multi-home).
- And that the costs of collecting and analyzing Big Data are decreasing (outsourcing), that Big Data is increasingly available since the sources become more widespread such as for example with the development of the Internet of Things.

Innovation is not enough

- The value of the data collected is not absolute. It depends on the amount of the data a company already has. Because more data improves the results of algorithms (increasing non linear returns to scale).
- Companies which amassed huge amounts of data disclose algorithms but don’t give access to data. Therefore the role of data is context specific.
- Firms still pay considerable amounts for data access.

Data ended up being spotted

- Back in 2016 a joint study of French and German Competition authorities* noted **Big Data** as a **Competition** issue:

"The collection, processing and commercial use of data is often seen not as a competition law issue but rather as an issue which concerns data protection enforcement. However, several recent proceedings point to the fact that competition authorities have begun to look at possible competition issues arising from the possession and use of data, even if, in the end, none were ascertained in the specific cases"

* AUTORITÉ DE LA CONCURRENCE; BUNDESKARTELLAMT. Competition Law and Data. 2016.

Product line extension

	Google worldwide market share 2017 (%)
Search	90
Mobile operating System (Android)	72
Web browser (Chrome)	51
Online advertising	41
Email client (Gmail)	23

Source: The Economist 21st July 2018, “Antitrust theatre”, based on data from Litmus, StatCounter, Statista

Addressing the "data advantage"

- In the Facebook/WhatsApp merger*, the European Commission determined:

"For the purposes of this decision, the Commission has analysed potential data concentration only to the extent that it is likely to strengthen Facebook's position in the online advertising market or in any sub-segments thereof.

Any privacy-related concerns flowing from the increased concentration of data within the control of Facebook as a result of the transaction do not fall within the scope of the EU competition law rules but within the scope of the EU data protection rules."

* Source: Facebook/WhatsApp (Case Comp/M.7217), Commission Decision C(2014) 7239 final, 3 October 2014

Conclusion

- Harm to consumers has been hard to proof but excessive concentration and dominance is a legitimate concern. More regulation and competition authorities scrutiny is therefore likely
- A number of remedies are still being debated among practitioners on how they could be applied to online platforms; some involve data issues beyond privacy:
  - Blocking new mergers or mandating spin offs
  - Limiting large online platforms from offering certain services
  - Imposing data access
  - Reverse the burden of proof

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AI Ethical Guidance

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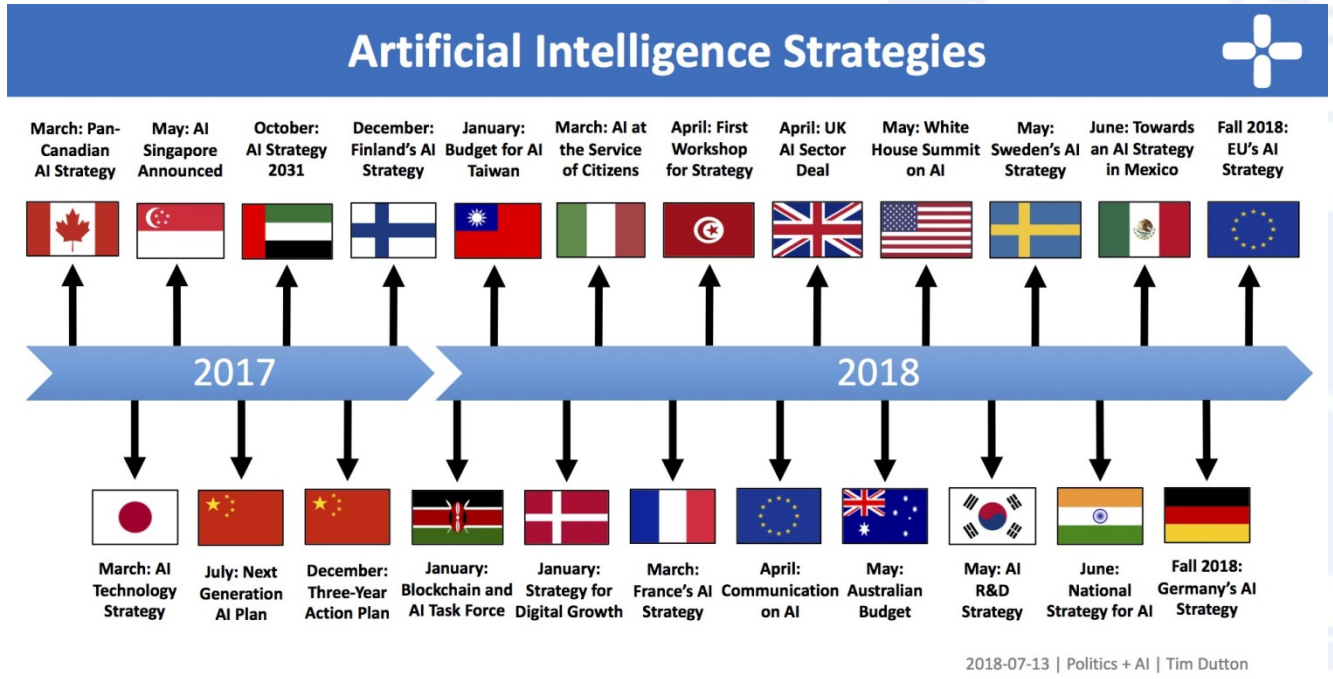
AI Strategies



- Aritificial Intelligence is such a hot and important topic that many countries are setting high level policies and goals.
- In general, to give a few examples, they aim at achieving world leadership, improve industrial competitiveness, or define goals for sustainable development and job creation

Source: Tim Dutton, An Overview of National AI Strategies, available at https://medium.com/politics-ai/an-overview-of-national-ai-strategies-2a70ec6edfd

Tunisia National AI Strategy

- Tunisia's Secretary of State for Research has created a task force and a steering committee to develop a AI strategy for Tunisia. The strategy was initially scheduled to be published in the first quarter of 2019.
- The primary goal will be to facilitate the emergence of an AI ecosystem that acts as a strong lever for equitable and sustainable development and job creation.
- Titled "National AI Strategy: Unlocking Tunisia's capabilities potential," this initiative was officially launched in April 2018 during a workshop hosted by the UNESCO Chair on Science, Technology and Innovation Policy, in partnership with the National Agency for Scientific Research Promotion-ANPR.

Source: http://www.anpr.tn/national-ai-strategy-unlocking-tunisias-capabilities-potential/

AI Definition

- European Commission's High-Level Expert Group on Artificial Intelligence recently made public a definition of AI in the following terms:

"systems that display intelligent behaviour by analysing their environment and taking actions – with some degree of autonomy – to achieve specific goals. AI-based systems can be purely software-based, acting in the virtual world (e.g. voice assistants, image analysis software, search engines, speech and face recognition systems) or AI can be embedded in hardware devices (e.g. advanced robots, autonomous cars, drones or Internet of Things applications)."

Source: High-Level Expert Group on Artificial Intelligence. A definition of AI: main capabilities and scientific disciplines. Definition developed for the purpose of the High-Level Expert Group's deliverables. 2018

Humans and machines

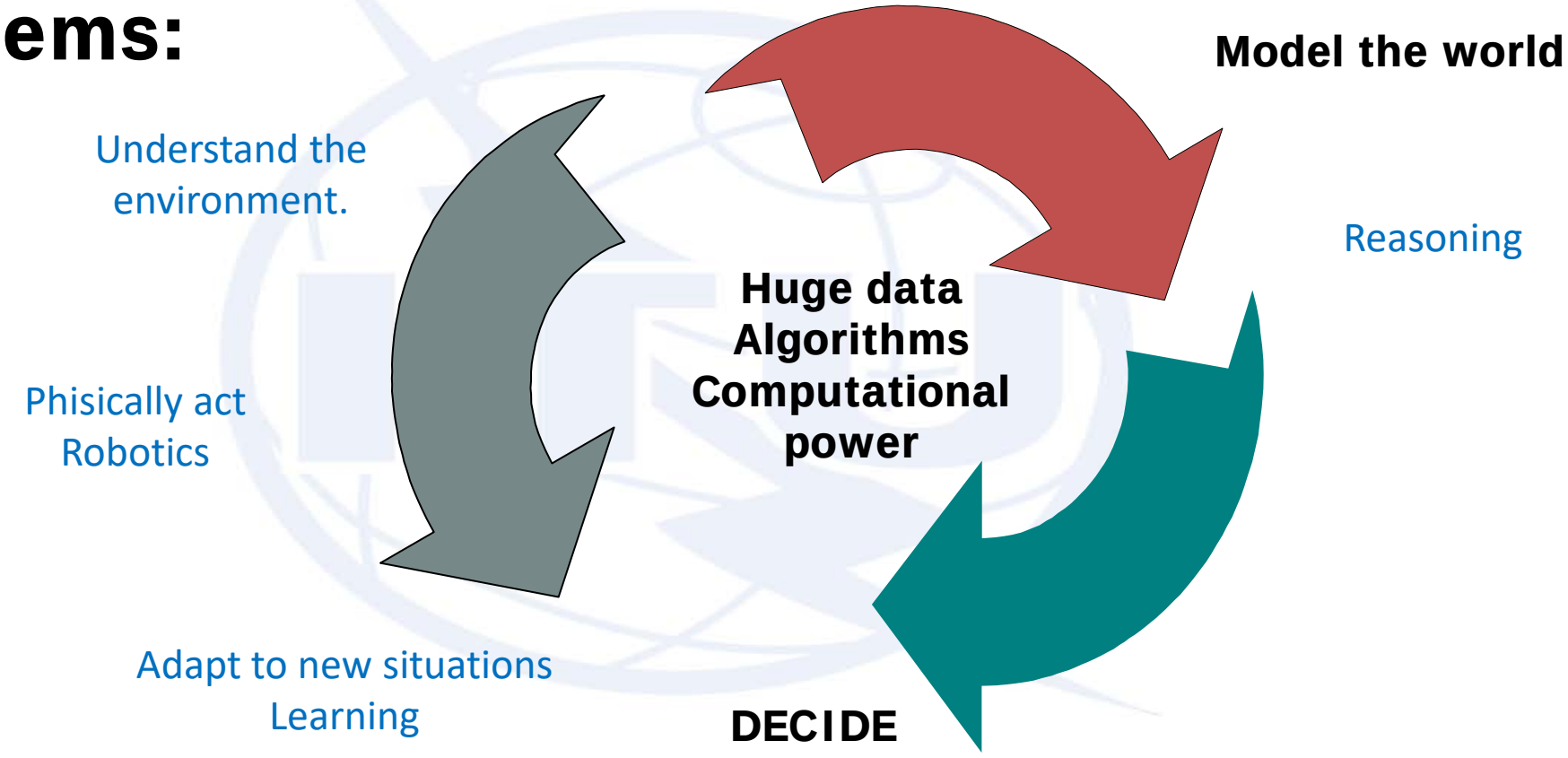
Humans are better	Machines are better
• Defining goals. • Common sense (sometimes) • Value judgement	• Computational power • Pattern discovery • Statistical manipulation

So one can say there is some complementarity

Source*: ARTIFICIAL INTELLIGENCE: ETHICS, GOVERNANCE AND POLICY CHALLENGES, Report of a CESP Task Force*

AI is more than machine learning

AI Systems:



Source: High-Level Expert Group on Artificial Intelligence. A definition of AI: main capabilities and scientific disciplines. Definition developed for the purpose of the High-Level Expert Group's deliverables. 2018

AI systems limitations

Development of AI systems issues, some examples

Common sense	Need to provide some form of common sense to AI systems namely if our goal is to interact with them.
Data bias	Algorithms are very dependent on the quality of data.
Ethical behaviour	How can a machine help about ethical issues?

Why are ethical issues so important?

- Large societal changes
- Transparency and trust in the economic agents and policy makers developing AI systems
- Ethical behaviour of AI systems:
  - There is a need to discriminate between good and bad decisions
  - If systems are autonomous which means we delegate decisions to them
  - In systems which imply human-machine interactions since we require trust

Examples of Ethical issues in AI

- Web search
- Healthcare support systems
- Social media
- Driverless cars
- Robots to support senior people: how they must behave in face of different cultures or social norms?

AI Ethics challenges

- Which/whose Ethical principles?
  - There is no universal set of ethical principles
  - They are cultural or sometimes even task specific
- Embedding professional codes such as existing professional codes of conduct and ethical principles
- Guidance on which cases might be problematic from the standpoint of the application of identified principles

Ethical guidance initiatives

- Some considerable effort has already dedicated to the elaboration of Ethical principles lists that should be followed when developing AI systems:
  - The Asilomar AI Principles;
  - The Montréal Declaration for Responsible AI;
  - Several versions of the IEEE “Ethically Aligned Design: A Vision for Prioritizing Human Well-being with Autonomous and Intelligent Systems”
- A more valuable one is ITU’s “AI for Good Global Summit”, which focuses on the uses of AI that can help the global community achieve the Sustainability Development Goals.

Thank you