ROLE OF DATA SCIENCE IN FOOD CHAIN SAFETY DECISION MAKING: CURRENT STATUS AND FUTURE TRENDS

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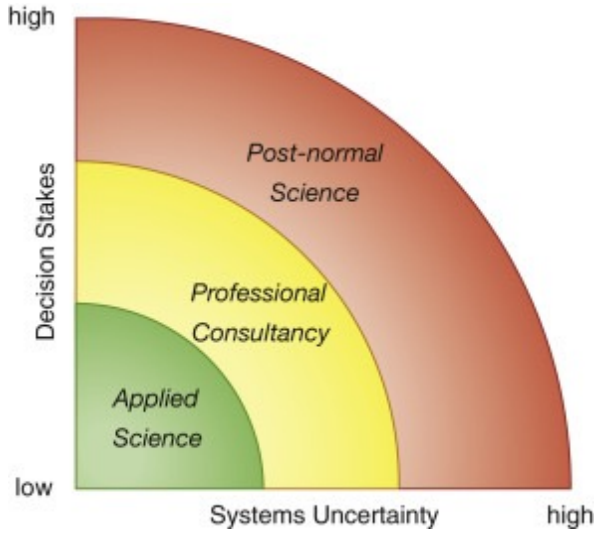
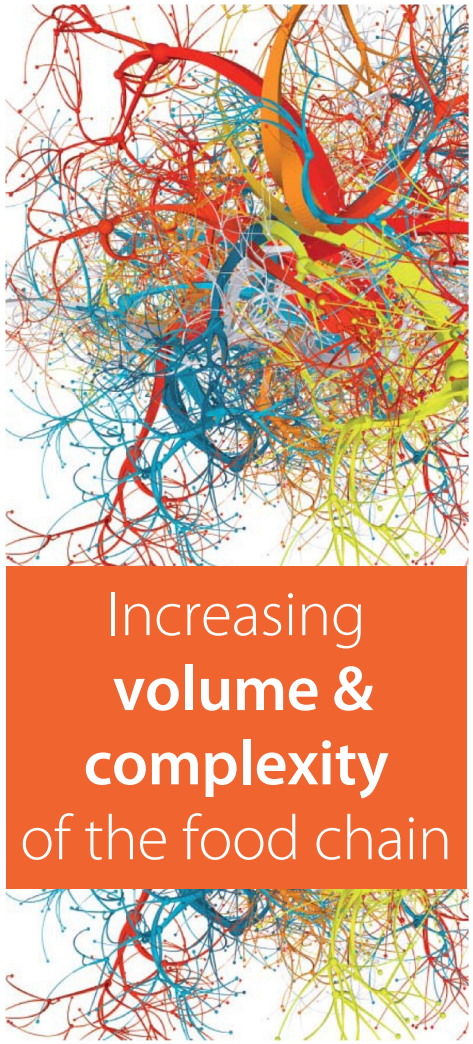
FOOD SAFETY DECISIONS: **POST-NORMAL** SCIENCE

- Decision making problems:
  - based on uncertain facts
  - disputes over costs, ethics and values
  - urgent decisions needed
  - that may have far-reaching consequences

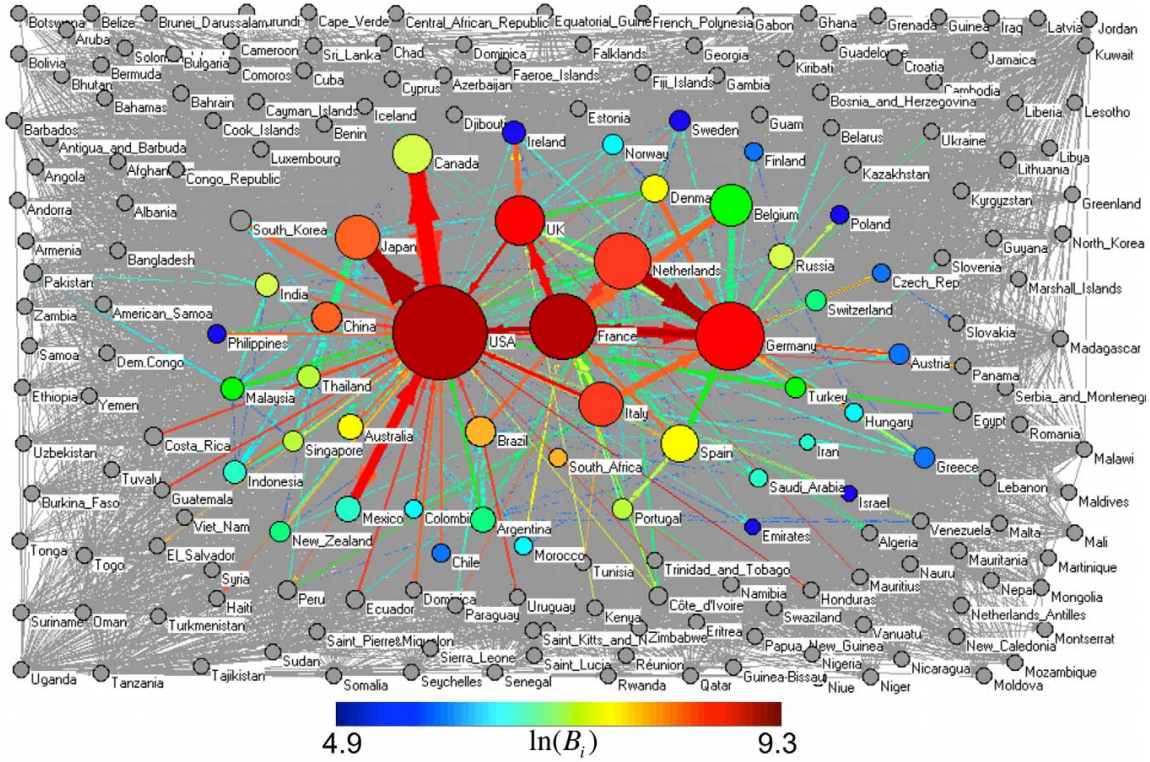


Source: Silvio Funtowicz, Jerry Ravetz: Chapter 2 - Post-Normal Science: How Does It Resonate With the World of Today? In: Science for Policy Handbook, Elsevier, 2020. https://doi.org/10.1016/B978-0-12-822596-7.00002-4.


Increasing
volume &
complexity
of the food chain

7 COUNTRIES FORM THE CORE OF THE AGRI-FOOD TRADE NETWORK

Each trading with over 77% of all the countries in the world



Source: Ercsey-Ravasz M, Toroczkai Z, Lakner Z, Baranyi J (2012) Complexity of the International Agro-Food Trade Network and Its Impact on Food Safety. PLoS ONE 7(5): e37810. doi:10.1371/journal.pone.0037810

COMPLEX DRIVERS

GLOBAL TRADE

FOOD SYSTEM STRUCTURE

CLIMATE CHANGE

ECONOMIC STABILITY

TECHNOLOGICAL DEVELOPMENT

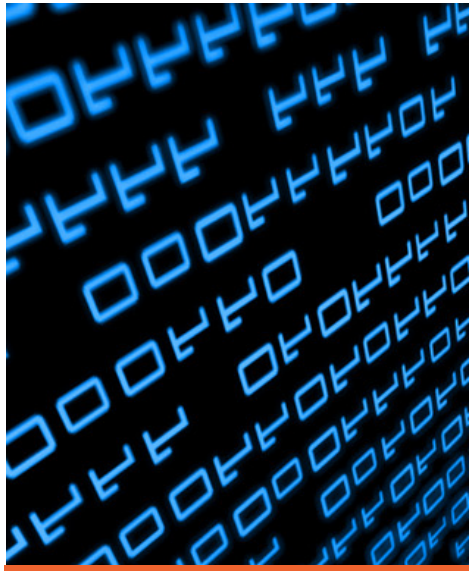
DEPLETION OF NATURAL RESOURCES

POLITICAL AND SOCIAL ENVIRONMENT

FOOD QUALITY & NUTRITION

POPULATION GROWTH

Increasing **volume & complexity** of the food chain



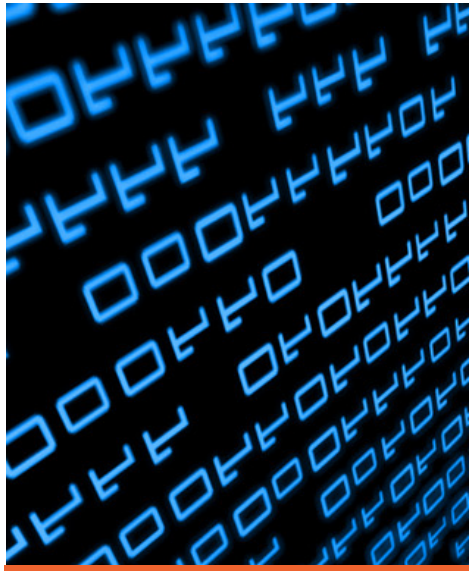
Growth of the amount of **data available** for analysis

INFORMATION **BOOM**

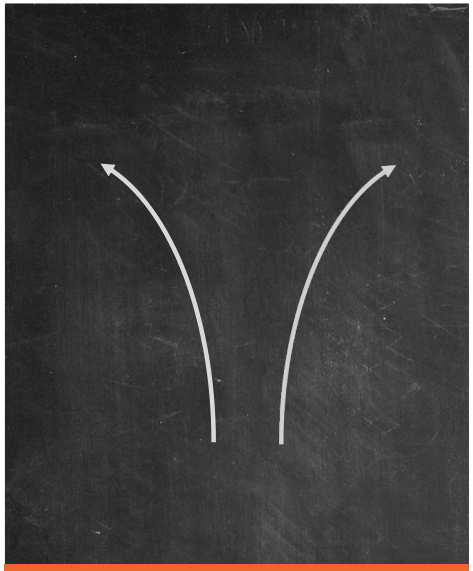
- **From the dawn of the civilization to 2003** humans produced **5 exabytes** of data in total
- IBM has estimated in 2016 that 2.5 exabytes (2.5 billion gigabytes) of data are produced every day
- Now it is around 5 exabytes **daily**
- We are in the middle of a **transition from a society of facts to a society of data**

Source: https://www-01.ibm.com/software/data/bigdata/what-is-big-data.html

Increasing **volume & complexity** of the food chain



Growth of the amount of **data available** for analysis



Better evidence-based **decision making?**

COMPUTATIONAL SCIENCE AS A SOLUTION

- Computational science:
  - Able to detect patterns which can not be detected by a smaller set of data
  - Those **emerging patterns** can be surprising & counter-intuitive
- 'more is different'

HOW DATA SCIENCE HELPS IN ENSURING FOOD CHAIN SAFETY?

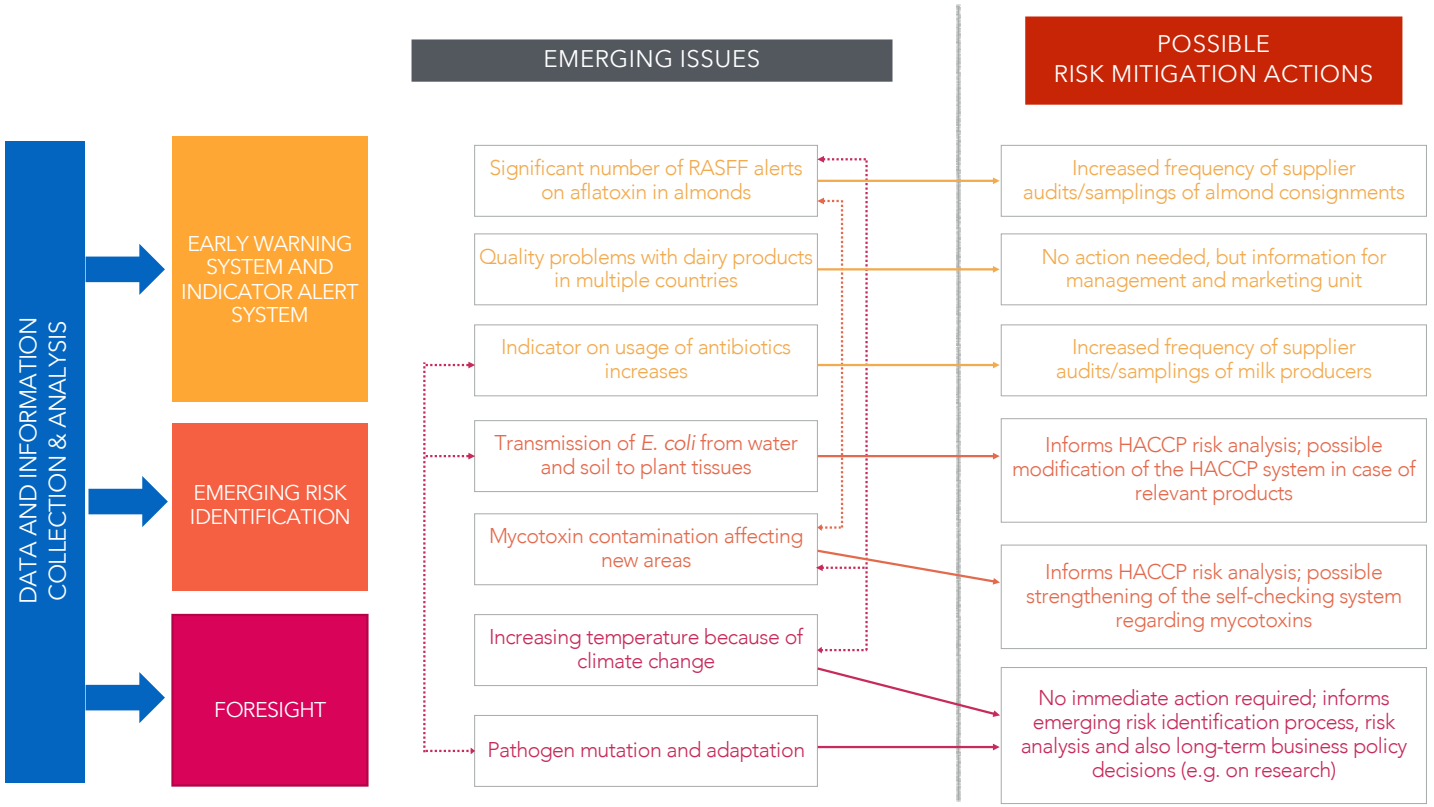
- More data → deeper insight into food chain processes
  - **Finding high risk** businesses and trade routes in the network of businesses (e.g. animal farms) with network analysis
  - **Optimising** food production and minimising loss with machine learning
  - **Predicting the spreading** of hazards (e.g. animal epidemics) along the food chain with network analysis and spatiotemporal spreading simulation tools
  - **Finding emerging (upcoming) risks** with social network analysis, text mining, AI and other computational science tools
  - …

HOW DATA SCIENCE HELPS IN ENSURING FOOD CHAIN SAFETY?

EMERGING ISSUE IDENTIFICATION

EMERGING ISSUE IDENTIFICATION

SYSTEMATIC APPROACH

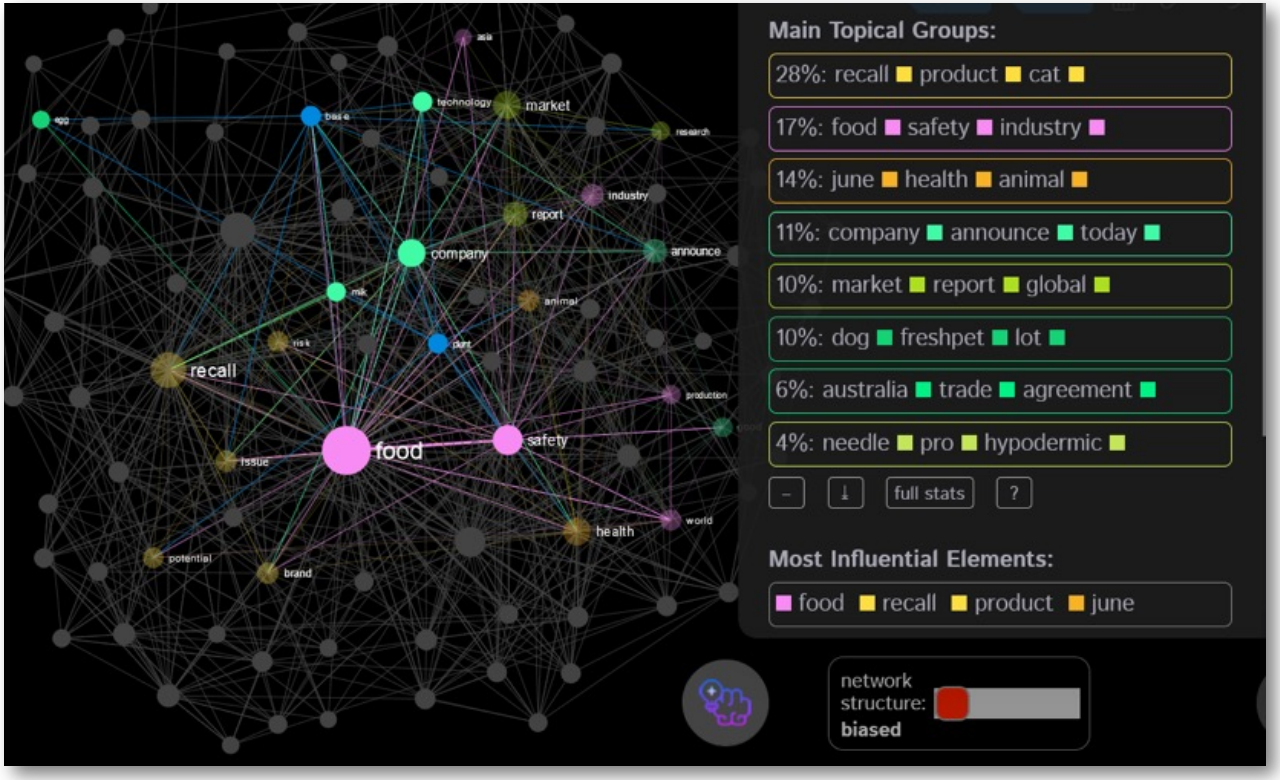


EMERGING ISSUE IDENTIFICATION

EMERGING ISSUE IDENTIFICATION SYSTEM OF THE DIGITAL FOOD INSTITUTE

EMERGING ISSUE IDENTIFICATION

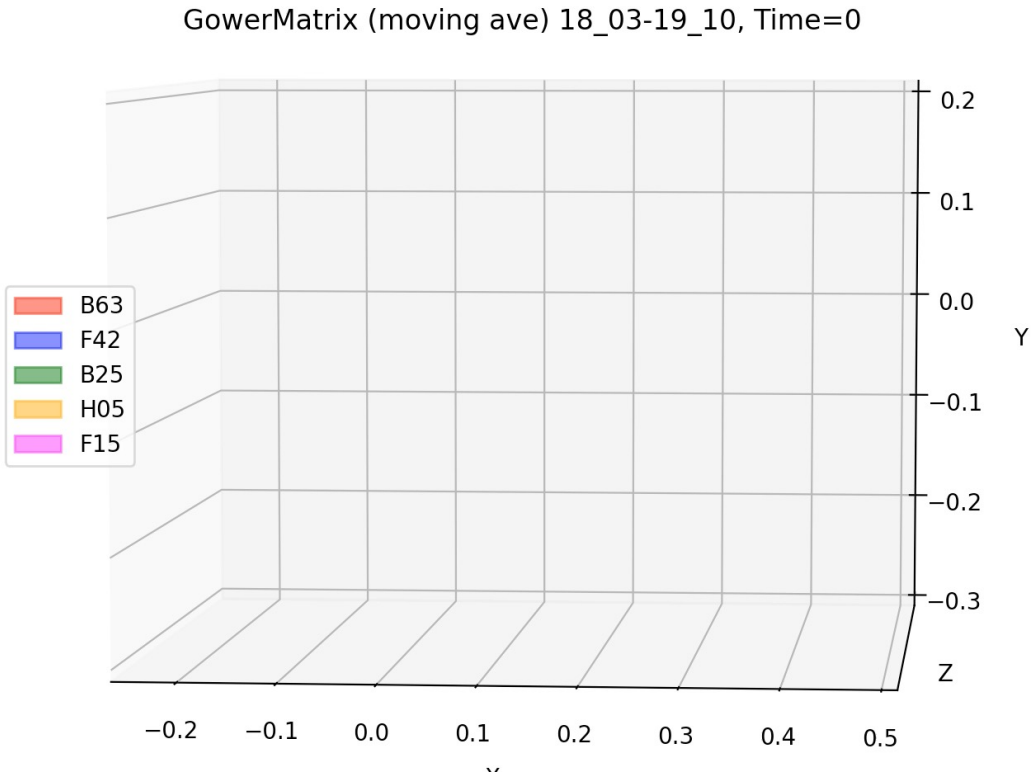
IDENTIFYING TRENDING TOPICS IN NEWS BASED ON TEXT MINING AND NETWORK ANALYSIS



EMERGING ISSUE IDENTIFICATION

PATENT NETWORK ANALYSIS: INTELLECTUAL ECOLOGY

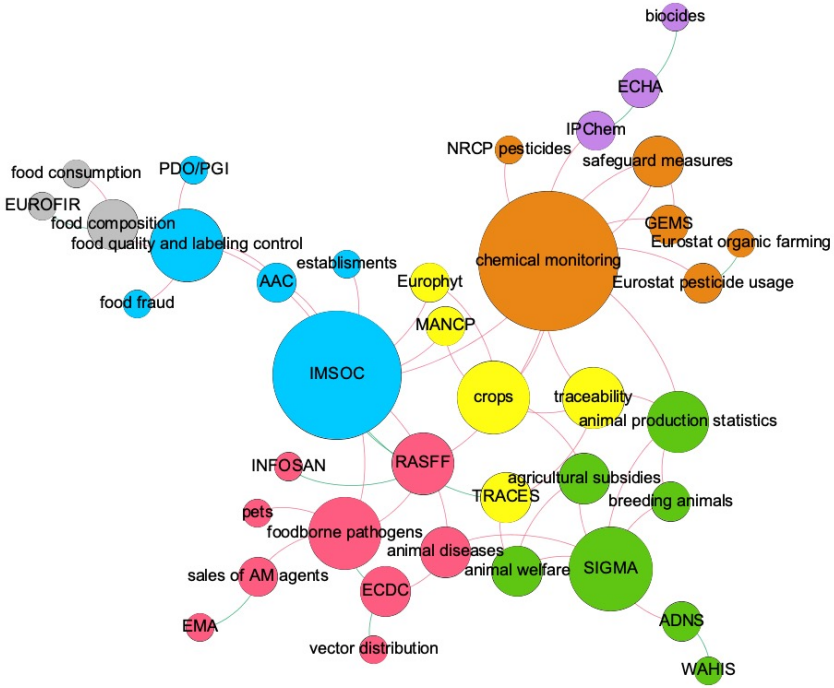
- We want to capture the evolutionary aspect of the patent universe
- The dynamic network can be conceived as a kind of **intellectual ecology**
- Bray-Curtis dissimilarity:
  - used in numerical ecology and biology
  - captures evolutionary aspect



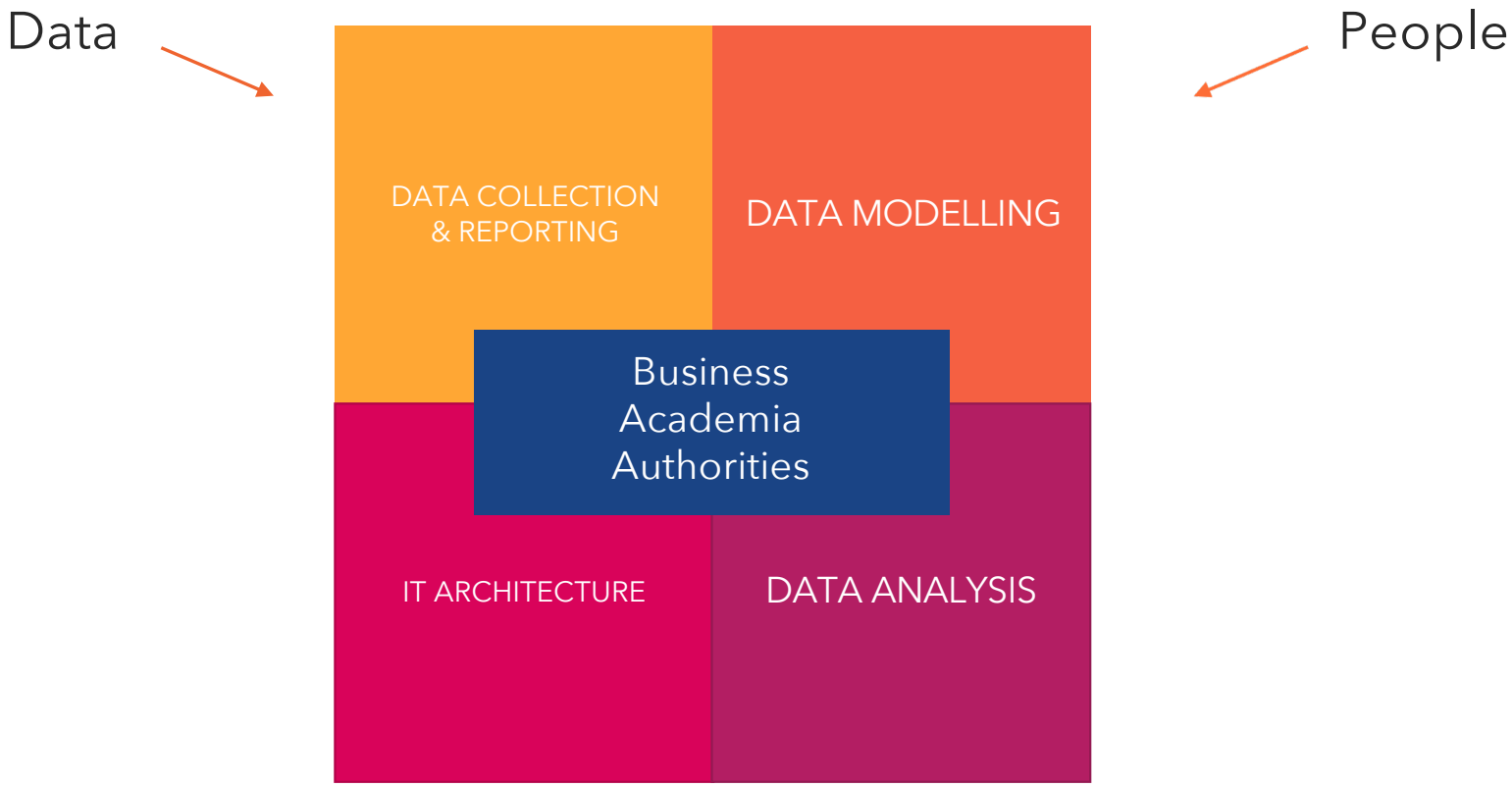
EFSA
ADVISORY GROUP ON DATA

EFSA ADVISORY GROUP ON DATA

- Act as a governance body providing recommendations
  - https://doi.org/10.2903/sp.efsa.2020.EN-1901
- Act as a Think Tank providing input on project ideas
- Act as a channel providing access to knowledge, expertise, competencies and staff in Member States
- Provide strategic input on and oversight of alignment of EFSA's data roadmap



DATA ANALYSIS FRAMEWORK



STRATEGIC **RECOMMENDATIONS**

- Achieve **critical mass of data literacy** by supporting and encouraging data related education activities
- EFSA, and also other institutions should continue their activities towards **becoming data driven organisations**
- Initiate discussions on a common "**European food safety data model**" along the food chain
- Initiate discussions also on the applicability of **solutions other than relational databases**
- Explore deeper the potential use of **traceability data** (including blockchain based solutions)

STRATEGIC **RECOMMENDATIONS**

- Encourage **process automation** for data exchange and data analysis by investing in standardised and openly available tools and analysis program codes
- **Collaborative joint projects** and **sharing best architecture practices** should be encouraged
- All national and EU systems being built today should be built with **interoperability** in mind
- Discussions should be initiated on designing the '**future food safety data ecosystem of Europe**'

STRATEGIC **RECOMMENDATIONS**

- Support the development and application of **novel data analytical approaches**, including user-friendly tools and frameworks
- Initiate discussions on **application of results produced by computational science solutions** in risk management and policy decision-making
- Good practices of **data visualisation** should be identified and also capacities in data visualisation should be built
- Future problems caused by **'black boxes'** produced by AI solutions should be addressed

ARE WE READY?

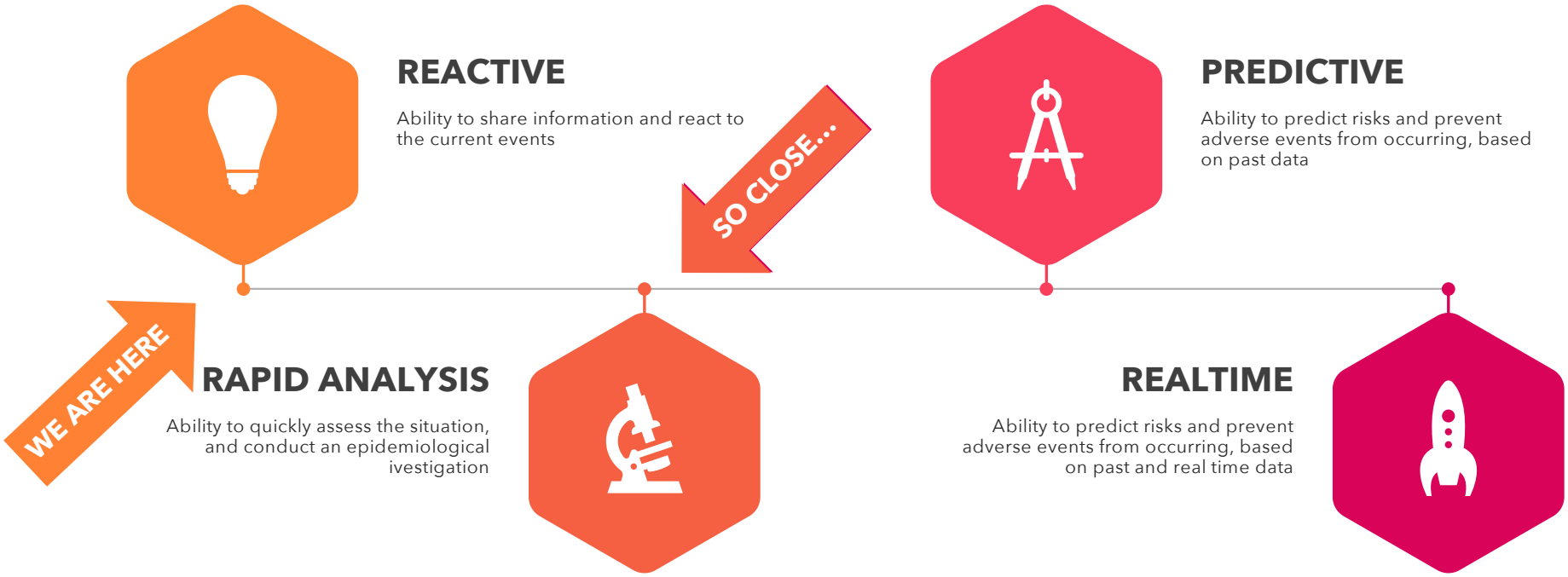
DATA DRIVEN ORGANIZATION

- Data are in the core of business activities
- Data drive the strategy
- Organizational, procedural, capacity building changes
  - data-informed culture, agile working, room for experiments…
  - more expertise on data is needed → education
- We don’t (just) need data scientists, we need data focused food scientists: enabling interpretation and validation

ARE WE **READY?**

- We need to invest in **data sharing** and **exploring capacities**
- We need careful **strategic planning** for multiple timelines
- Building the future may destroy some of the current investments/achievements
- IT systems become obsolete after 7-10 years
  → build from scratch is better than patching
- **Expectation management** & **Change management**

ARE WE READY **FOR THE FUTURE?**



FOOD SCIENTISTS WILL NOT BE REPLACED BY AI...

...THEY WILL BE REPLACED BY FOOD SCIENTISTS USING AI

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