

# Circular Economy & Private Sector Development: Emerging Technologies



Capitalising from  
skills Building on  
Education



...a race against time?

THE 17 GOALS

169  
Targets

2999  
Events

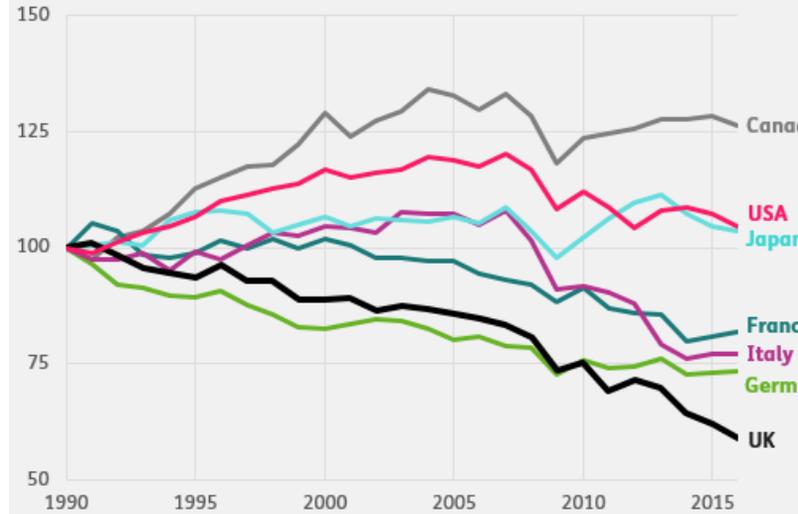
1248  
Publications

5358  
Actions



## The race to cut G7 emissions

Indexed change in gross greenhouse gas emissions for G7 countries since 1990, kt CO<sub>2</sub> equivalent

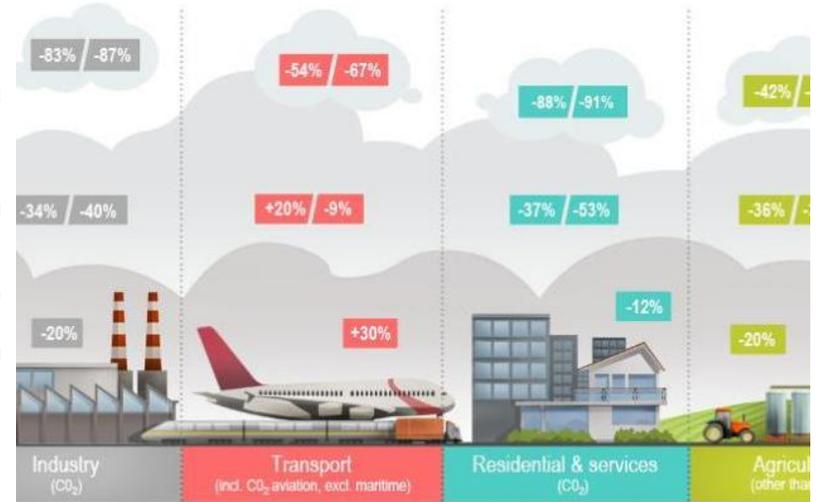


Date of graph creation: 24 November 2019

Source: World Resources Institute, Climate Watch data, accessed 10 June 2019

## Low-carbon strategy for 2050

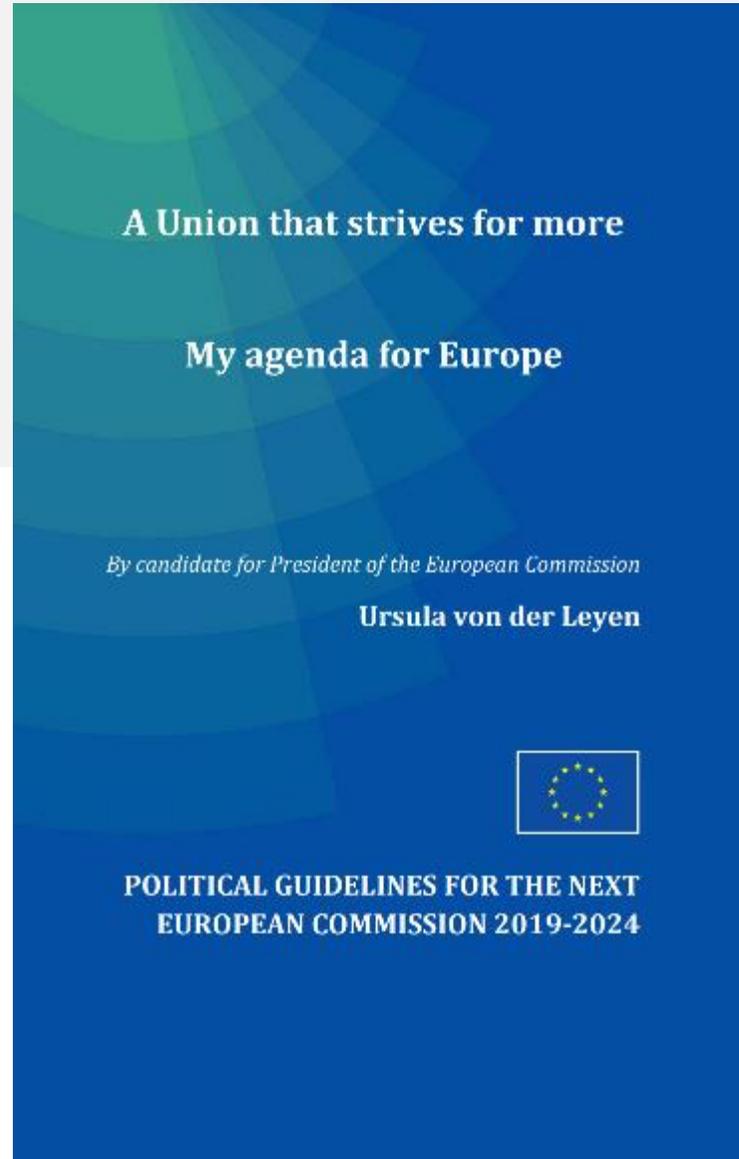
Targets compared to 1990 levels



It seems like that...



A glance at policy  
and education:  
the sunk cost of  
the transition



## At the leadership level of the EU

- To help drive the change we need, I will put forward my plan **for a future-ready economy, our new industrial strategy.**
- **We will be a world leader in circular economy and clean technologies.** We will work to decarbonise energy-intensive industries.

2015



2020



2020





Commission proposal for  
**Horizon Europe**  
Framework  
Programme for  
Research and  
Innovation  
(2021-2027)

*#EUBudget*



DECISION OF THE  
COUNCIL on  
establishing the  
specific programme  
implementing **Horizon  
Europe** - the  
Framework  
Programme for  
Research and  
Innovation

# Important References

- 4. CLUSTER 'DIGITAL, INDUSTRY AND SPACE'
- The EU has the unique chance of being a global leader and increase its share of world markets, by showcasing **how digital transformation**, leadership in key enabling and space technologies, the transition to a low-carbon, **circular economy** and competitiveness can reinforce each other through scientific and technological excellence.
- To make the **digitised, circular**, low-carbon and low-emission economy a reality, action is needed at EU level because of the **complexity of value chains**, the systemic and multi-disciplinary nature of the technologies and their high development costs, and the cross-sectoral nature of the problems to be addressed.
- It will ensure that research and innovation in these areas feed into, and contribute to the implementation of, the EU's policies for industry, **digitisation**, environment, energy and climate, **circular economy**, raw and advanced materials and space

## 4.2.8. Circular Industries

- Europe is at the forefront of the global transition towards a circular economy. **Europe's industry should become a circular industry**: the value of resources, materials and products should be maintained much longer compared to today, even opening up new value chains

## WHITE PAPER On Artificial Intelligence - A European approach to excellence and trust

- for business development, for example a new generation of products and services in areas where Europe is particularly strong (machinery, transport, cybersecurity, farming, the green and **circular economy**, healthcare and high-value added sectors like fashion and tourism);



## Communication: Shaping Europe's digital future (19 February 2020)

- A FAIR AND COMPETITIVE ECONOMY
  - Propose an Industrial Strategy Package putting forward a range of actions to facilitate the transformation towards clean, **circular, digital** and globally competitive EU industries, including SMEs and the reinforcement of single market rules.
- AN OPEN, DEMOCRATIC AND SUSTAINABLE SOCIETY
  - A circular electronics initiative, mobilizing existing and new instruments in line with the policy framework for **sustainable products of the forthcoming circular economy action plan**, to ensure that devices are designed for durability, maintenance, dismantling, reuse and recycling and including a right to repair or upgrade to extend the lifecycle of electronic devices and to avoid premature obsolescence (2021).





The need to built on skills and education

## KEY FACTS

**61 million Europeans**  
lack adequate reading, writing and digital skills

**40%**  
European employers report that they cannot find  
people with the right skills to grow and innovate

# The European Union example





# EUROPEAN SKILLS AGENDA FOR SUSTAINABLE COMPETITIVENESS, SOCIAL FAIRNESS AND RESILIENCE

- The **twin green and digital transitions** are reshaping the way we live, work and interact.
- Europe needs agile, resilient and future-proof VET systems, which can support young people to manage their entry to a changing labour market and ensure that adults access **vocational programmes tailored to the twin green and digital transitions**
- The **green transition requires** investments in skills of people to increase the number of professionals who build **and master green technologies, including digital, develop green products, services and business models, create innovative nature-based solutions and help minimise the environmental footprint of activities.**
- Europe will only become a climate neutral continent, a resource efficient society and a circular economy with an **informed population and workforce that understands how to think and act green.**



That's all  
great...what do  
we finally need?

# A blended approach for Circular Economy

An inclusive approach

## ◆ Family

Mindset, culture, believes values

## ◆ Traditional Education

Schools, Universities, Research Centers.

## ◆ Best Practices

Actual successes and failures that resulted to concrete outcomes

## ◆ Cross domain fertilisation

Circular Economy is all about synergies and applications from different domains. Prime example the interaction of ICT with many domains.



## ◆ Knowledge fusion

The multidisciplinary requirements of Circular Economy require and generate a unique out of the box fusion of knowledge.

## ◆ Disruptive models

The generation of new disruptive models with regenerative characteristics are crucial.

## ◆ Up-skilling and Re-Skilling

Capitalising on new knowledge for advancing the skills of people or reskilling them to remain current and competitive

## ◆ Vocational, Education and Training

New knowledge needs to be systematically infused through programs and structures for personal and professional development



*Thank you for your attention!*

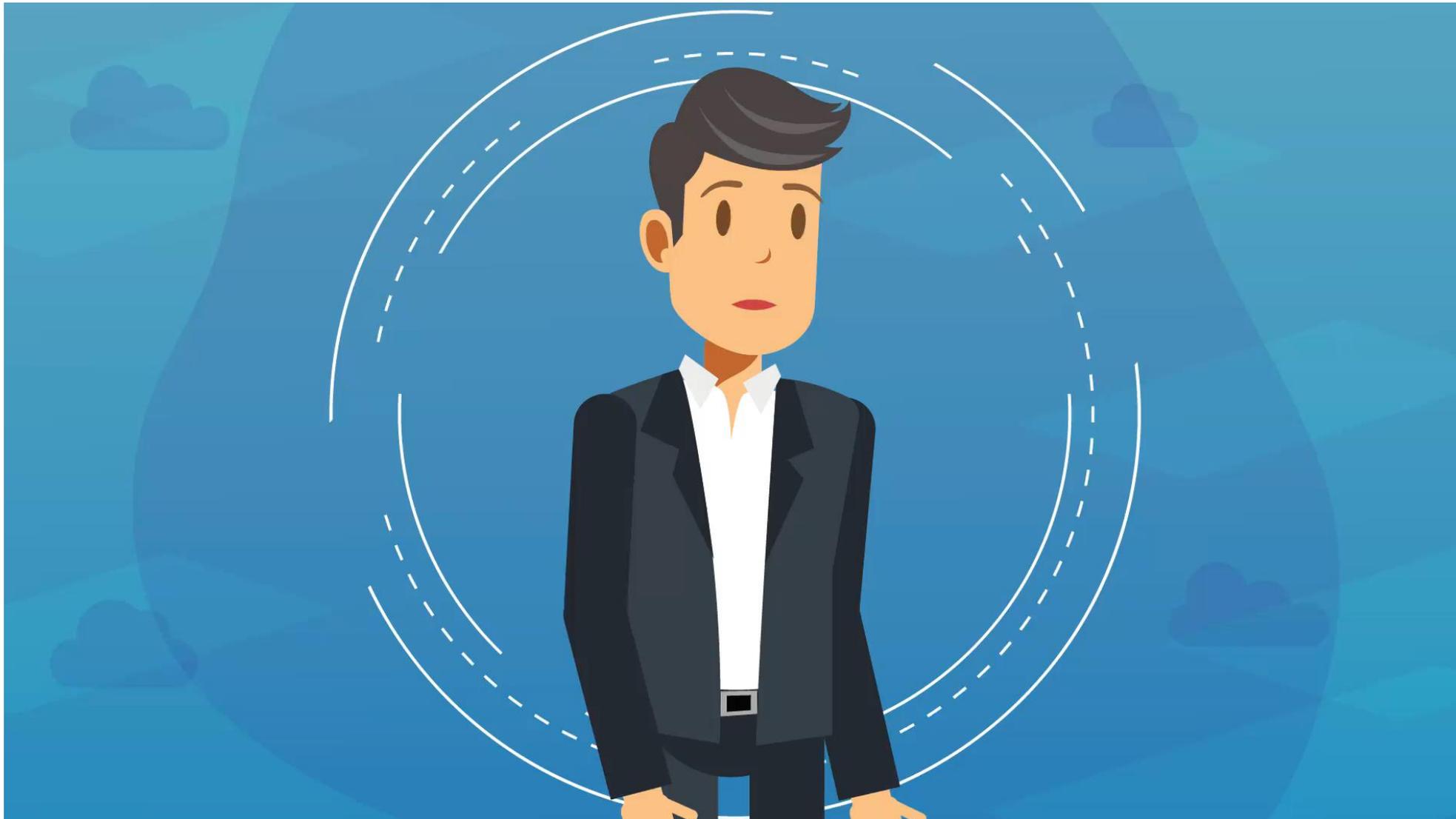




A Framework for Pairing Circular Economy and IoT:  
IoT as an enabler of the Circular Economy & circularity-by-design as an enabler for IoT

# Circular skills in the context of the CE-IoT Project

George Alexandris (ENPC)

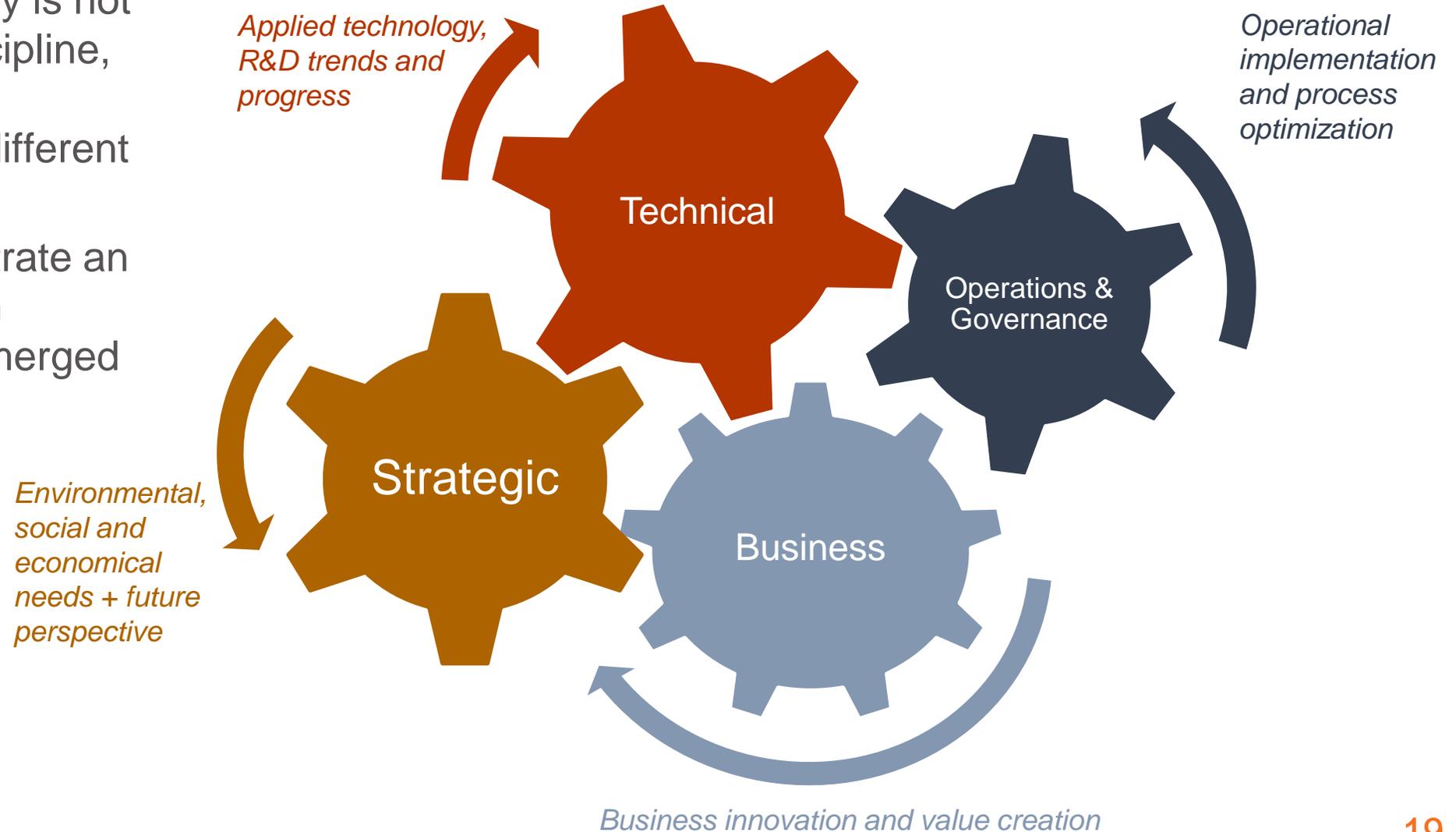


[Link to the video](#)

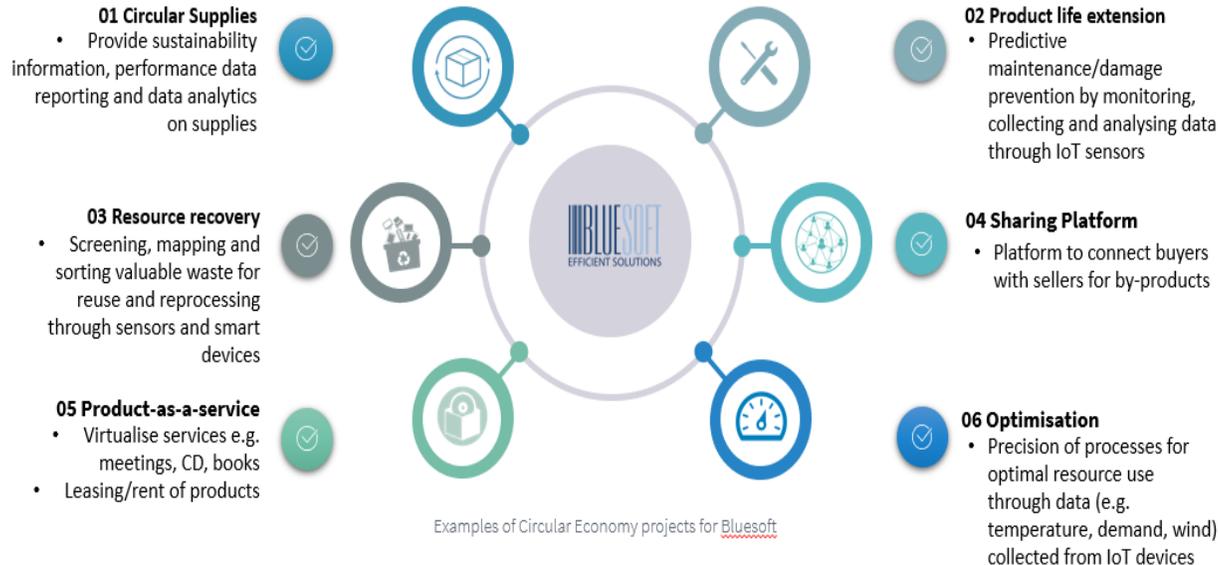


# CE-IoT as an interplay of different skills

- Circular economy is not just a single discipline, but the proper combination of different skill categories
- We will demonstrate an example of each category as it emerged from our project



# Strategic Skills: Circular Transition Scenario for a Company



Being Circular - maintain the value of products, materials and resources for as long as possible

- **“Know Thyself”**: Motivation, Goals
  - But also investment willingness & risk tolerance
- Contextualize the **value**
- Develop a **roadmap**
  - “No Brainers” ~1 year,
  - “Big Bets” ~3 years,
  - “Moonshots” ~5 years

→ Explore the **strategic domains** of the company

- **New business models**
  - Product-as-a-Service, Sharing, Buy-Backs...
- **Circular product design**
  - Modular design, reusable materials,...
- **Reverse logistics**
  - Reuse & recycling in the supply chain,...
- **Market enablers**
  - Collaboration & partnerships, regulatory incentives, financing,...



Formulate a multi-disciplinary circular strategy

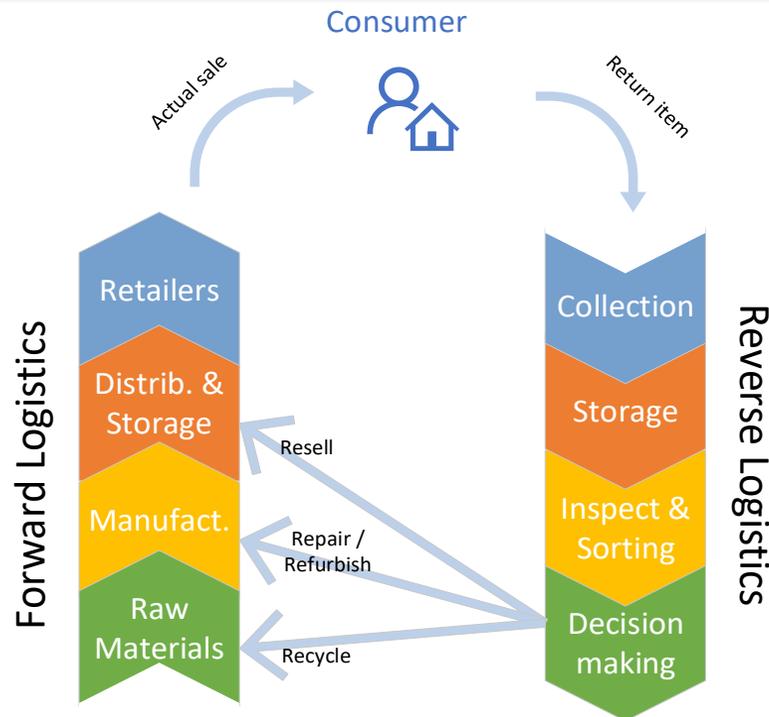


Establish short-term, medium-term and long-term goals



Communicate vision and strategy milestones

# O&G Skills: Reverse Logistics Scenario



Manage the **reverse flow of goods**, from end-user to manufacturer, and even back to raw materials

- **Collect & organize** returned products via a distribution network.
- Recovery of product: **evaluation** of the product condition, refurbishing or remanufacturing
- Make products available for **other markets**

→ Enhance processes which **amplify circularity**

- Investigate what and how to measure
  - Process times, quantities, product quality...
- Define success factors
  - Lead times, product quality and defects, returns revenue, costs...
- Foster cross-party visibility, accountability and information flow
- Standardize and optimize processes



Identify processes and establish KPIs inline with circular targets

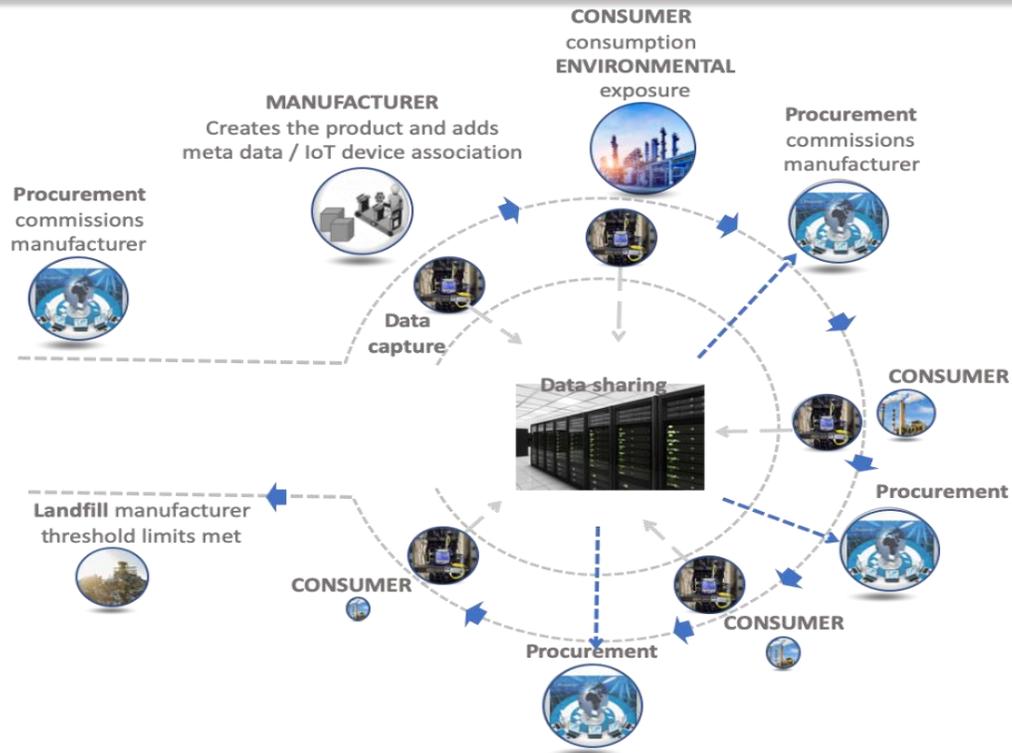


Measure improvements through metrics and periodical assessments



Evolve processes and advance circular maturity

# Business Skills: Building Materials Scenario



Current practice: traditional “design-bid-build” approach

- **Excess materials** in Bill-of-Materials for contingency, risk mitigation in case of overrun
- **Disposal** of unused materials via landfills
  - usually due to lack of traceability, shelf life constraints, inadequate storage facilities



Reduce resources & costs by incorporating circular materials



Establish partnerships and incentives for obtaining & transferring materials



Create added value through intelligent use of facilities (e.g. storage, transport, ...)

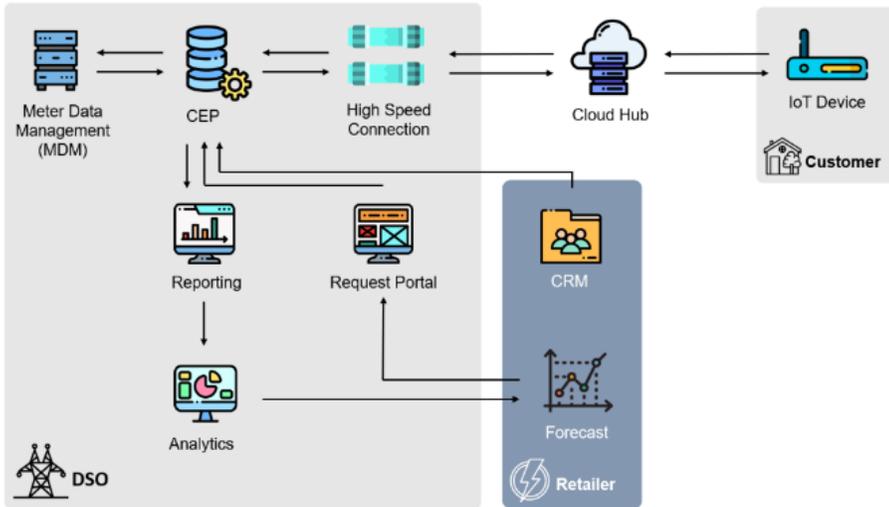


Promote and market the circular concept

→ Enable the **reuse** of excess materials by other parties

- Common **data-sharing** platform for all parties allows transparency & collaboration
- Quality assurance, traceability and tracking of materials is made possible by **IoT**
- Enabling trust between untrusted parties using **distributed ledger (Blockchain)** technologies

# Technical Skills: Energy Grid Scenario



## Current Practice: “Demand-Side Response”

- Consumers are requested by energy retailers to **curtail power usage** during **peak hours**
- Consumers are **motivated** by multi-tier pricing or reward-based incentive programs.
- Currently the process is **non-automated** and requires intervention from multiple parties, thus making it **inefficient**.

## → Introduction of **automated, IoT-based load-control**

- Instead of following the demand, intelligently curtail the **consumption** so that it **follows the supply**
- Remotely **connect and disconnect electrical devices** from the electrical network depending on their criticality
- Determine the **essential vs non-essential load consumptions**
- Establish communications between devices to determine **energy shortfall and surplus**.
- Based on supply and demand, take **remedial actions**.



Predict consumption patterns using analytics and deep-learning



Real-time data capture and processing at scale



Protocols & device interoperability  
Appliances, Distribution network, Generators,...



Privacy and security

# Key Takeaway

- Powering the circular economy requires a **variety** of skills and mindsets...



- ...but all of them should be **interlocked** by the **same principles**.

- What strengths can **you** contribute?



A Framework for Pairing Circular Economy and IoT:  
IoT as an enabler of the Circular Economy & circularity-by-design as an enabler for IoT

Thank you for your attention



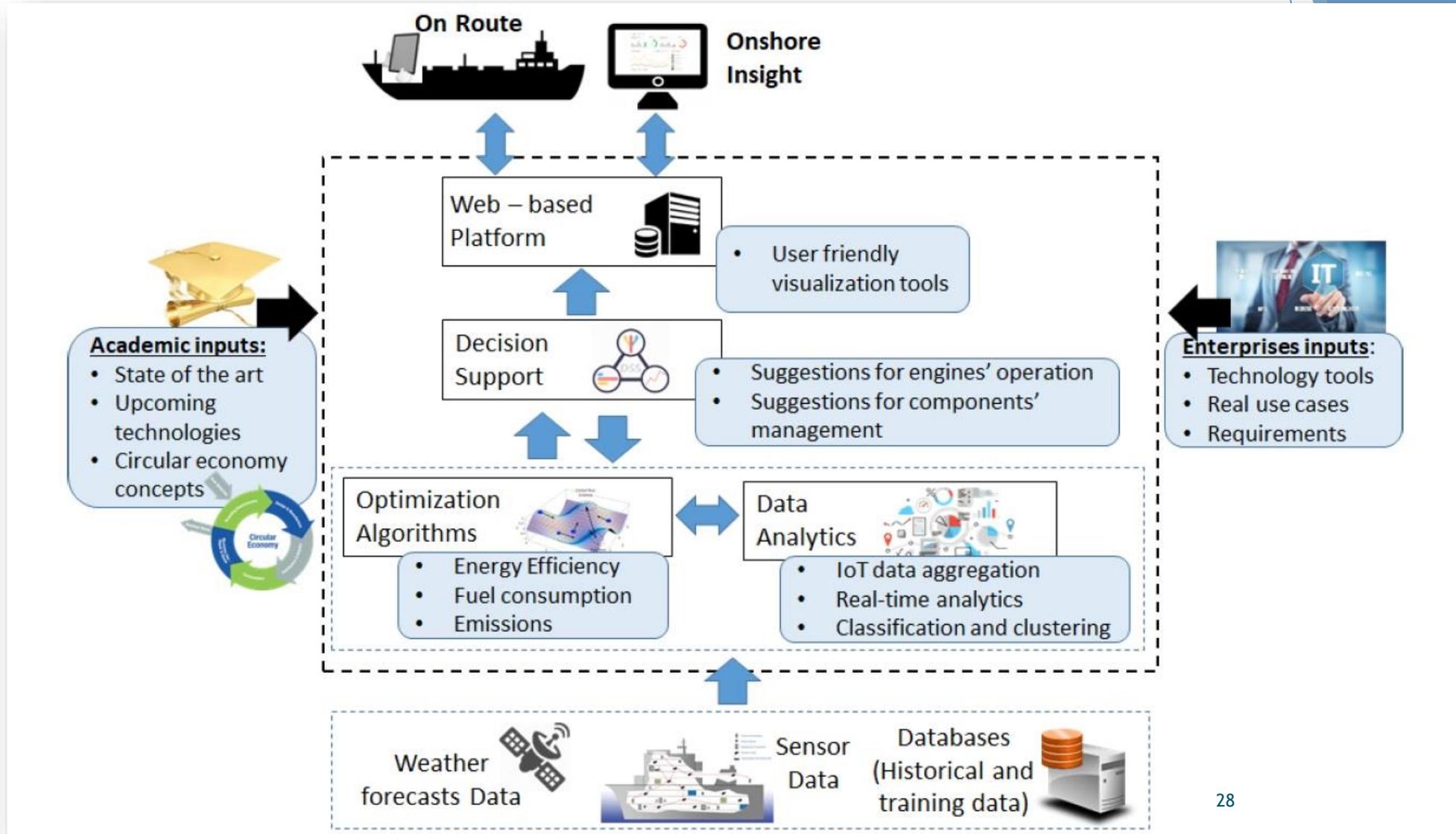


# **Digitalisation and Skills in a circular economy in the context of the SmartShip project**

# GHG emissions



# SmartShip architecture and knowledge transfer



# Scenarios and applied use cases



- ▶ Weather routing optimization
- ▶ Route monitoring
- ▶ Condition based predictive maintenance



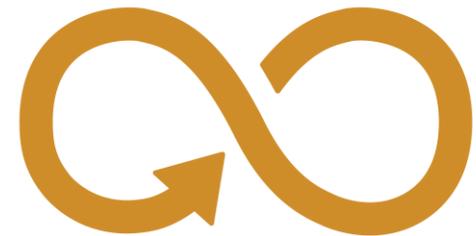
## *Applied Use Cases:*

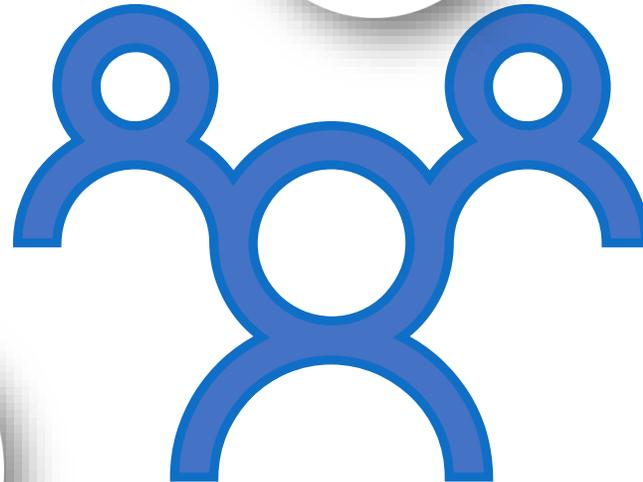
- Voyage planning / Route optimization
- Predictive Analytics - Maintenance - Supply decision making
- Bunkering optimization
- Compliance / Sustainable operation / Environmental Friendly operation

# 13 CLIMATE ACTION



# 12 RESPONSIBLE CONSUMPTION AND PRODUCTION





# Partners

Circular Economy Research Center

# SmartShip users

**Circular skills:**

- Circularity of materials from product design to recycling and reuse
- Support the circularity infrastructure
- Repairing and maintaining goods
- Service skills
- Creative skills

**Skills:**

- Risk assessment
- Fleet management
- Safety and environmental awareness
- Maritime business knowledge
- Governance

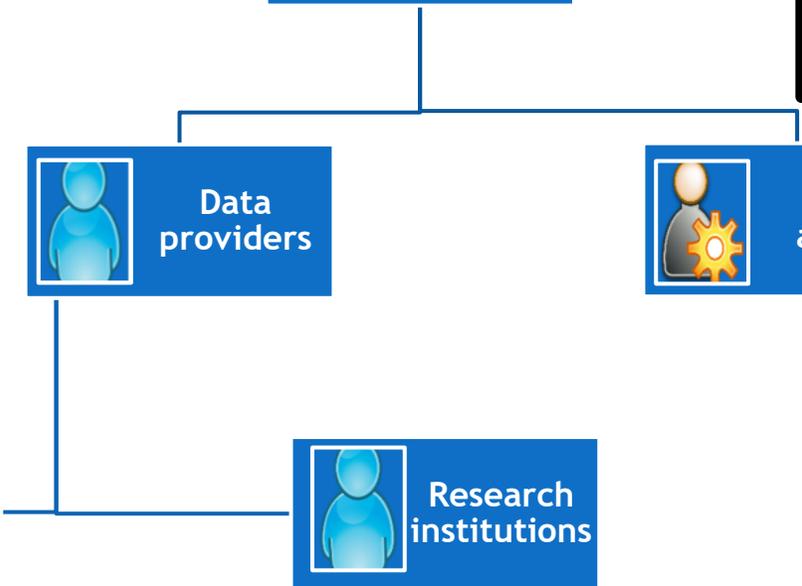
**Soft skills:**

- Communication
- Team work
- Problem solving
- Conflict management

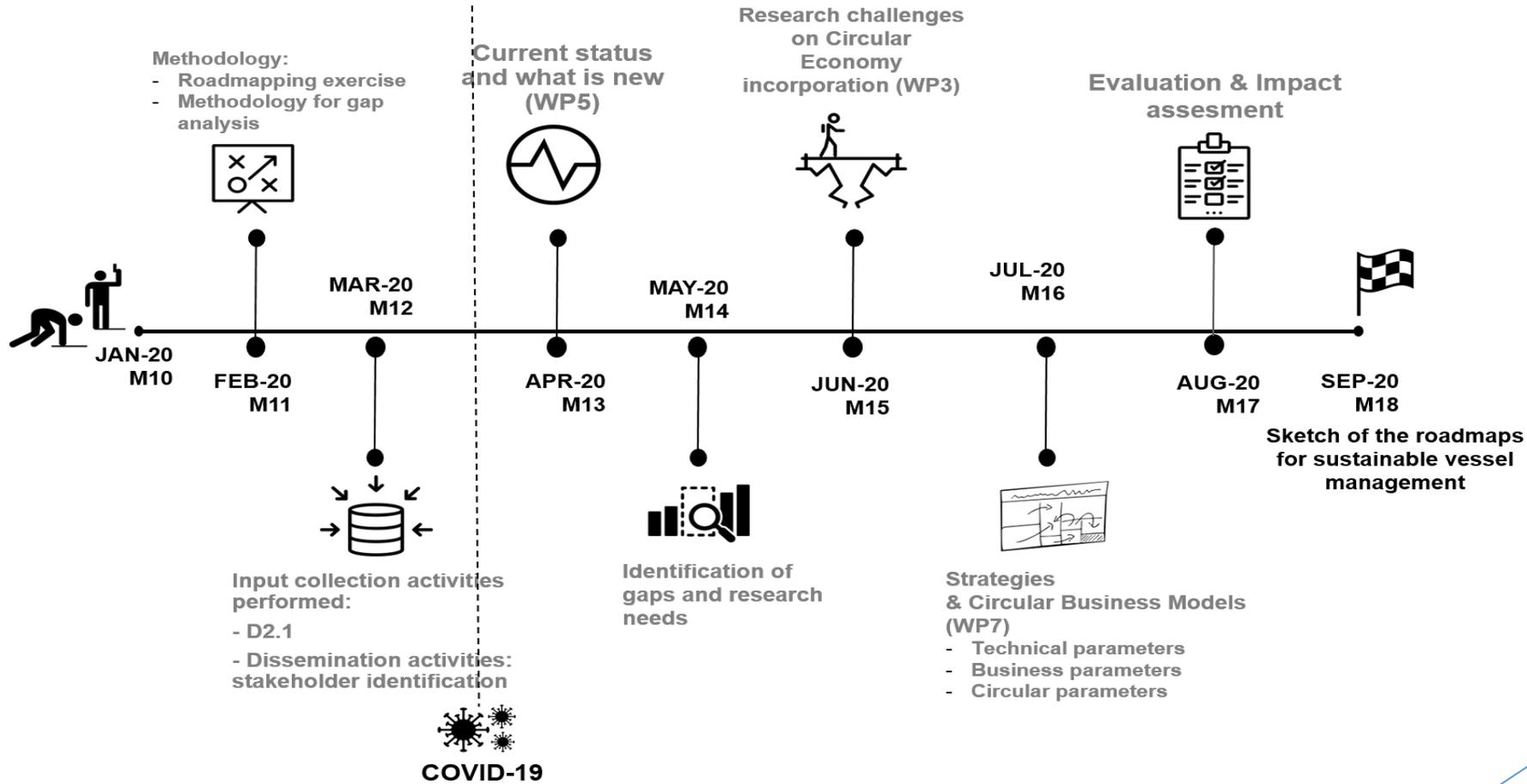


**Skills:**

- ICT skills
- Big Data
- Statistics



# Roadmap



*Thanks for your attention*

# Industrial-Driven Big Data as a Self-Service Solution

**Digitalisation and skills**

**Hernan Ruiz Ocampo**

**Circular City week**

**March 23, 2021**



## Project Consortium

13 partners

## PROJECT NAME

Industrial-Driven Big Data as a Self-Service Solution

## TOTAL BUDGET / TOTAL EC

### FUNDING

€ 4 997 035

## PROJECT TYPE

RIA

## START DATE

1 January 2018

## DURATION

36 months



<http://www.ibidaas.eu/>



@Ibidaas



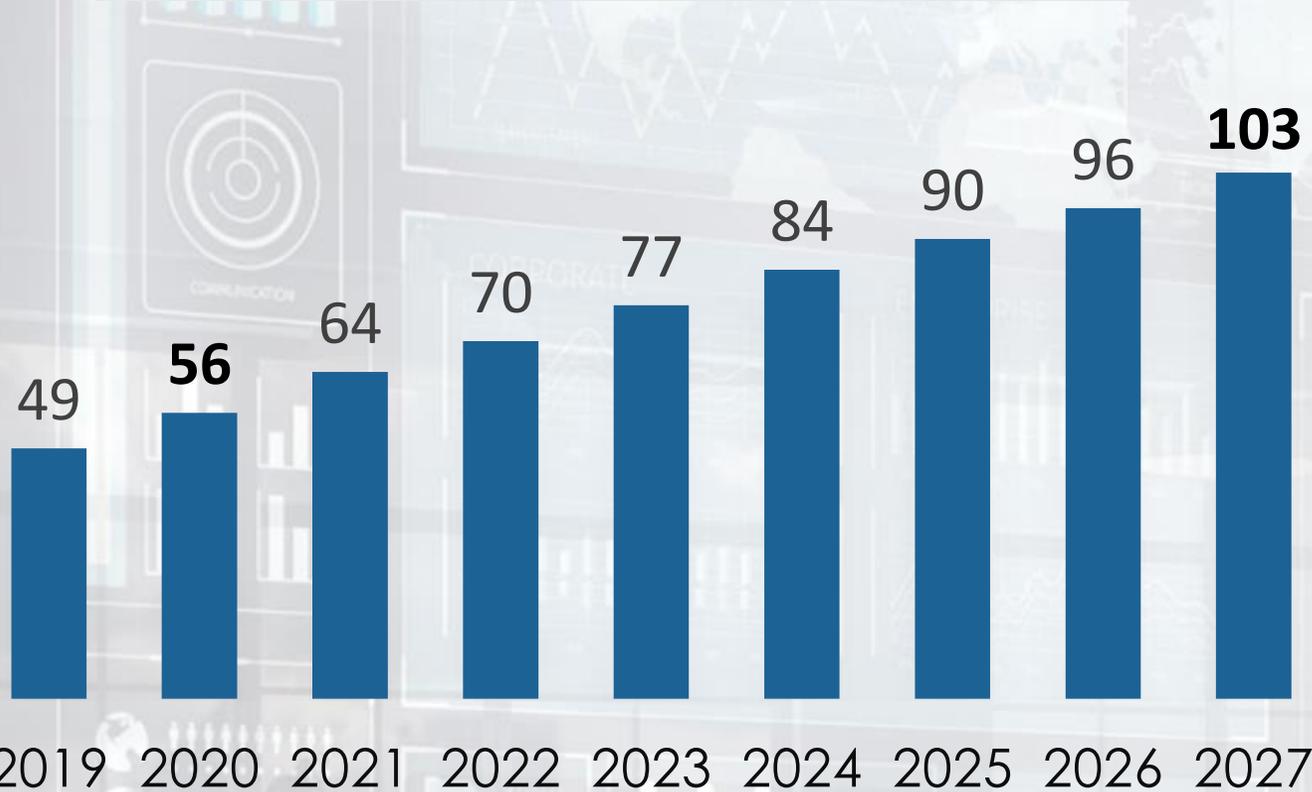
<https://www.linkedin.com/in/i-bidaas/>

1. FOUNDATION FOR RESEARCH AND TECHNOLOGY HELLAS (**FORTH**)
2. BARCELONA SUPERCOMPUTING CENTER - CENTRO NACIONAL DE SUPERCOMPUTACION (**BSC**)
3. IBM ISRAEL - SCIENCE AND TECHNOLOGY LTD (**IBM**)
4. CENTRO RICERCHE FIAT SCPA (**CRF**)
5. SOFTWARE AG (**SAG**)
6. CAIXABANK, S.A (**CAIXA**)
7. THE UNIVERSITY OF MANCHESTER (**UNIMAN**)
8. ECOLE NATIONALE DES PONTS ET CHAUSSEES (**ENPC**)
9. ATOS SPAIN SA (**ATOS**)
10. AEGIS IT RESEARCH LTD (**AEGIS**)
11. INFORMATION TECHNOLOGY FOR MARKET LEADERSHIP (**ITML**)
12. University of Novi Sad Faculty of Sciences Serbia (**UNSPMF**)
13. TELEFONICA INVESTIGACION Y DESARROLLO SA (**TID**)

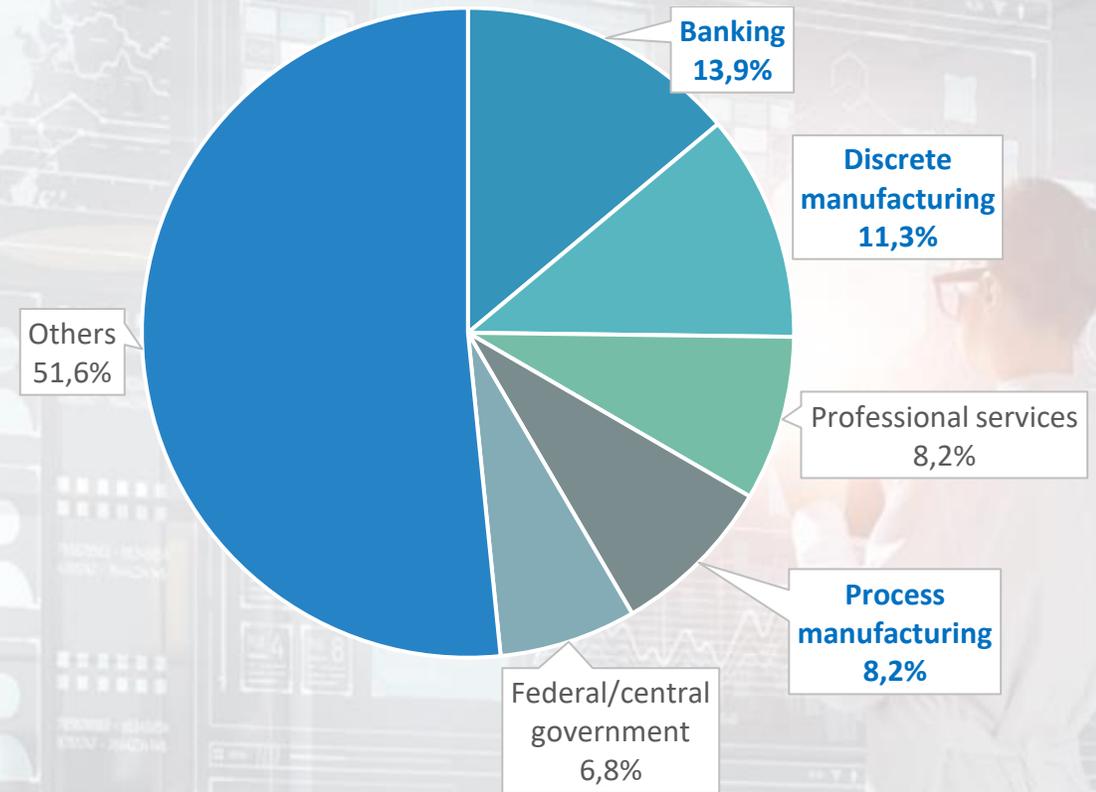




Forecast: Big Data size revenue worldwide from 2019 – 2027 (in billion U.S. dollars)



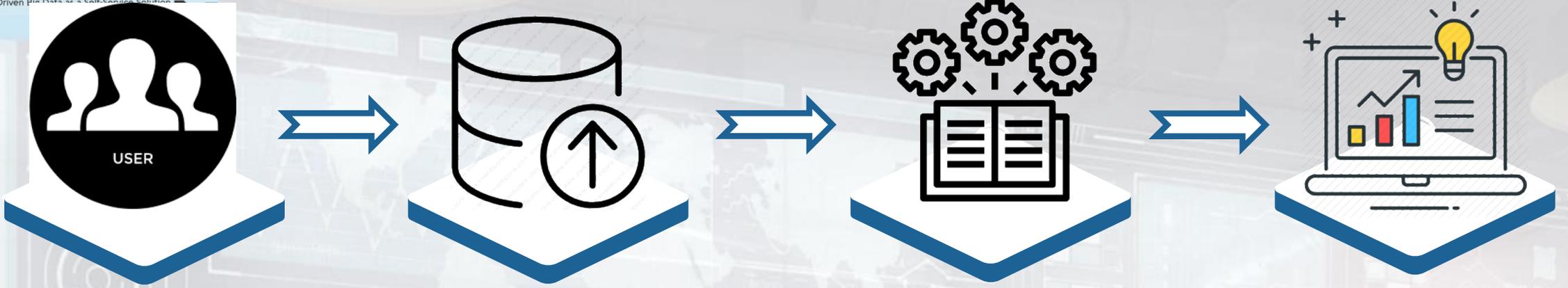
Share of Big Data and business Analytics revenue worldwide in 2019 by Industry



# Our Mission

We believe we are creating a unique product that allows you to  
**Incorporate BigData Analytics into your Business Decisions**





## Users

- Expert mode
- Self-service mode
- Co-develop mode

## Data

- Import your data
- Fabricate Data
- Tokenize data

## Analyze your Data

- Stream & Batch Analytics
- Expert: Upload your code
- Self-service: Select an algorithm from the pool
- Co-develop: custom end-to-end application

## Results

- Visualize the results
- Share models

**Flexible solution**

**Data sharing & breaking silos**

## Benefits of using I-BiDaaS



Do it yourself  
In a flexible  
manner



Break data silos



Safe environment



Interact with Big Data  
technologies



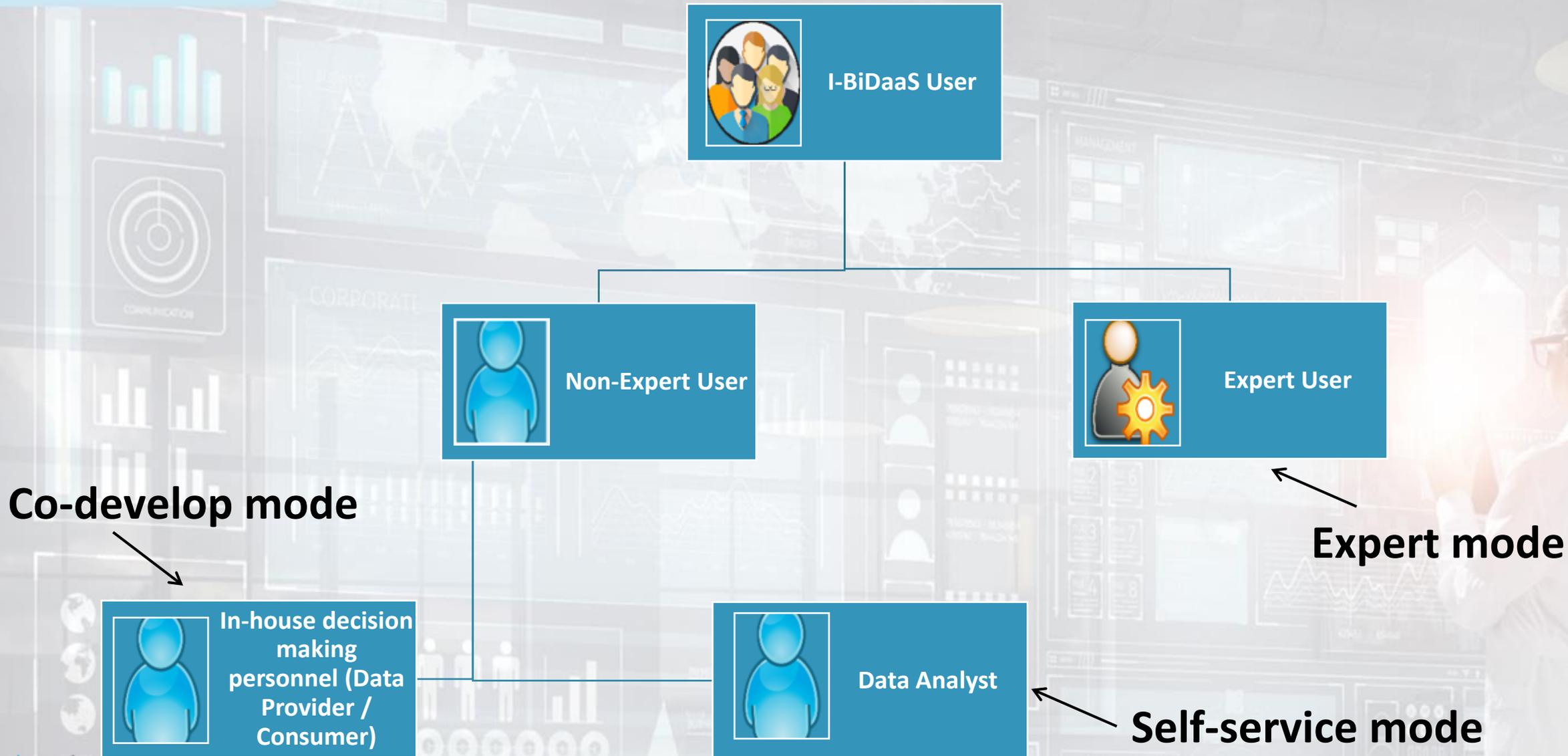
Increase speed of  
data analysis



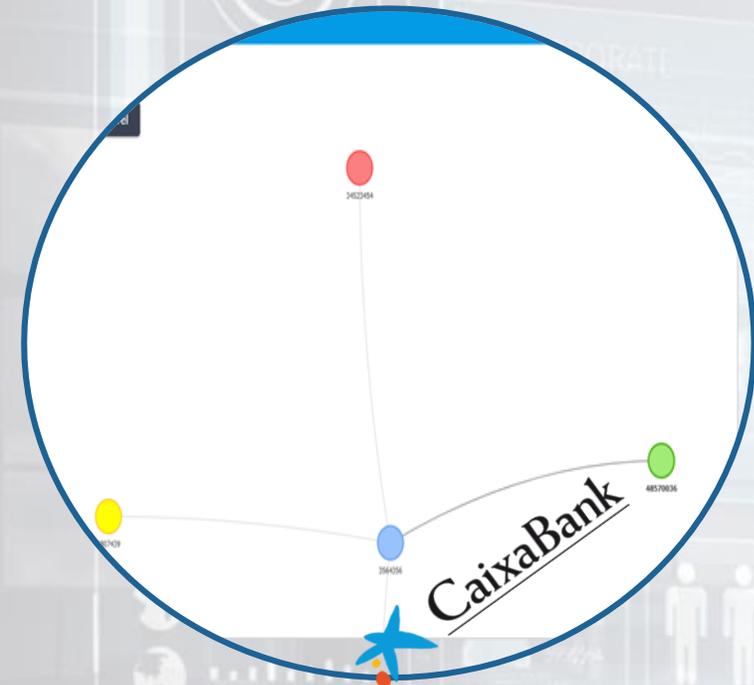
Intra- and inter-  
domain data-flow



Cope with the rate of data  
asset growth



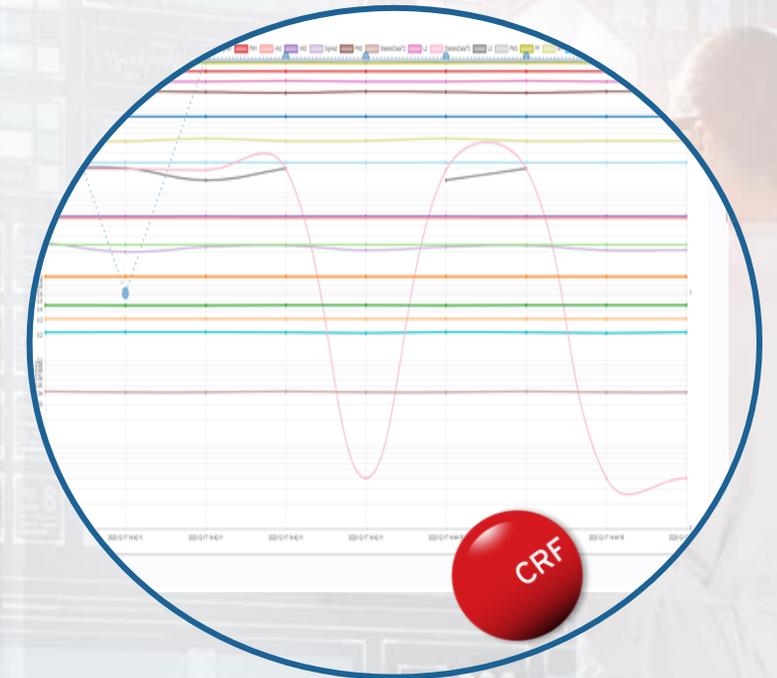
- Enhance control of customers to online banking
- Advanced analysis of bank transfer payment in financial terminal
- Analysis of relationships through IP addresses



- Accurate location prediction with high traffic and visibility
- Optimization of placement of telecommunication equipment
- Quality of Service in Call Centers



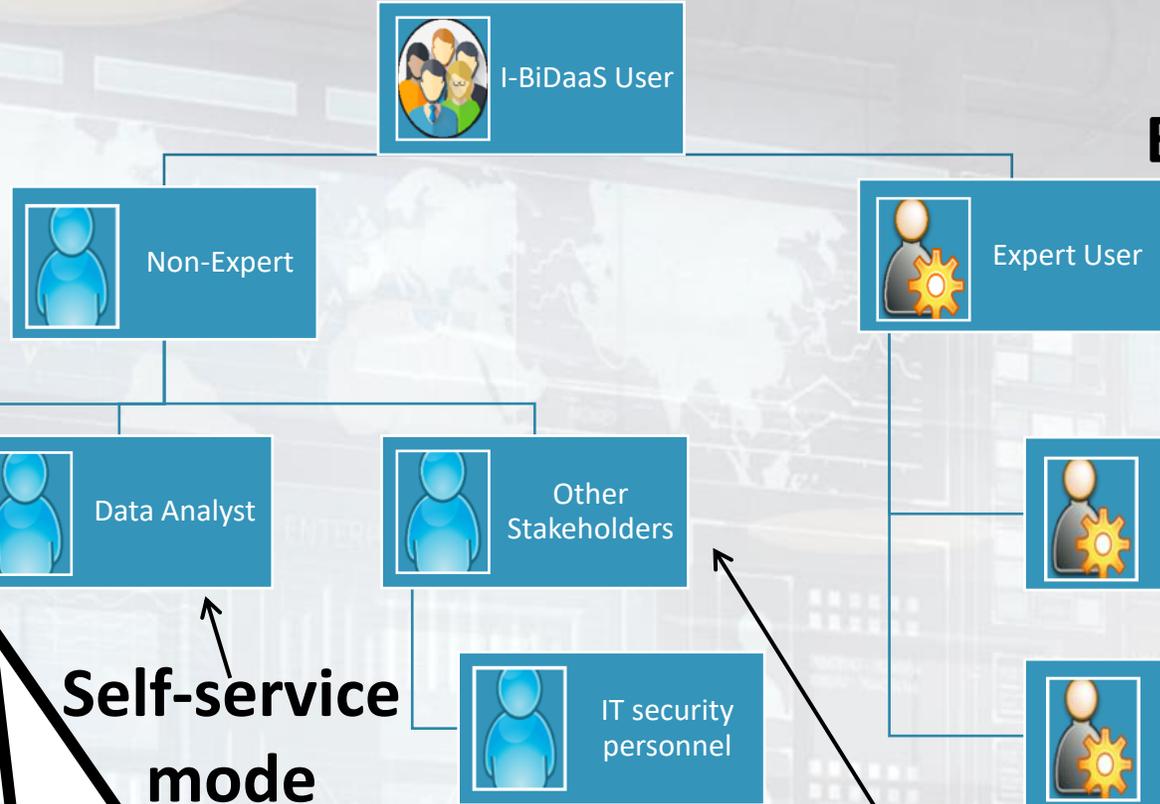
- Maintenance and monitoring of production assets
- Production process of aluminium Die-casting



**Skills:**

- Domain knowledge
- Manipulation of user-friendly visual interface

**Co-develop mode**



**Expert mode**

**Skills:**

- Python (numpy, pandas, etc.)
- PyCOMPSs (recommended)
- Parallelization and parallel processing (recommended)
- ML techniques, data pre-processing, data manipulation, visualization

**Self-service mode**

**Skills:**

- Basic data analysis & statistics
- Domain knowledge (recommended)

**Evaluation Administration (Not users per-se)**

## Business KPI

Measure the contribution to the business goals  
Ex. Product/service quality, Time efficiency

## Application Level Performance Indicators

Measure the analytical capabilities of the platform  
Ex. Data quality, End-to-end execution Time

## Platform Level Performance Indicators

Measure and monitor the platform performance  
Ex. Throughput, Cost

# Experiment	Indicator	Metric	Baseline value / Benchmark	I-BiDaaS value
<b>Business Level</b>	Time efficiency	Time to test new technologies	6 months – 1 year	
<b>Application Level</b>	Reliability & accuracy of insights generated	Accuracy Recall TP rate TN rate	90% of accuracy	
<b>Platform Level</b>	Cost	Price of technologies.	Cost of commercial product licenses	

# Comparison to DataBench Benchmarks

Industrial Sector	KPI	Benchmark: EU project DataBench (Improvement range)	I-BiDaaS value
Financial Services	Time efficiency	10–24%	75%
Telecom and Media	Product/Service quality	25–49%	200%
Manufacturing Sector	Cost reduction	4%	20-30%
Manufacturing Sector	Product/Service quality	10-24%	0.05 – 7%

## Long term value creation

### Circular Business Models: Product life-extension (CRF)

Product life extension enables companies to extend the lifecycle of products and assets so value that would otherwise be lost through wasted materials is instead maintained or even improved

#### Efficiency of the manufacturing plant

##### Overall Equipment Effectiveness (OEE)

Increase of 1-1.5 % in current Overall Equipment Effectiveness (OEE)

##### Cost reduction

Decrease of 20-30 % in maintenance costs

#### Enhance production times to reduce costs: Quality levels

Increase of 3-7 % good products

Decrease of 1-4% and 0.5-2 % defective products

#### Reduce time to produce decisions

From one month to few hours, a turn of job or 1 day

## Implement an efficient Big Data analytics lifecycle:



- implement a methodology (lessons learned - the best practices)
- implement a training environment to display the I-BiDaaS solution to potential end-users within our organisation
- promote a big data culture and new technologies to support the transition to circular industries

## CRF Training environment



### Strategy

**1st**

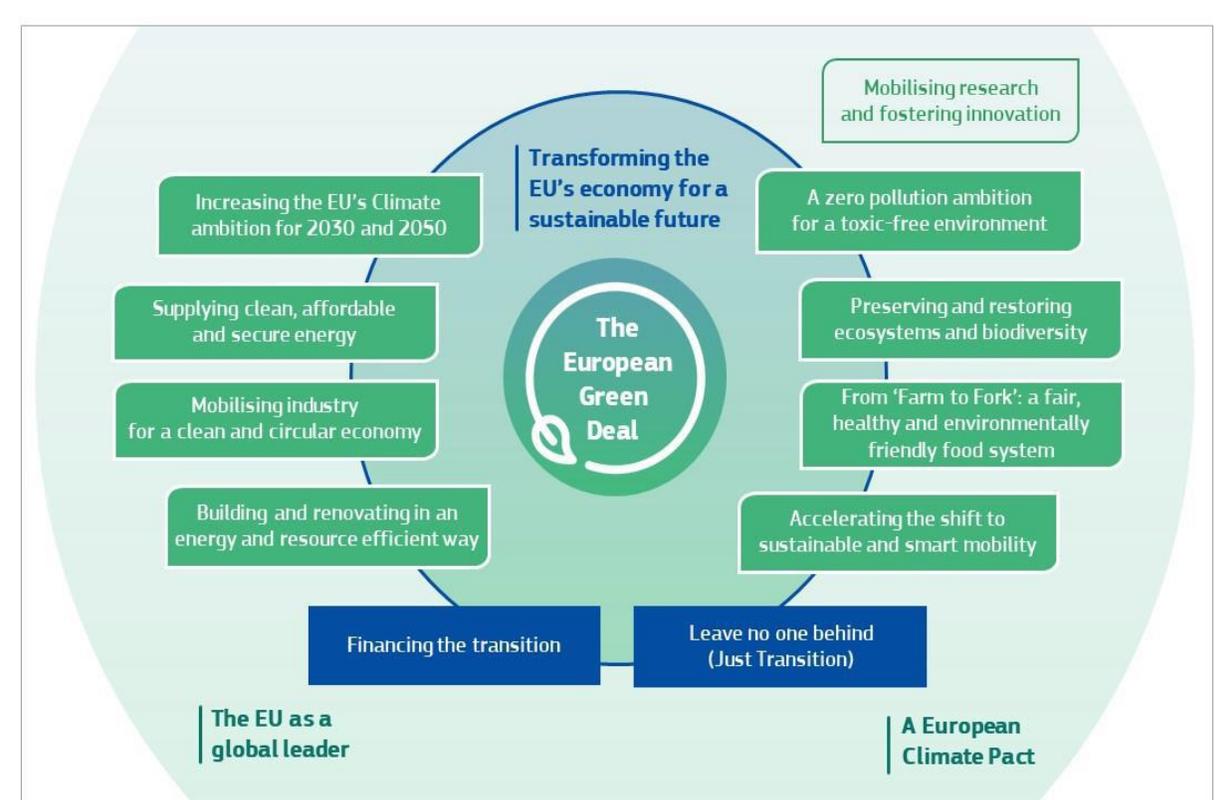
Presentation use cases, type of data collected and how data have been managed to perform the analytics

**2nd**

To show and explain step-by-step the I-BiDaaS platform in Interactive session to test the different features with the employees

**3rd**

**Potential achievements:** To integrate I-BiDaaS inside CRF premises & implement Circular Business Model to extend life cycle of products



## 2050 European Growth Strategy

### 4. CLUSTER 'DIGITAL, INDUSTRY AND SPACE'

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- Europe is at the forefront of the global transition towards a circular economy. **Europe's industry should become a circular industry:** the value of resources, materials and products should be maintained much longer compared to today, even opening up new value chains

**THANKS FOR YOUR  
ATTENTION**



**IDEAL-CITIES: Intelligence-Driven Urban Internet-of-Things Ecosystems for Circular, SAfe and InCLusive Smart CITIES**

<http://ideal-cities.eu>



Supported by



The Ideal-Cities project has received funding from the European Union's Horizon 2020 research and Innovation programme under the Marie Skłodowska Curie grant agreement No 778229

Circular City Week NY, 2021

# Data-driven Circular Economy

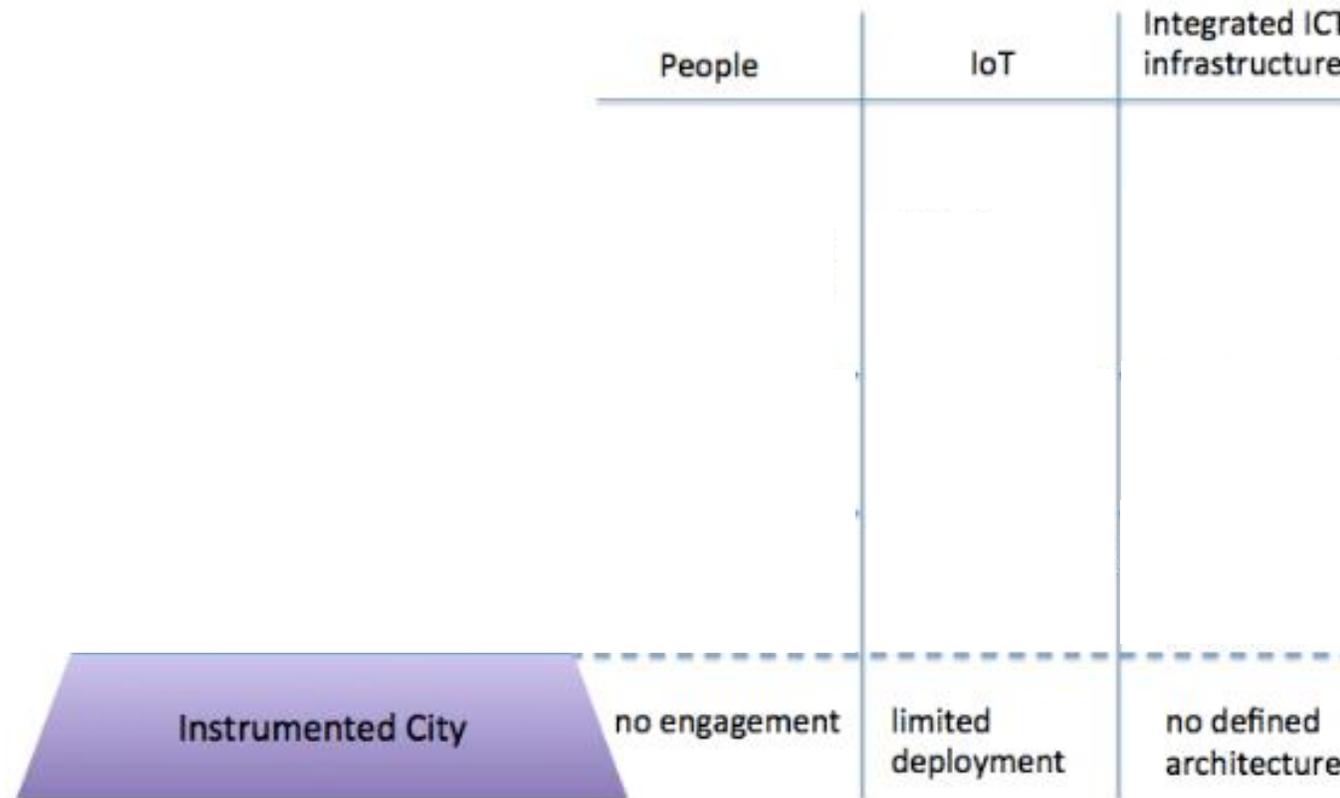
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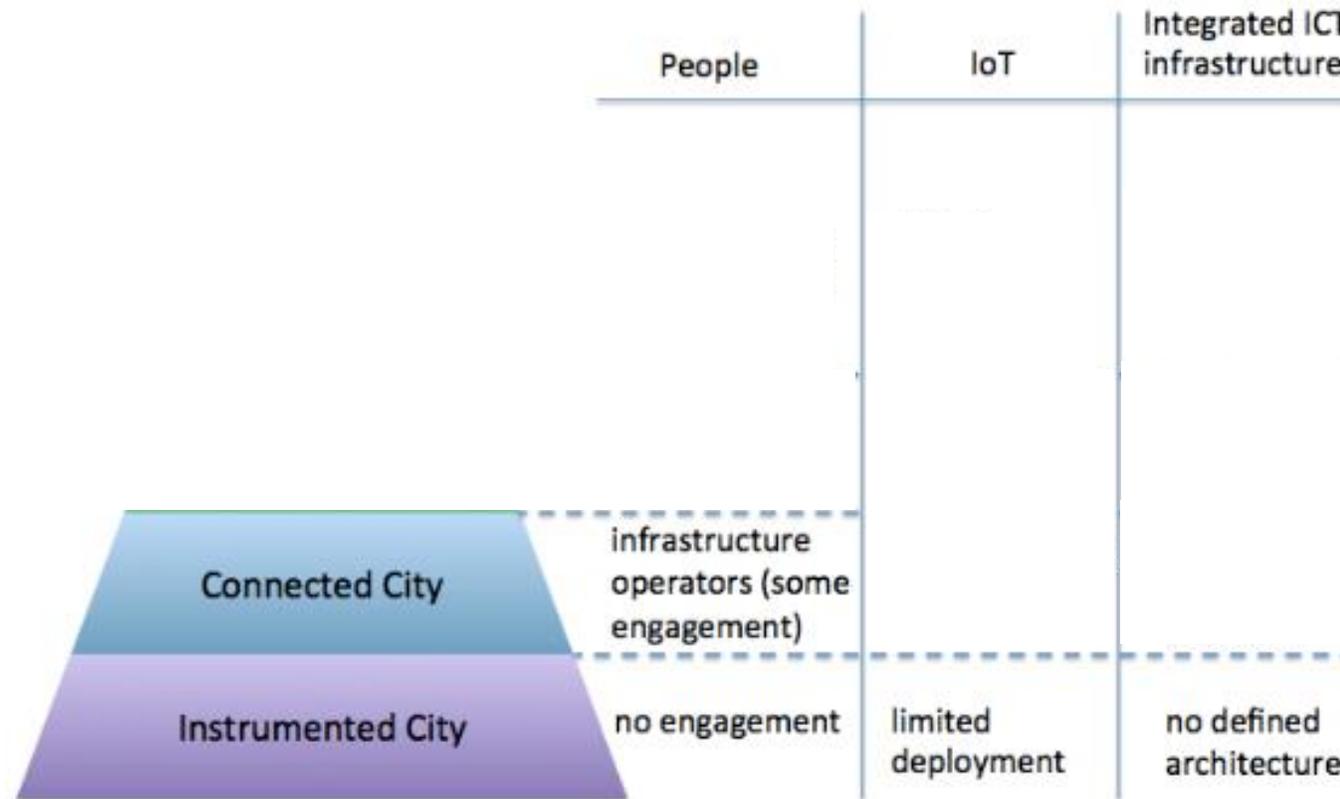
Data driven CE: The interplay between CE and ICT

...with a view of creating **intelligent assets** that will **enable** the delivery of CE services through real-time, fine grained decision making

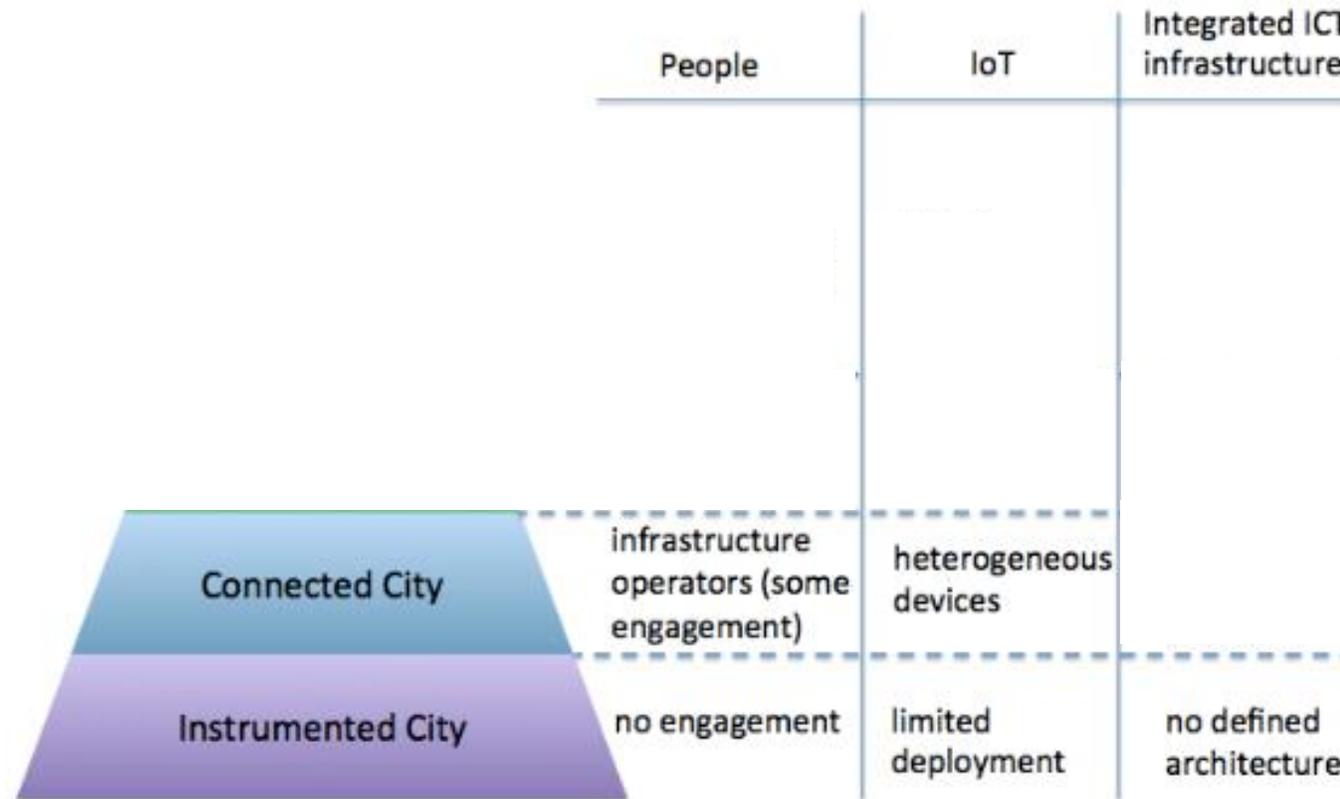
# A maturity model for smart, circular cities



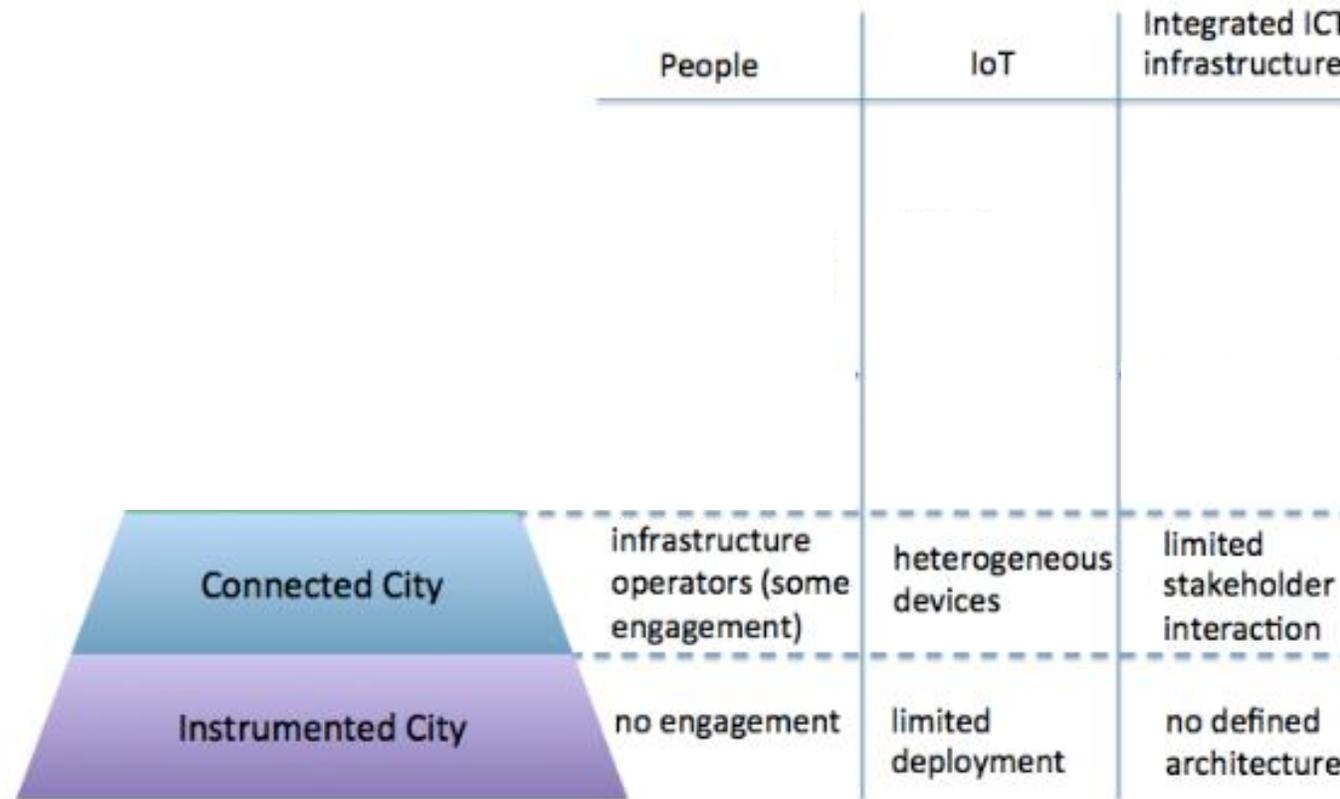
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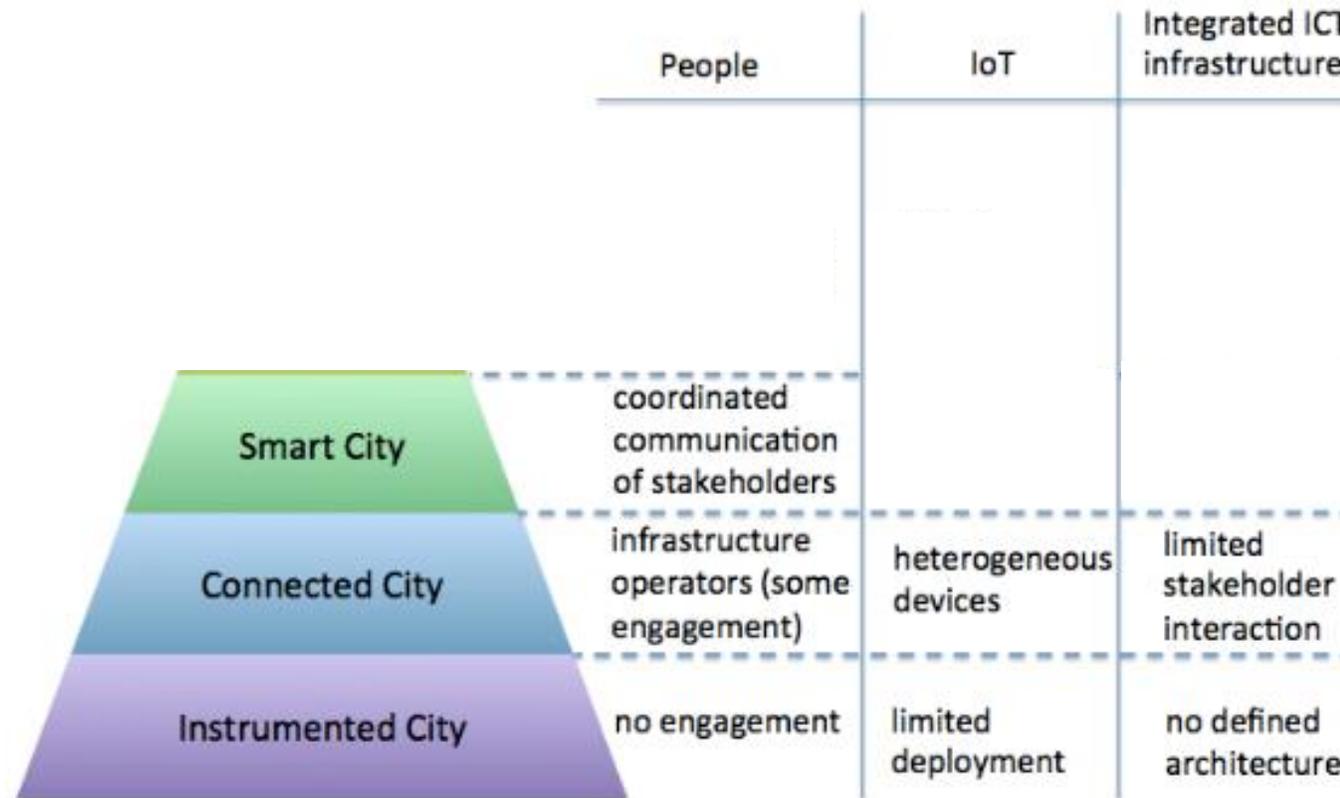
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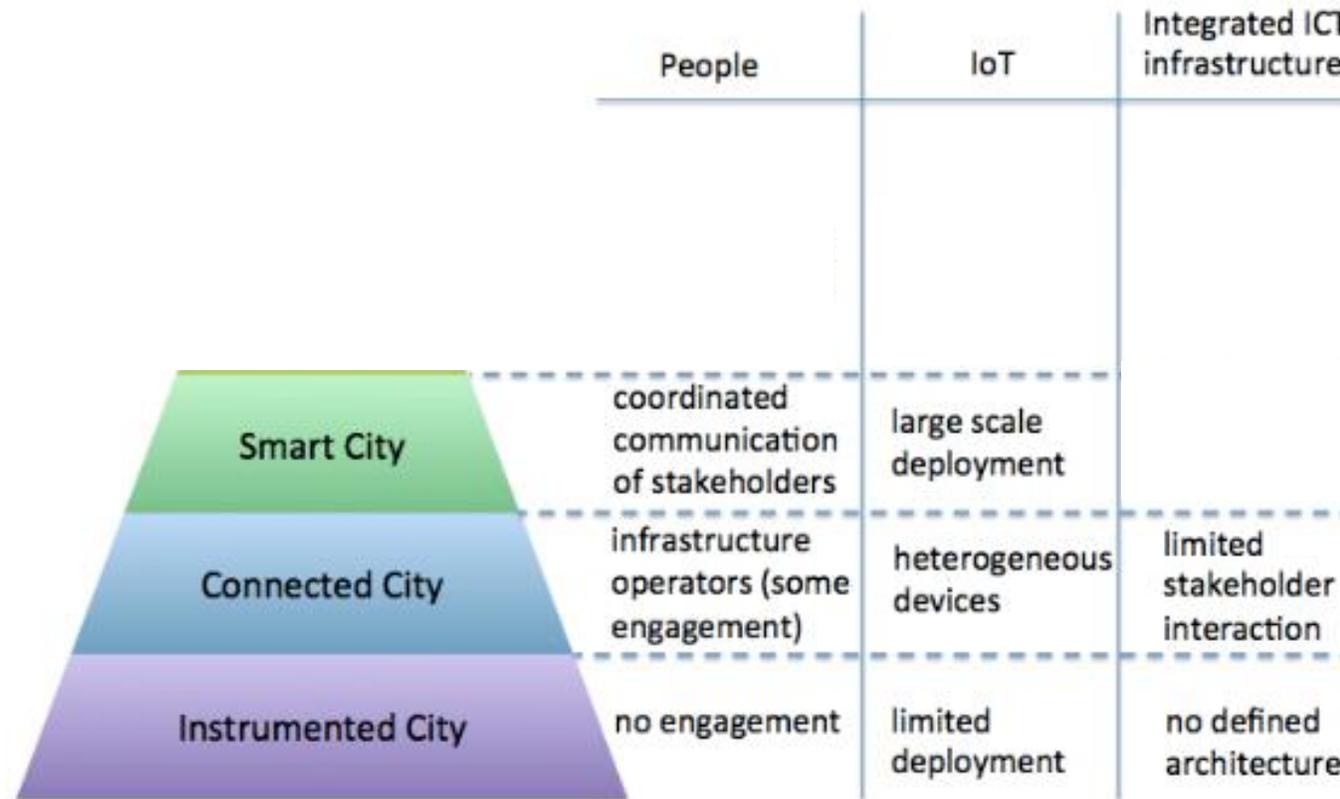
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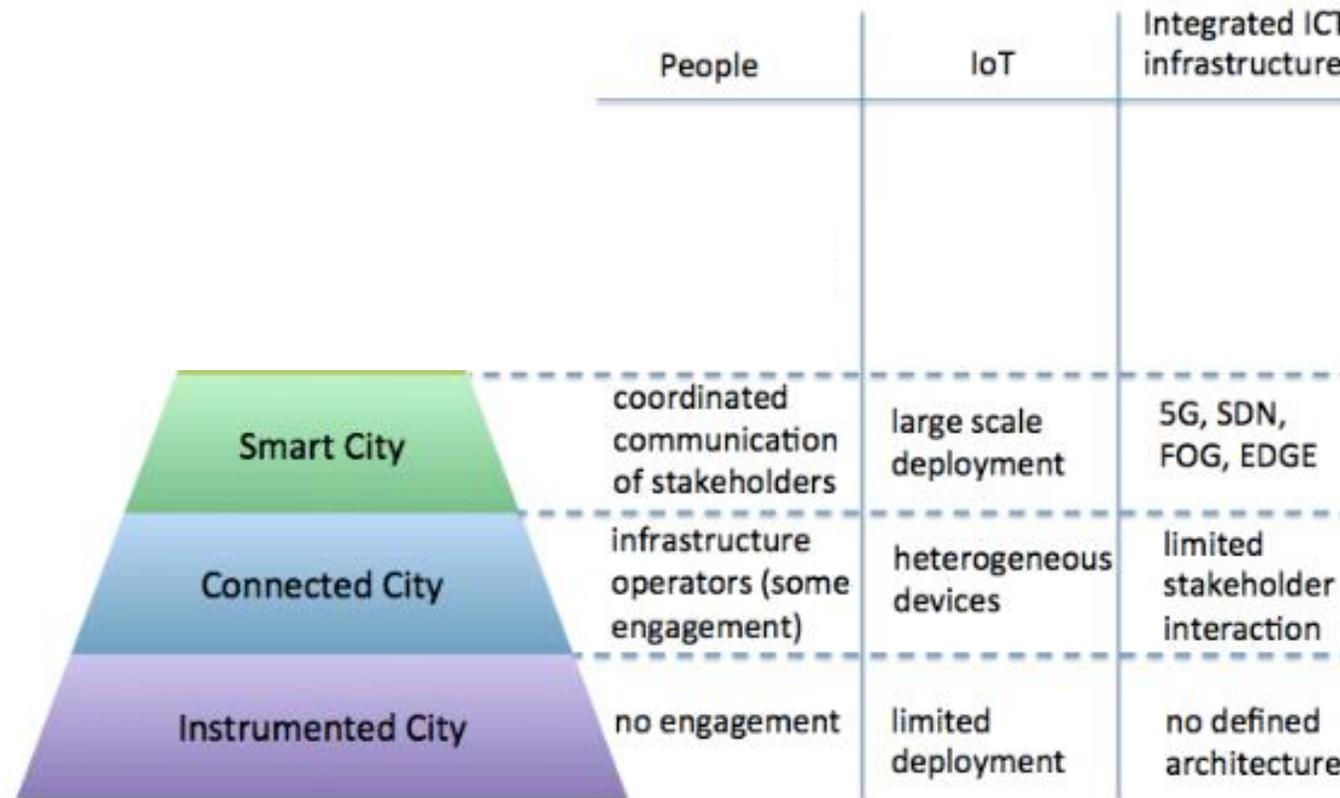
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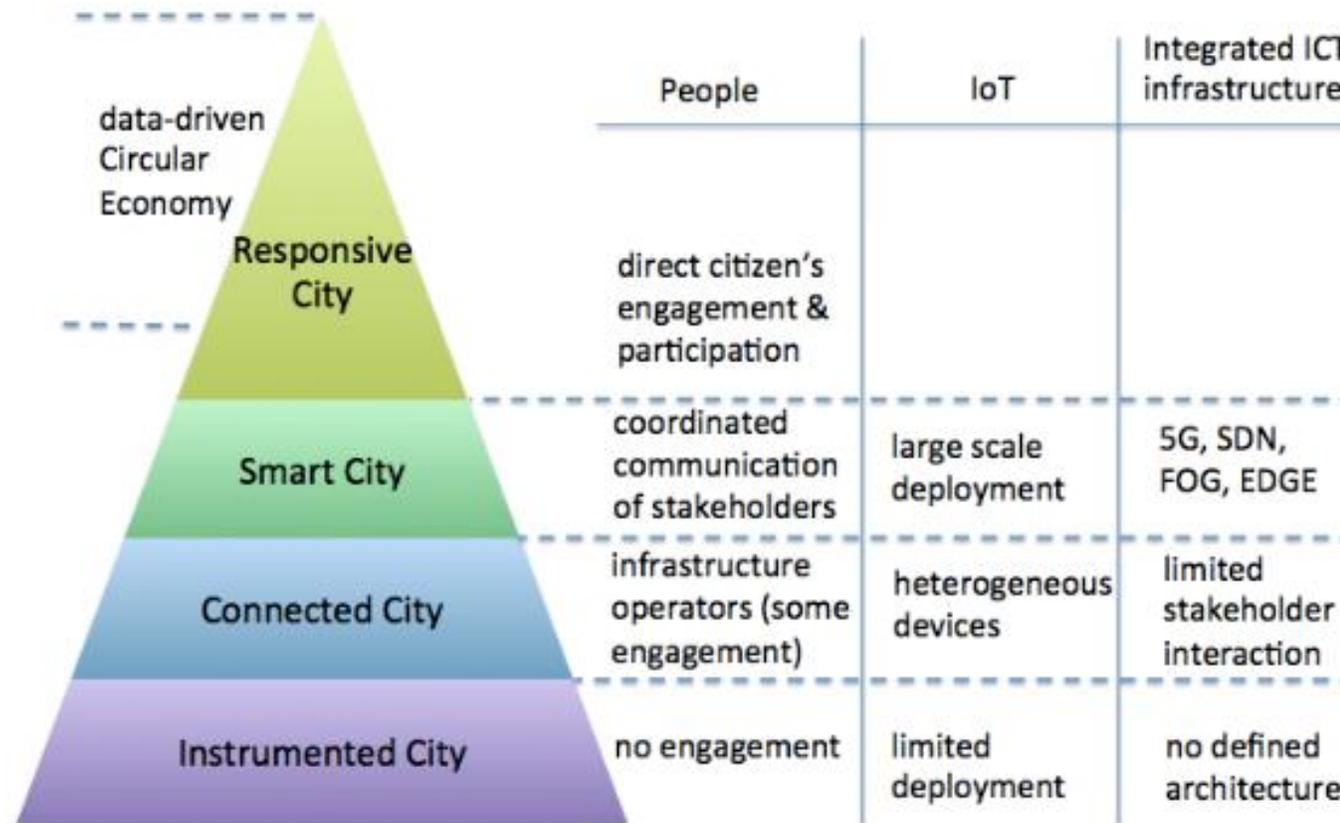
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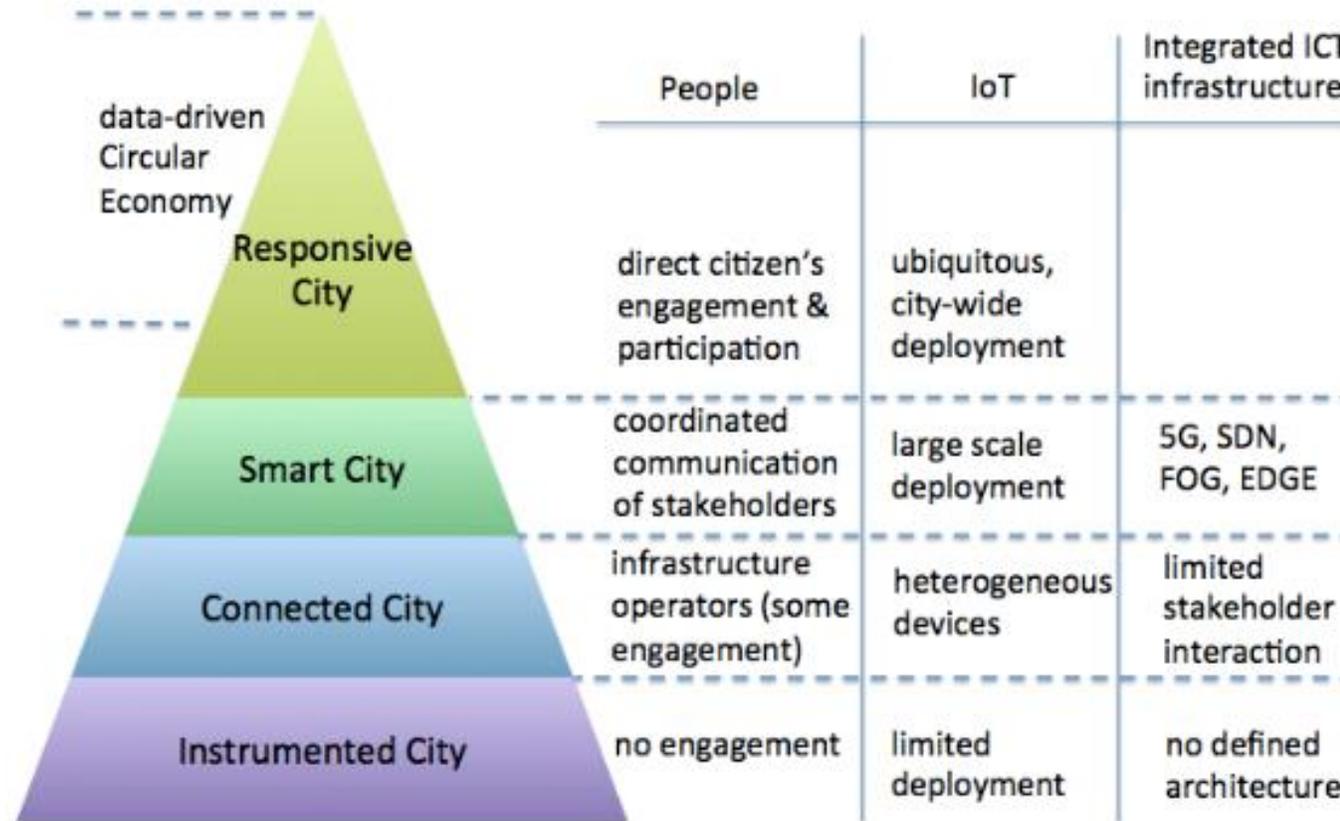
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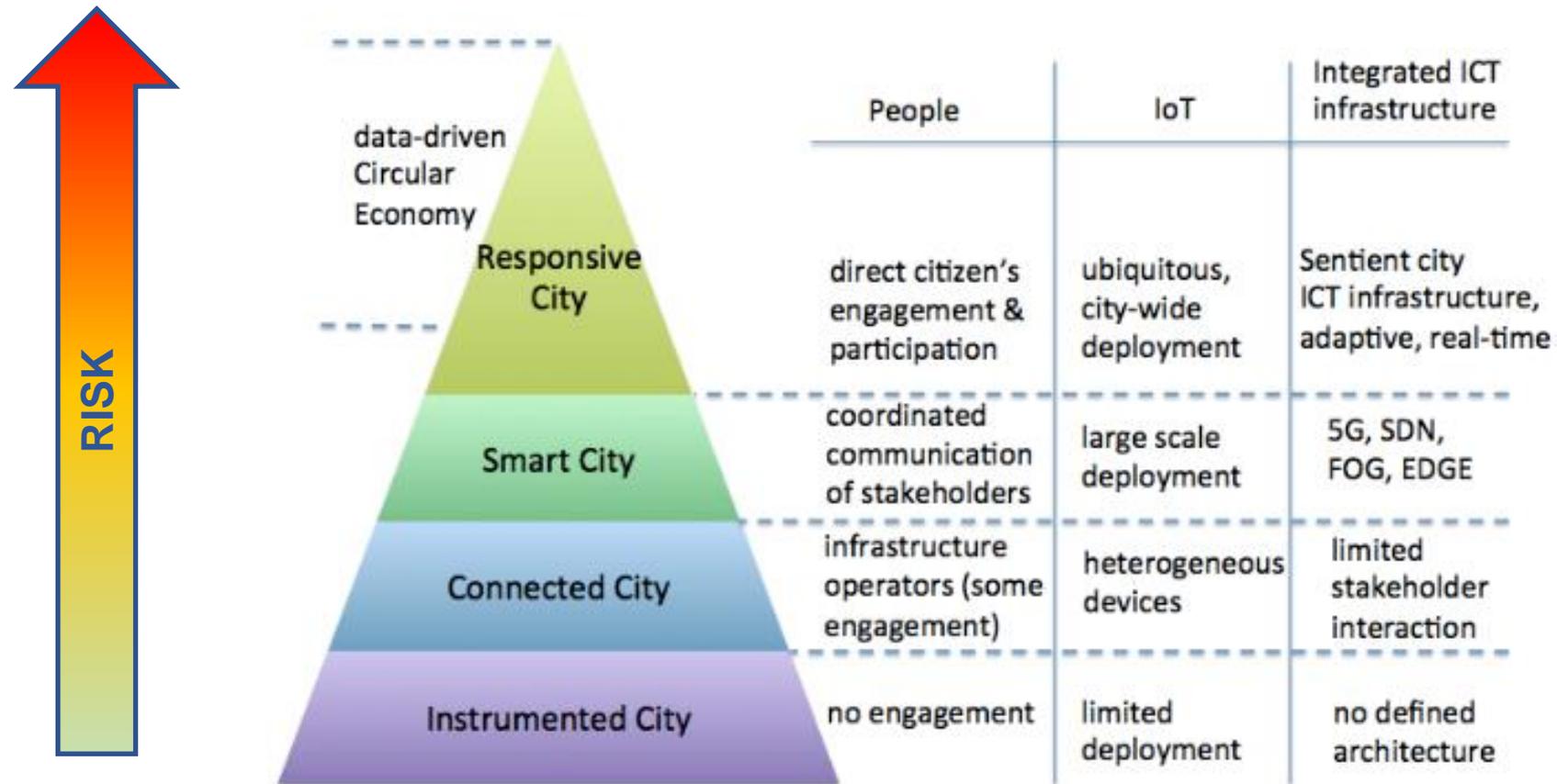
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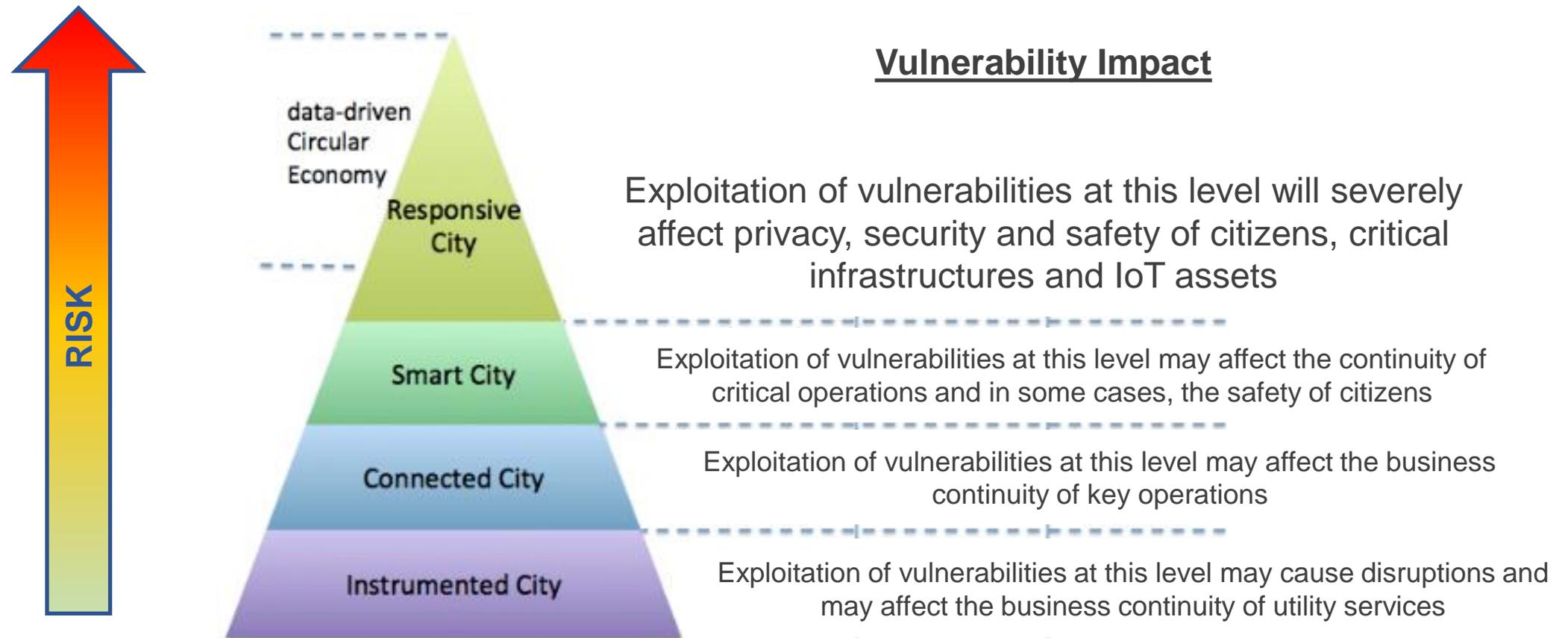
# A maturity model for smart, circular cities



# A maturity model for smart, circular cities



# A maturity model for smart, circular cities



- Question:
  - How can we achieve actionable threat intelligence through vulnerability management for the benefit of a smart city?

Table 1. Dataset description

<b>Vulnerabilities</b>		<b>City metrics</b>	
source	features	source	features
NVD[32]	CVE, CVSS	Cities in Motion[6]	96 variables over 9 indicator categories, including population, human capital, technology, city in motion score
Shodan	vulnerable devices, geolocation	IMD[7]	adoption of digital technologies, citizen perceptions, smart city ranking
MITRE[29]	CWE	C40[10]	leading CE cities

# Vulnerabilities exposure



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[Exploits](#) [Maps](#) [Images](#) [Share Search](#) [Download Results](#) [Create Report](#)

## TOTAL RESULTS

2,771,110

## TOP COUNTRIES



United States 2,771,110

## TOP SERVICES

HTTP	592,856
HTTPS	447,707
4567	340,103
SSH	109,077
DNS	56,428

## TOP ORGANIZATIONS

Akamai Technologies, Inc.	477,735
Optimum Online (Cablevision Sy...	356,400
WEBSITEWELCOME.COM	202,595
MCI Communications Services, I...	152,908
DigitalOcean, LLC	91,572

## TOP OPERATING SYSTEMS

Ubuntu	24,728
Debian	7,966

**New Service:** Keep track of what you have connected to the Internet. Check out [Shodan Monitor](#)

### IPCam Client

80.225  
pool-...net  
...Inc. ...  
**Business**  
Added on 2021-03-23 09:50:34 GMT  
United States, New York City  
Technologies:

HTTP/1.1 200 OK  
Content-Type: text/html  
Accept-Ranges: bytes  
ETag: "1896238687"  
Last-Modified: Wed, 05 Jul 2017 07:44:25 GMT  
Content-Length: 18291  
Date: Tue, 23 Mar 2021 09:50:32 GMT  
Server: lighttpd/1.4.31

### 204.174

... LLC  
Added on 2021-03-23 09:50:23 GMT  
United States, New York City

\x04Host \\'...37.241\' is not allowed to connect to this MySQL server

database

### 401 Unauthorized

7.164  
...net  
...Systems)  
Added on 2021-03-23 09:50:08 GMT  
United States, New York City

HTTP/1.1 401 Unauthorized  
WWW-Authenticate: Digest realm="", qop="auth", nonce="cf939b3b33be103f46bfc201..."  
Content-Type: text/html  
Cache-Control: no-cache,no-store  
Pragma: no-cache  
Expires: Tue, 23 Mar 2021 09:50:07 GMT  
Date: Tue, 23 Mar 2021 09:50:07 GM...

### Invalid URL

# Some results



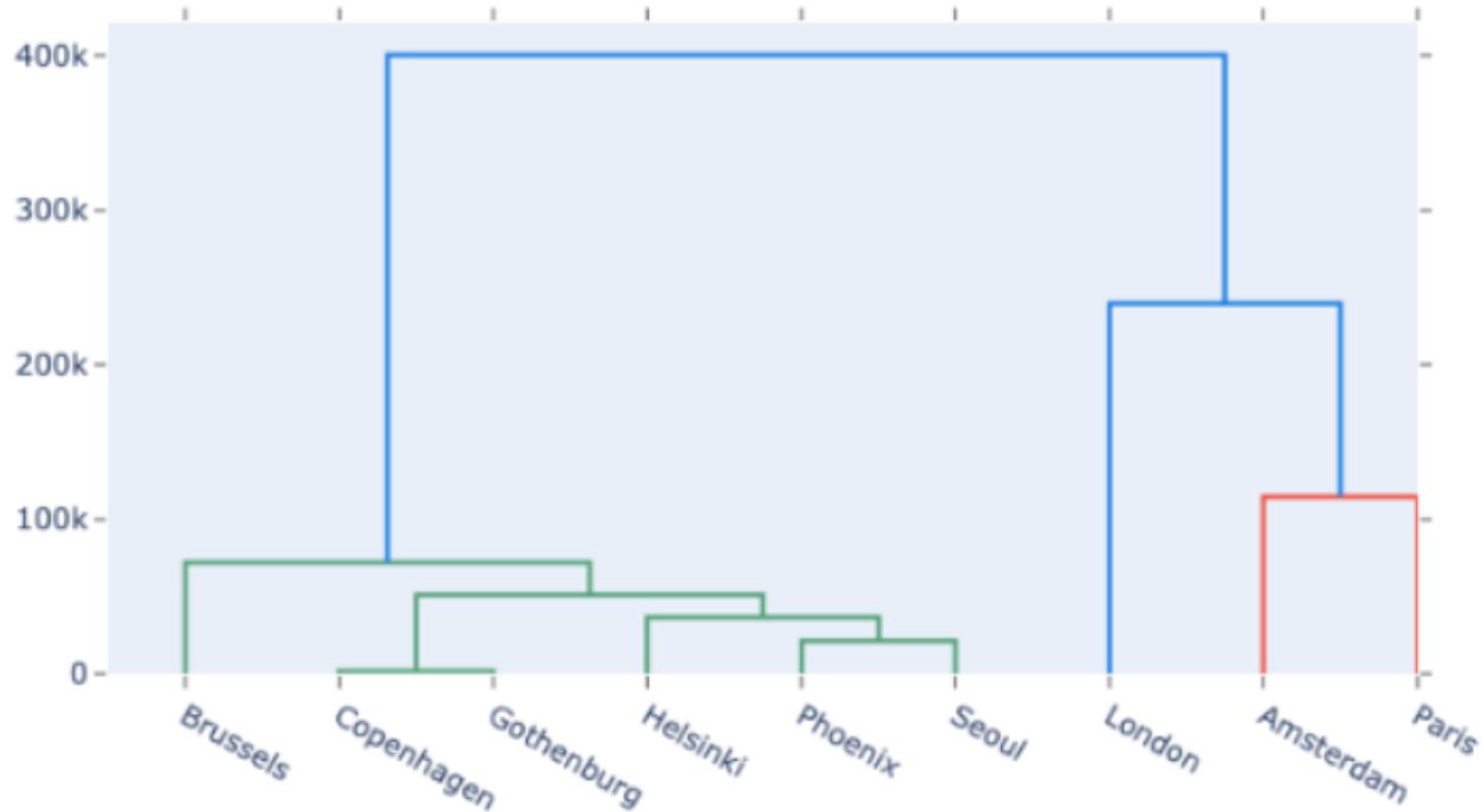
- Example Hypotheses:
  - $H_1$ : The severity of vulnerabilities in countries decreases with GDP per capita : **REJECT**
  - $H_2$ : The city type moderates the vulnerability exposure such that it is higher for smarter cities than plainer cities: **ACCEPT**
  - $H_3$ : The vulnerability exposure in cities increases with their population: **ACCEPT**
  - $H_4$ : The vulnerability exposure in cities decreases with their level of technology: **ACCEPT**

Table 3. Regression model 1

<b>Model Info</b>		<b>Model Fit</b>			
Observations:	170	F(3,166)=16727, p=0.000			
Dependent variable:	exposure	R <sup>2</sup> = 0.231			
Type:	OLS	Adj. R <sup>2</sup> = 0.217			
<b>Coefficients</b>					
	B	std. error	$\beta$	T	p
intercept	793555.776	743060.891		1068	.287
population	.187	.038	0.348	4891	.000
technology	-20047.553	4737.873	-.304	-4231	.000
city_type	775686.647	276255.132	.196	2808	.006

# Hierarchical clustering

- Cities having both a smart and circular economy agenda



Vulnerability exposure profile

# Key takeaway

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- Extend feedback loops on an interdisciplinary level
  - Cybersecurity to learn from CE practices
  - Cybersecurity to serve data-driven CE ecosystems
- Skills:
  - Cyber Threat Intelligence SHARING

‘Everything is connected!’

# Thank you!

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[vkatos@bournemouth.ac.uk](mailto:vkatos@bournemouth.ac.uk)



[vkatos](https://twitter.com/vkatos)



[Vasilis Katos](https://www.linkedin.com/in/VasilisKatos)