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PASSION FOR INNOVATION

Applied Data Science Project

L12 – Human Centred Design. Introduction: principles and tools

Politecnico di Torino

A.A.2023/2024

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I'm interested in the human dimension of technology.
I've been working on **research and innovation** projects,
leading activities related to the psychological and social aspects
that **influence the adoption and interaction with new technologies**.

I design and assess innovative and people-centred services,
applying the Human-Centred Design approach.

Why design is interesting for data science and viceversa?

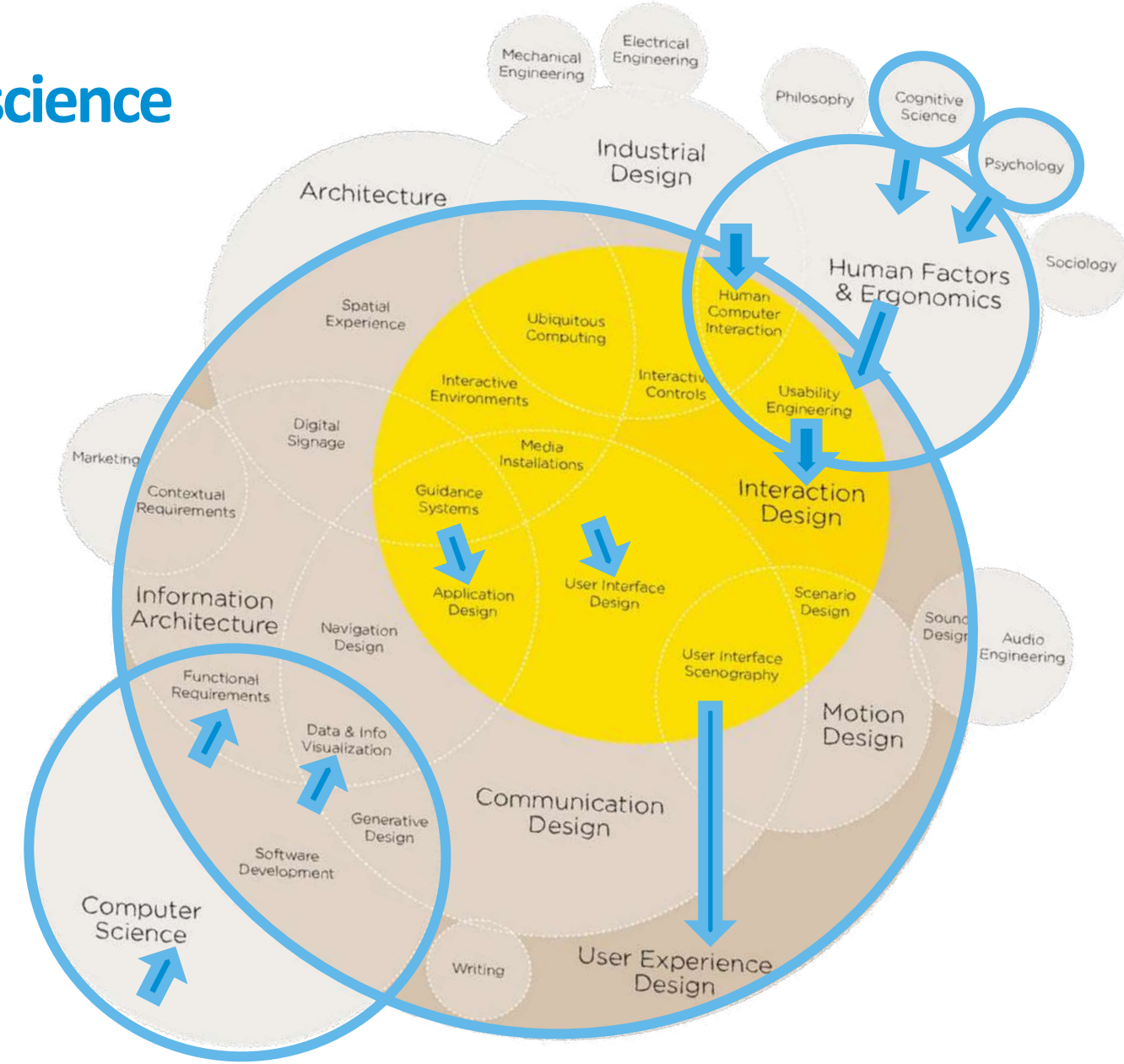
We know that we daily produce tons of data, even unintentionally.

Data science aims to **learn from data and extract value** from them, not only or not necessarily economic value.

Data scientists have the **responsibility and power to**

- decide which data to collect and use
- provide data and analysis to understand user needs
- collect and analyse data to test and improve services.
- monitor services over time to improve it

Psychologists and Designers provide the **mindset to work putting people first** and concretise **positive experiences**.



https://careerfoundry.com/

Why this module?

To **overcome and complete «*the impersonality of a purely technical approach to data*** *and to start designing ways to* ***connect data to what it really represents****: knowledge, behaviours, people*.»

«***Dealing with data and technology means dealing with*** *the lives of the* ***people*** *who use them, produce them, suffer the effects, the advantages but sometimes also discrimination*».

Big Data is a commodity and an intrinsic and iconic **feature of our present**.

Data Humanisms offers **a new way to think to data**, their usage, value and limitations informed by the real world, aware of the human diversity, needs and rights.

Data Humanism, the Revolution will be Visualized, 2017.

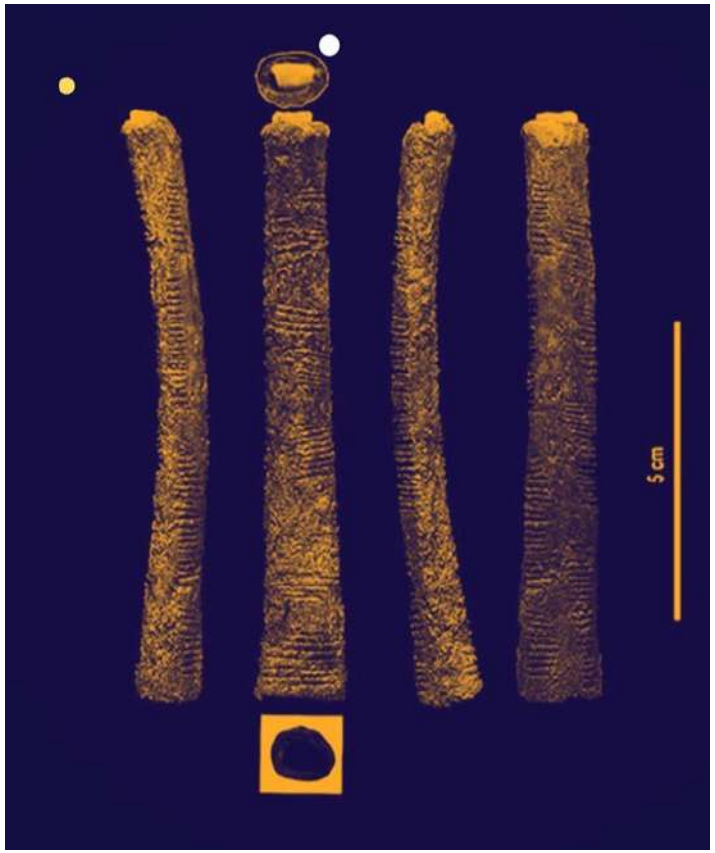
Content and activities of this module (9h)

9th of October 2024 10,00-11,30	**A humanistic approach to data**
30th of October 10,00-13,00	**The stakeholders analysis and mapping**
31st of October 13,00-14,30	**The users' Personas**
5th of November 10,00-13,00	**The user journey**

- Discover the principles and tools of the human-centred design approach
- Exploit the potential of data to reply to real needs and offer services
- Be driven by the problem and not by available data

20.000 A.C

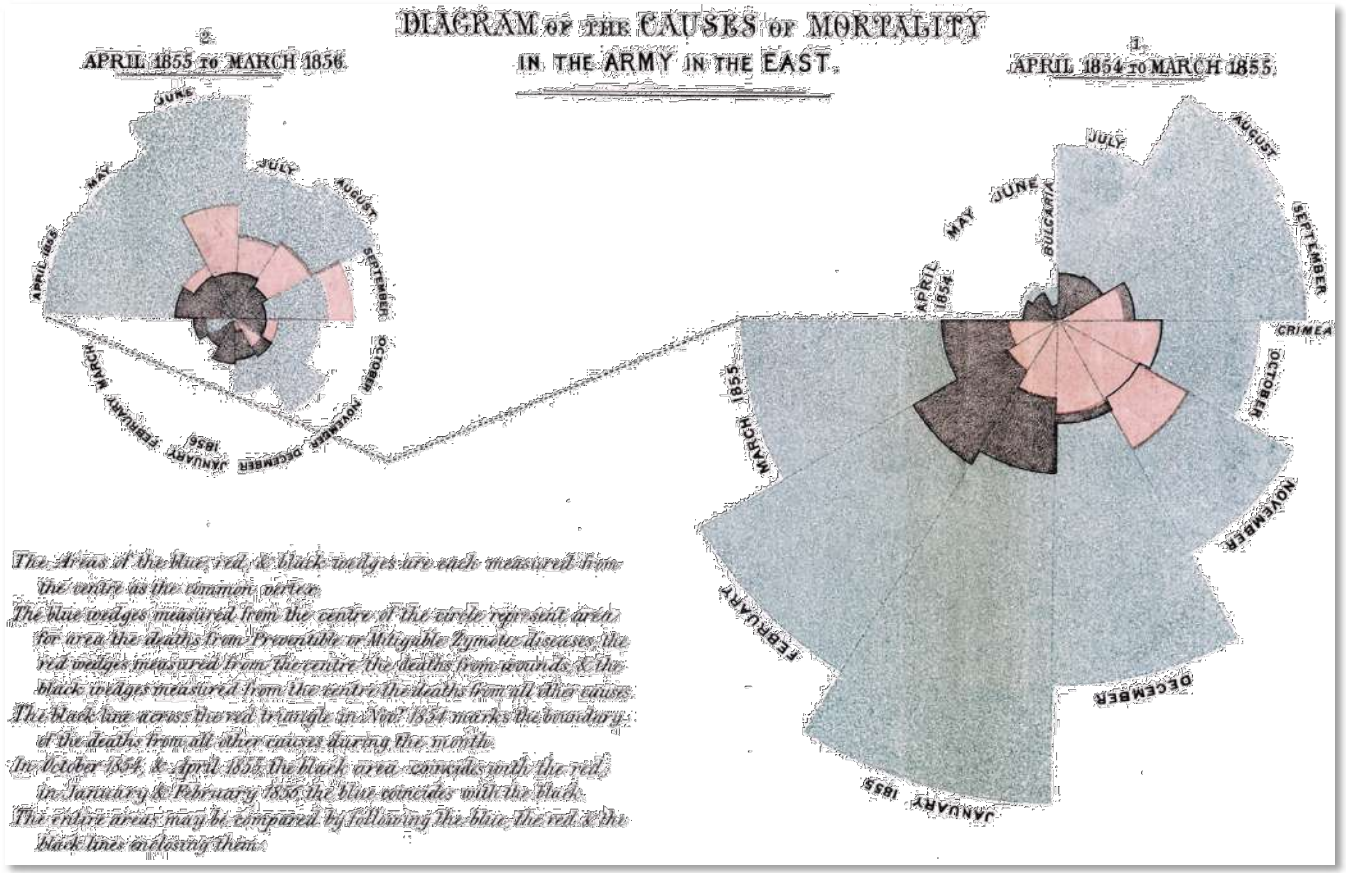
Data is always collected!



The first traces of data collection and calculation go back to the Paleolithic (2.5 million – 12.000 years ago).

Baboon bones, covered with signs grouped in 3 columns that occupy the entire length.
The ethno-mathematician Claudia Zaslavsky suggests that this instrument descends from the creative work of a human female; it would represent **the tracking of the lunar phases** in correlation with the menstrual cycle.

1859



The first visualization of complex data.

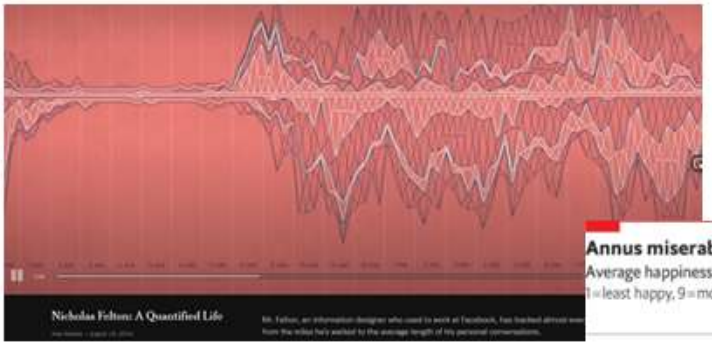
The nurse Florence Nightingale began to track the causes of death of British soldiers in military hospitals during the Crimean ear and **invented** the **polar chart** to display the pieces of evidence and communicate them.

Source: Florence Nightingale Rose
Wikimedia commons

2014

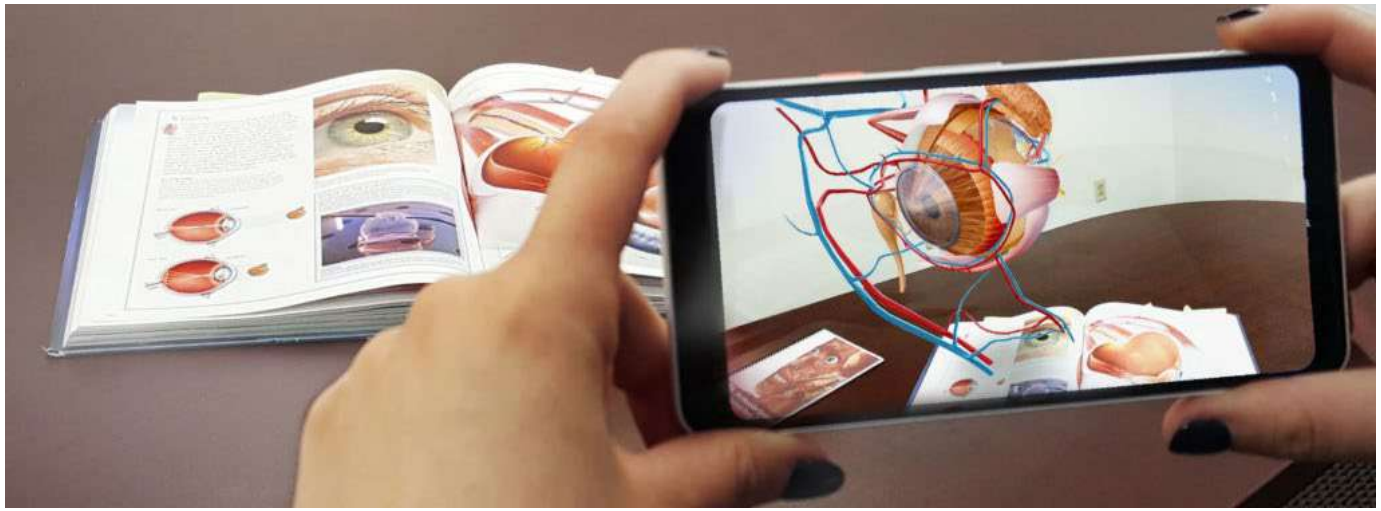
The so-called **quantified-self** rises, thanks to the mobile and wearable self-tracking apps allow the measurement and analysis of any kind of activity.

- Diet
- Sport
- Books read
- Finance
- Dreams
- …



Data change the way we perceive and get informed about the world and perceive complex phenomena.

Source: Feltron, 2014. The quantified self. The New York Times video, 2014.



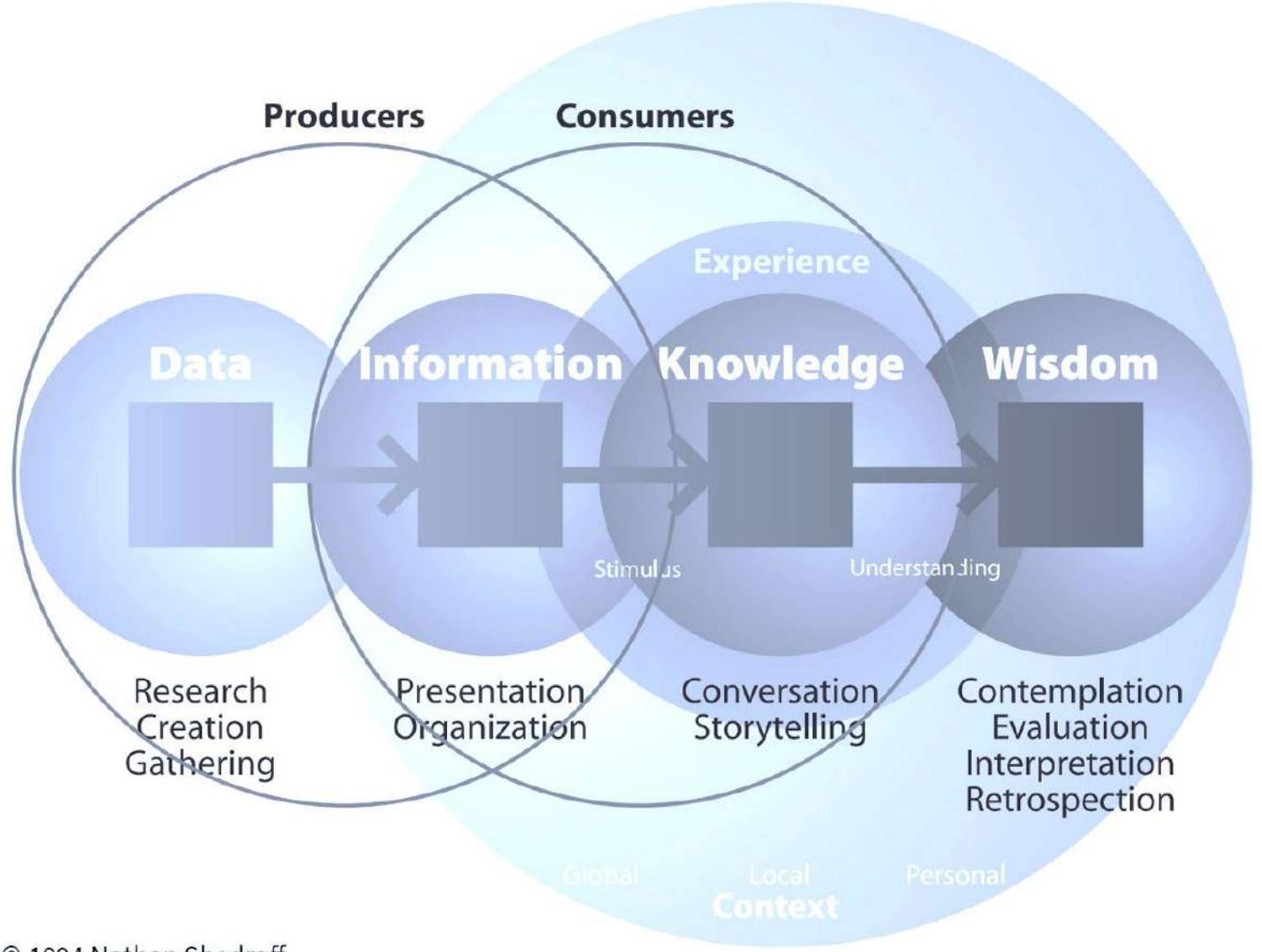
Data shape work practices and tools we use to accomplish several tasks.

Human – data interaction

DATIFICATION
The act of transforming objects and processes into data, that is the **quantitative description of an observed and coded phenomenon.**

DATA/INFO-VISUALIZATION (UX/UI)
Enrichment of data with narrative, visual elements, interaction modalities.

DATA-DRIVEN SERVICES (SD)
Design of services leveraging data analysis and insights to **guide decision-making**, optimize operations, and enhance user experiences.



Real-world data

- **Administrative** data (insurance claims, working documents)
- **Demographic** data (age, education, environmental factors, income, geographical location)
- **Behavioural** data (diet, lifestyle, physical activity)
- **Social** data (employment, family, family and social networks)
- **Clinical** data (electronic medical records, laboratories, imaging, genomics, metabolism, tissue, patient-reported results)
- **Attitude** data (patient experience and feelings)
- **Financial** data (expenses, income, credit card purchases)

Official sources

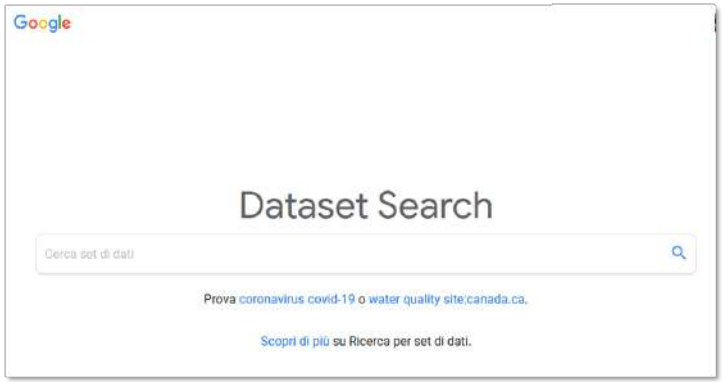
Istat
Eurostat
Istituto superiore di sanità
World bank
Public administrations

Private sources

Google Trends
Spotify
IDC
Gartner
Caritas
Save the Children
Legambiente
WWF
Fondazione Agnelli

Aggregators

Statista
WikiData
OurWorldInData
Data.world
Google public data
datasetsearch.research.google.com

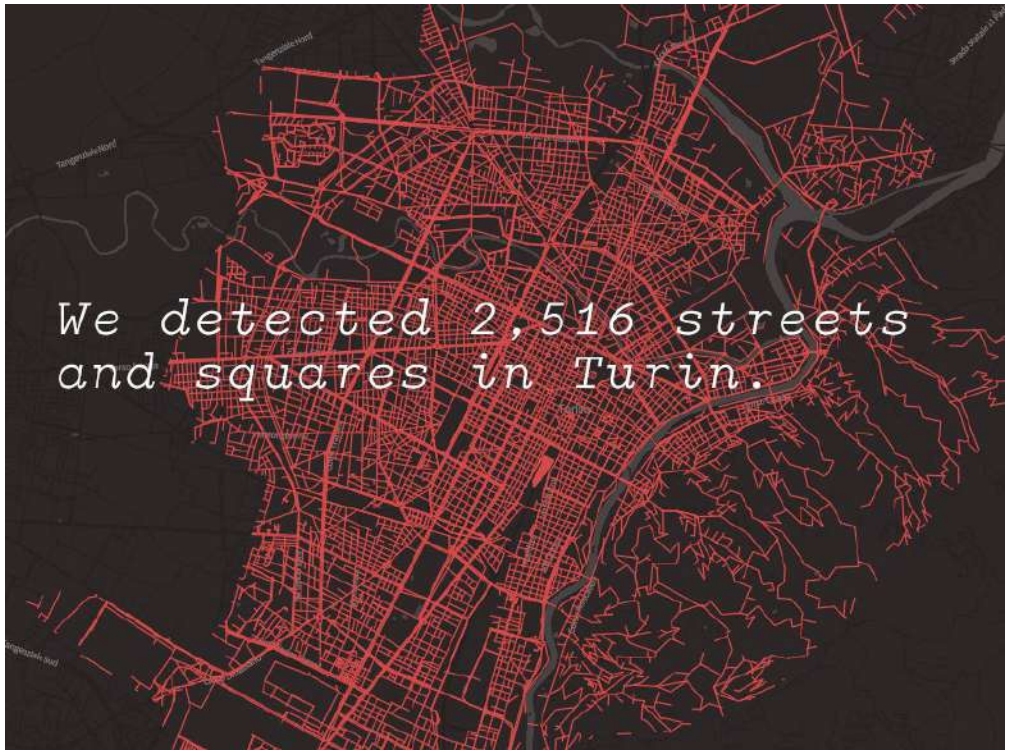


Ad hoc data

Aggregation of existing data

- Documentary sources (open data and private datasets, reports, …)
- Automatic data (logs)
- Ethnographic researrch (observation, diary, netnography)
- Ad-hoc (surveys, interviews, polls, ...)
- **Crowdsourcing**: collaborative data collection practice from user communities (e.g. Tripadvisor)
- **Citizens science/counterdata*:** bottom up initiatives collecting data on social phenomena not still counted (e.g. https://www.themigrantsfiles.com/)

Example > Mapping diversity



This project is based on open, crowdsourced data sources. What we did, in essence, was to match the list of streets built by OpenStreetMap (and made available by Geofabrik) with the Wikidata identifier of the entities they are dedicated to. Matching was first done automatically and then manually verified street by street using a dedicated interface.
Methodological note available online.

Mapping Diversity

https://mappingdiversity.eu/italy/turin/

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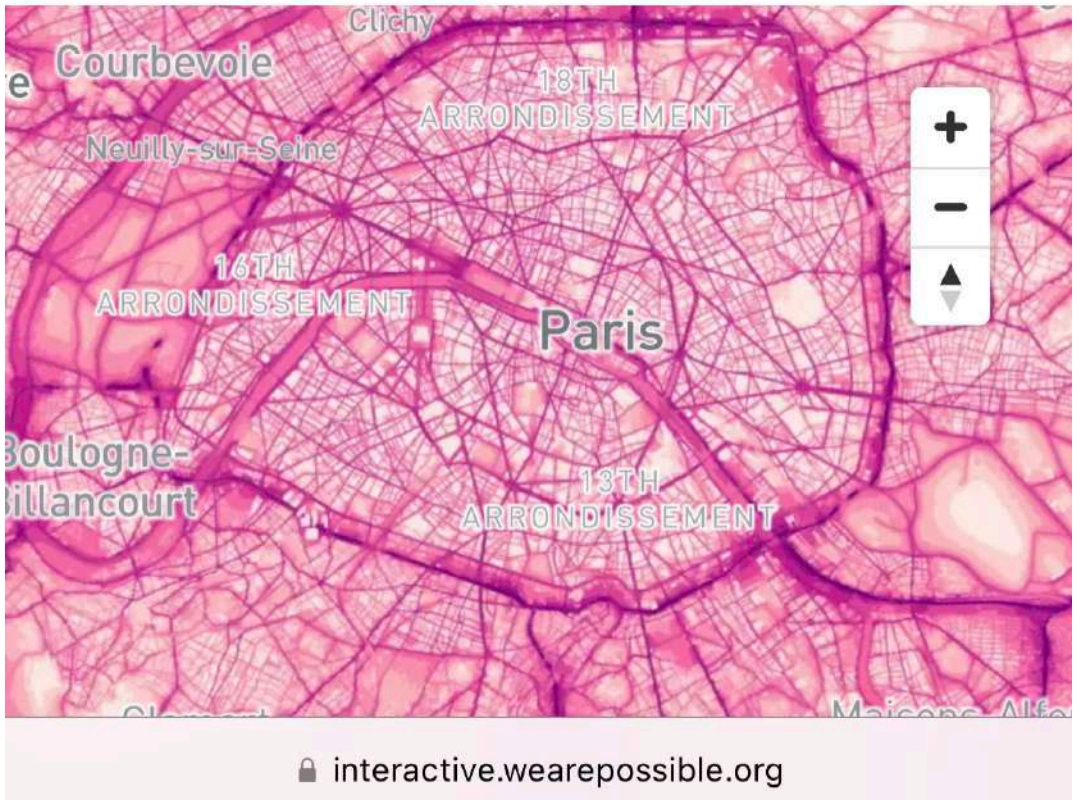
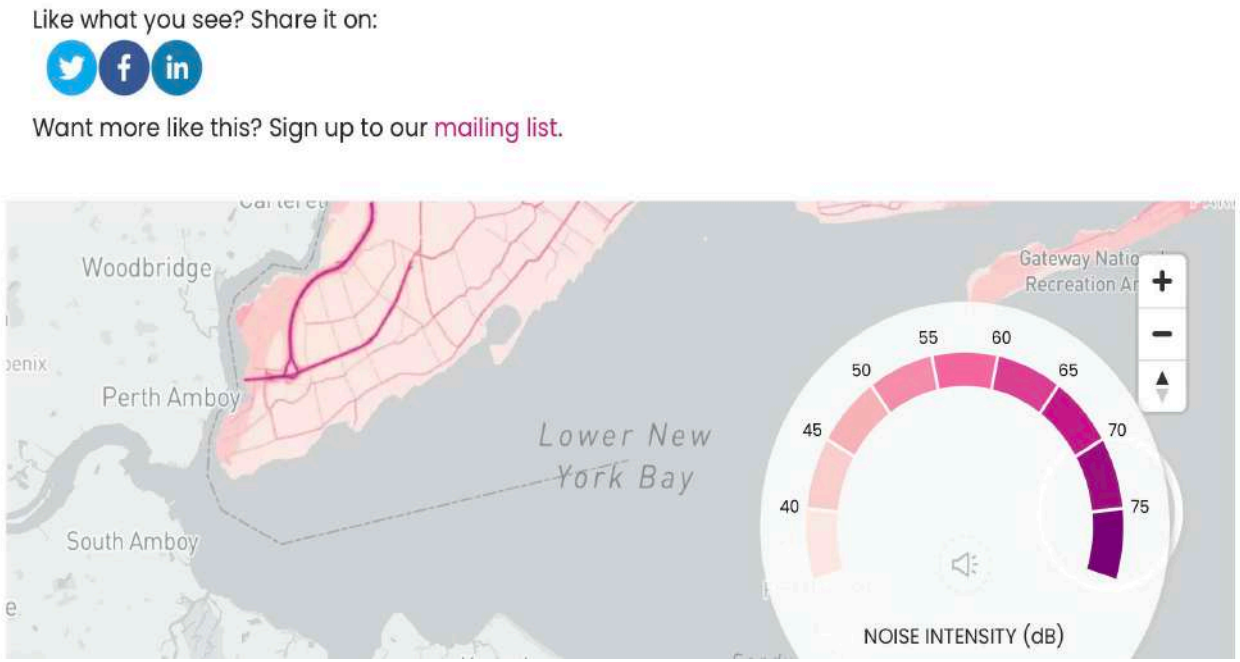
Example > Noisy cities





Data is taken from monitoring stations on the Rumeur network and intermediate points are modelled and validated against the collected data, including the effects of average weather conditions on noise levels. Methodological information available.

Without sound | With sound

Car Free Megacities Link

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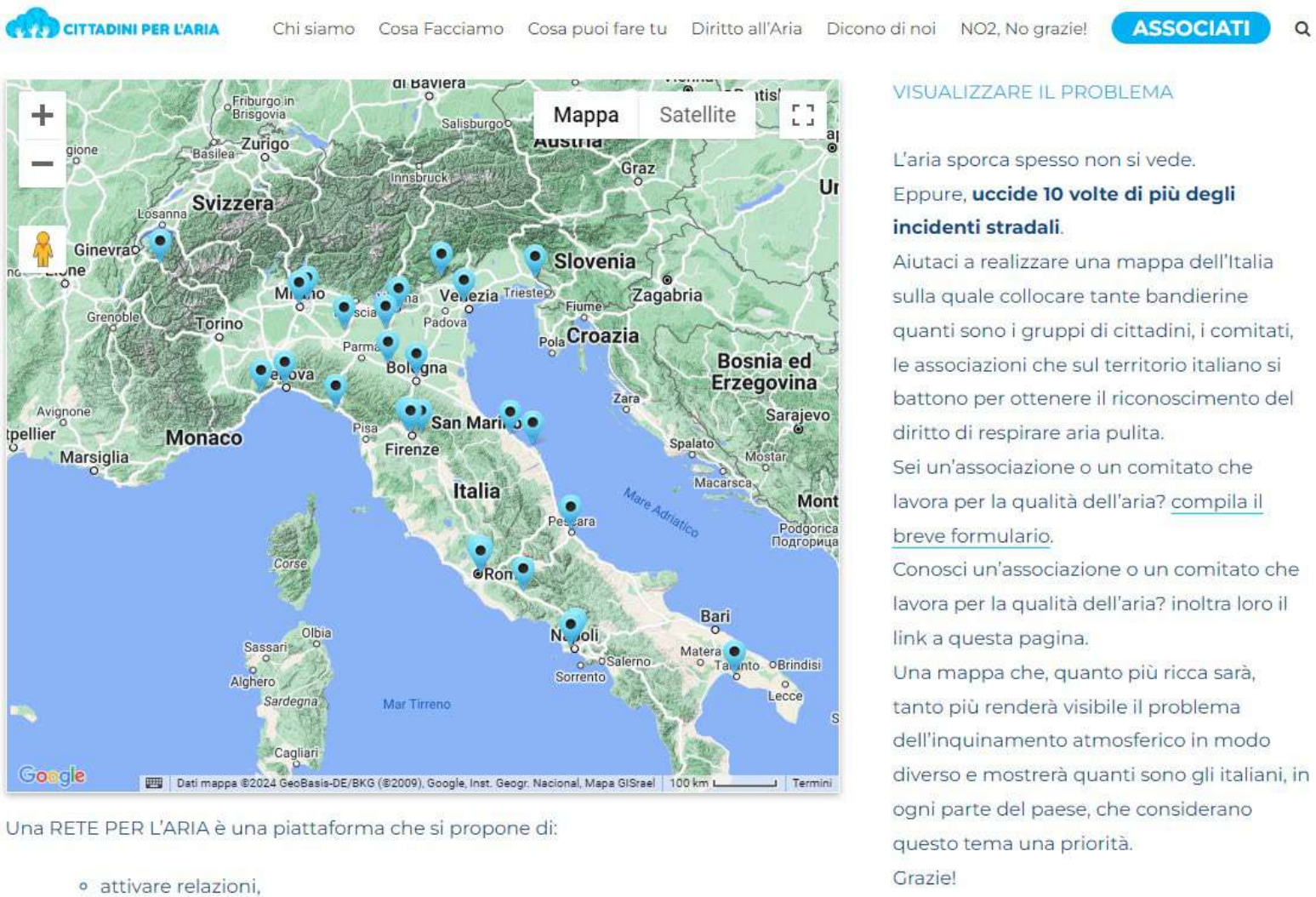
car free megacities

Example > Cittadini per l'aria



Una RETE PER L'ARIA è una piattaforma che si propone di:

- attivare relazioni,

VISUALIZZARE IL PROBLEMA

L'aria sporca spesso non si vede.
Eppure, **uccide 10 volte di più degli incidenti stradali**.
Aiutaci a realizzare una mappa dell'Italia sulla quale collocare tante bandierine quanti sono i gruppi di cittadini, i comitati, le associazioni che sul territorio italiano si battono per ottenere il riconoscimento del diritto di respirare aria pulita.
Sei un'associazione o un comitato che lavora per la qualità dell'aria? compila il breve formulario.
Conosci un'associazione o un comitato che lavora per la qualità dell'aria? inoltra loro il link a questa pagina.
Una mappa che, quanto più ricca sarà, tanto più renderà visibile il problema dell'inquinamento atmosferico in modo diverso e mostrerà quanti sono gli italiani, in ogni parte del paese, che considerano questo tema una priorità.
Grazie!

Citizen-science projects, based on crowdsensed data on levels of nitrogen produced by e crowdsourcing.
Studio Calibro designed and developed the map where citizens can read the nitrogen levels generate from diesel-powered cars and other sources.

https://www.cittadiniperlaria.org/rete-italiana

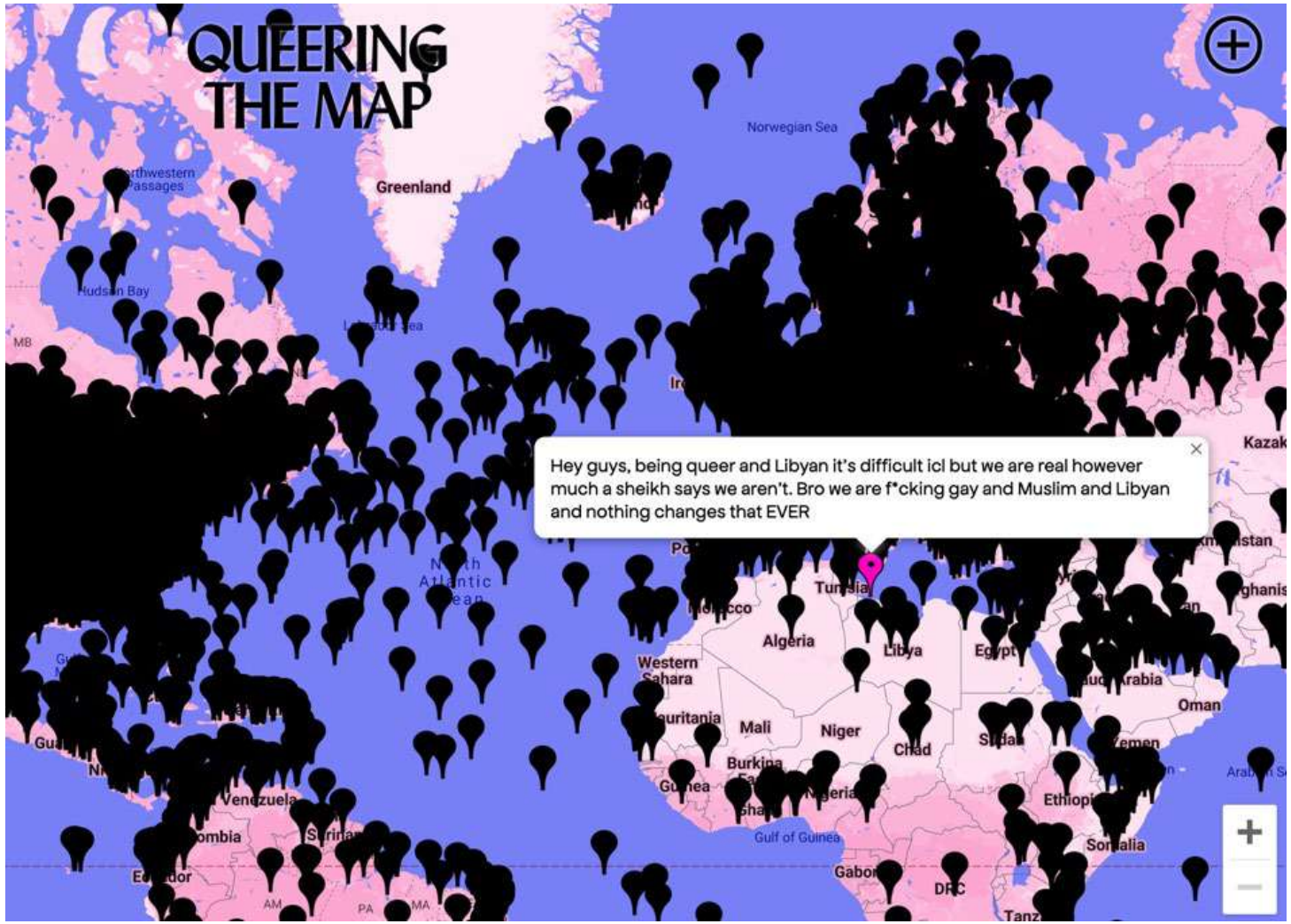
Example > Nimbo

The visual layer of a wider sytem and process i relevant to address targets that might be very different.
The general audience, lacking in «numeracy» or children to be introduced to ecology and climate matters might benefit from Data-storytelling.

- Enrich the language with metaphors and descriptions
- Simplify the visual layer

https://nimbo.thevisualagency.com/

Example > Queering the map



Queering the Map is a **community-generated counter-mapping** platform for digitally archiving LGBTQ2IA+ experience in relation to physical space.

The platform provides an interface to **collaboratively record** the cartography of queer life—from park benches to the middle of the ocean—in order to preserve our histories and unfolding realities, which continue to be invalidated, contested, and erased.

https://www.queeringthemap.com

Crowdsourcing

More than 7 billions of humans are able to acquire, produce and share data.

2005

Pope announcements in Vatican

2013

Crowdsourcing platforms

Da fonti sul Web

- Amazon Mechanical Turk
- 99designs
- Upwork Inc.
- Crowdspring
- OpenIDEO
- Designhill.com
- Microworkers
- Cad Crowd
- DesignCrowd
- Google Crowdsource
- InnoCentive
- Twine
- uTest
- Wazoku reviews
- Chaordix
- Idea pipeline
- IdeaScale
- Kaggle
- Namethis
- Ponoko
- Quri
- Topcoder
- UserVoice reviews

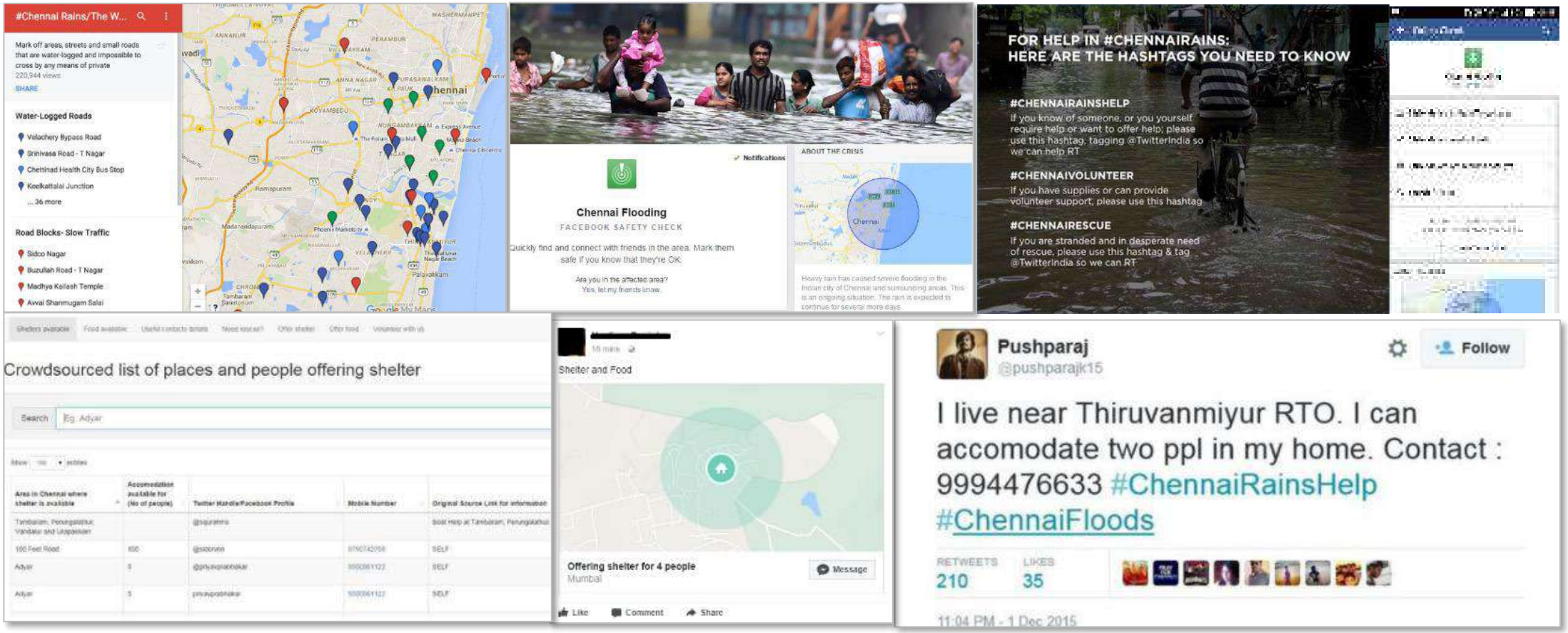
Mostra meno

Feedback

[37 Great Examples of Crowdsourcing]

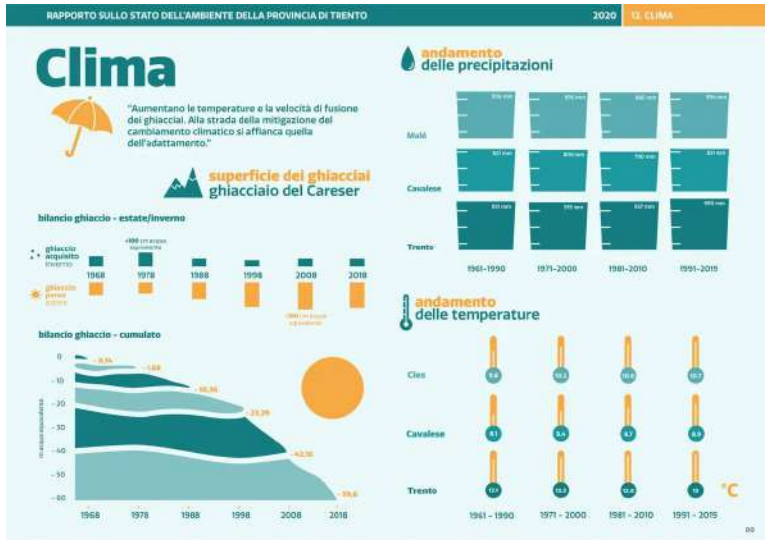
People + connected devices + events = Crowdsourcing

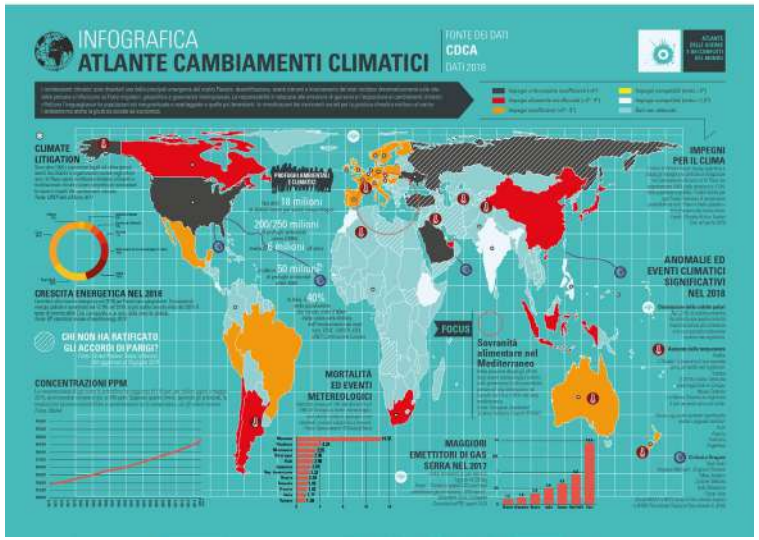
In critical conditions, regardless of the type of crisis and emergency, people need to exchange information, both receiving and providing it.
They use all the known channels (Social media, Maps-based services, IM)

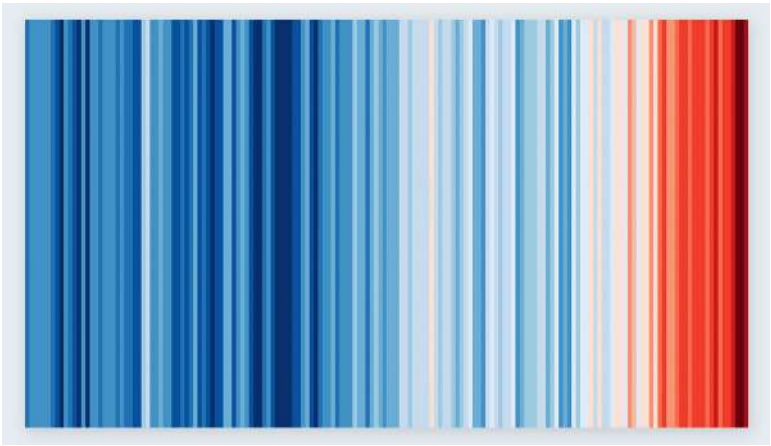


Infovisualization

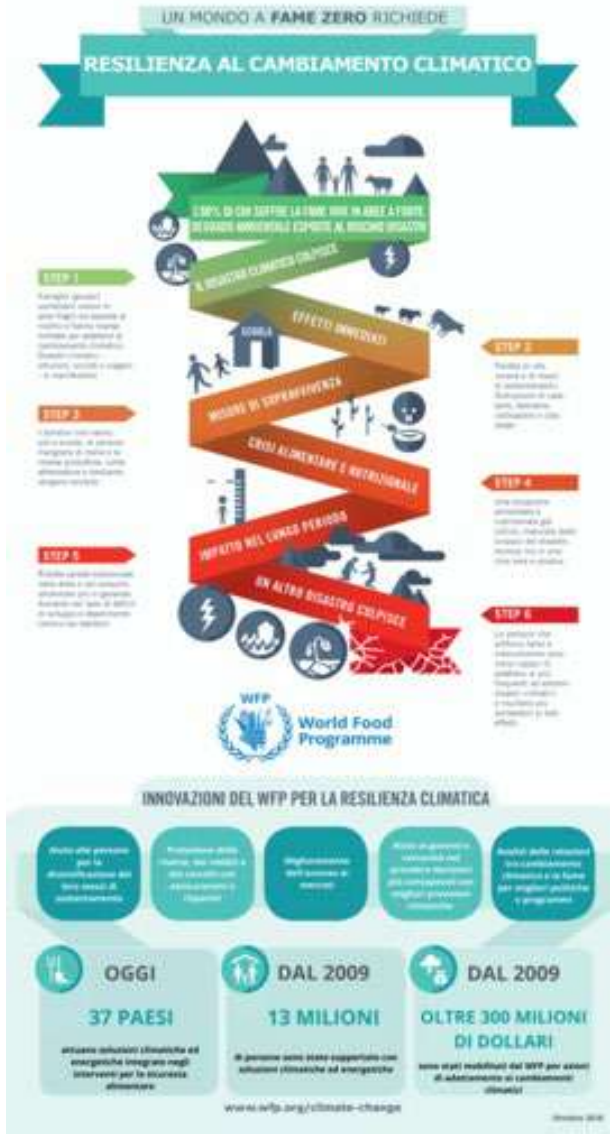
In 1896 the first work on global warming was published.







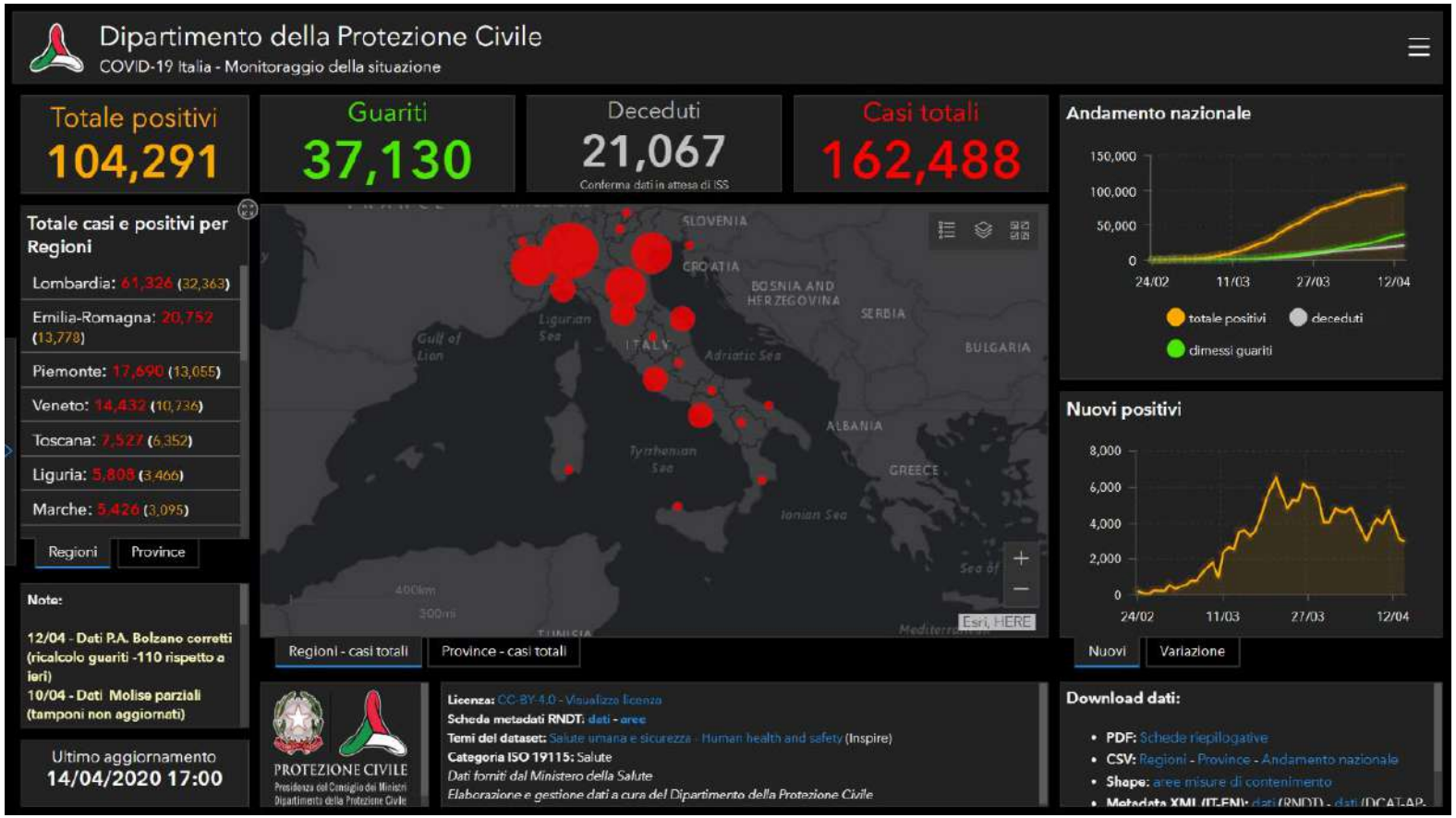
Warming stripes



Dashboard for professionals

Web-accessible dashboards that allow different types of actors to **view data and monitor complex phenomena.**

- Monitoring complex events/systems (total visibility)
- Trend identification
- Measure of efficiency
- Decision support
- Automated reports
- Fast identification of abnormal data and correlations
- Alert



Source: data.europa.eu

Dashboard for professionals (into the wild)

Dashboard for professionals (into the wild)

Perception (event detection, search)

Processing (analysis, comparison)

Reasoning (possible evolving scenarios)

Projection (possible interventions)

Decision and coordination (intervention execution and monitoring)

Situation awareness

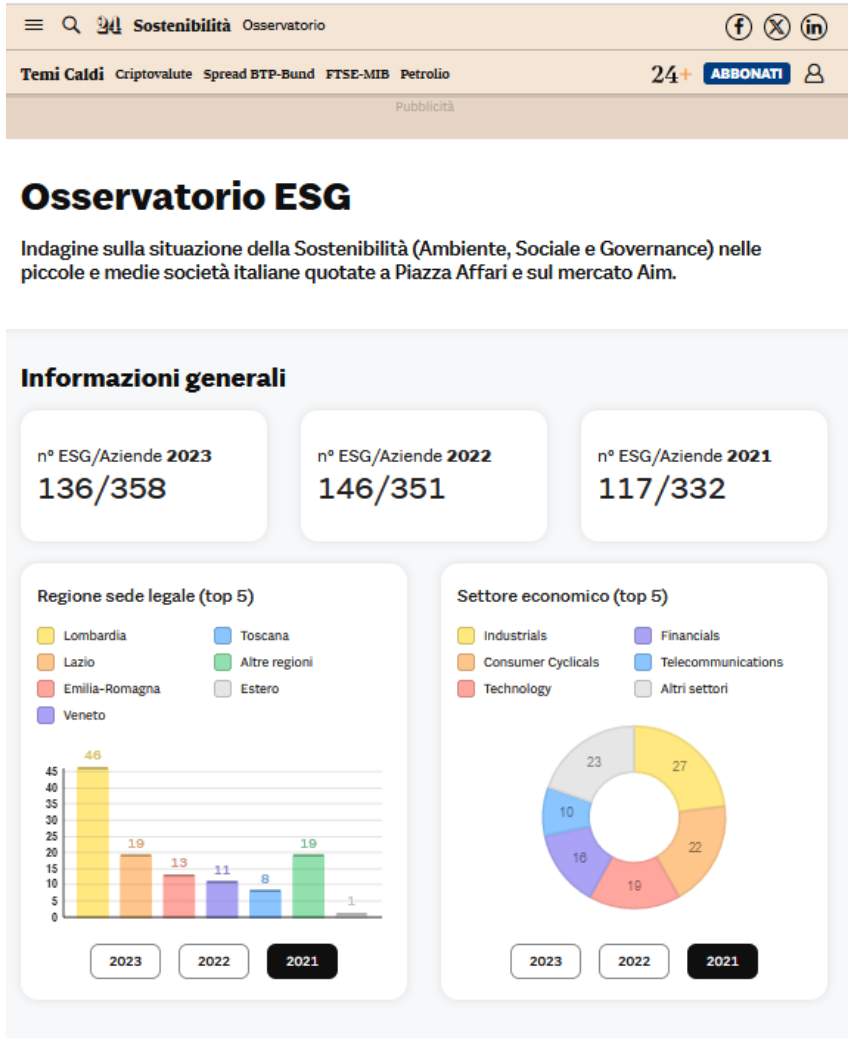
Dashboards for professionals and not only

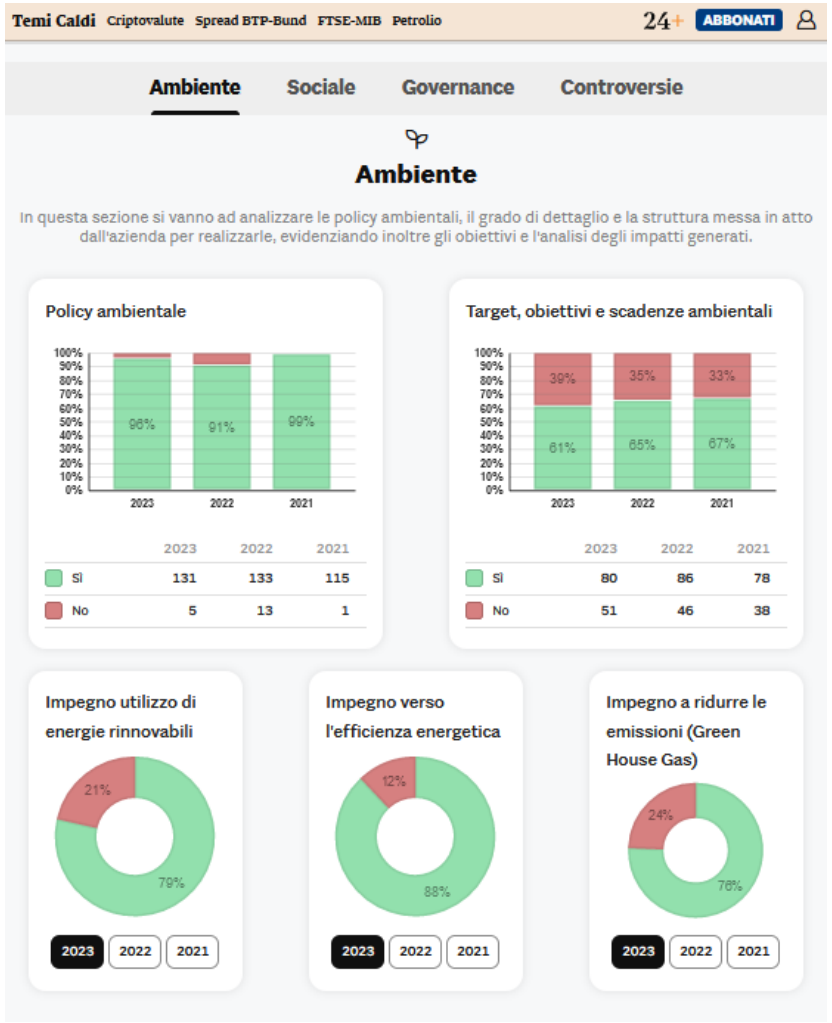
Plane control room

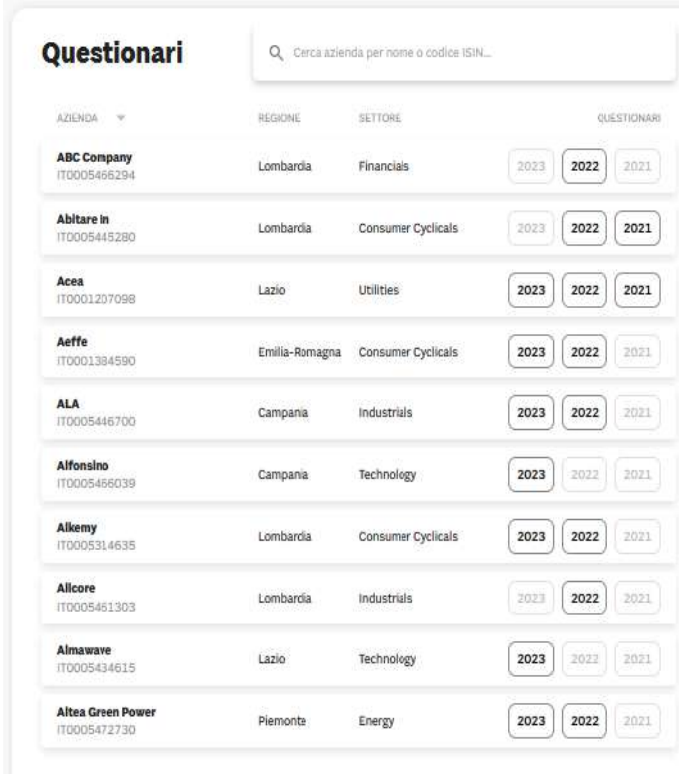
Airspace explorer (separation data)

Dashboard for the public

Source: https://www.ilsole24ore.com/sez/sostenibilita/osservatorio







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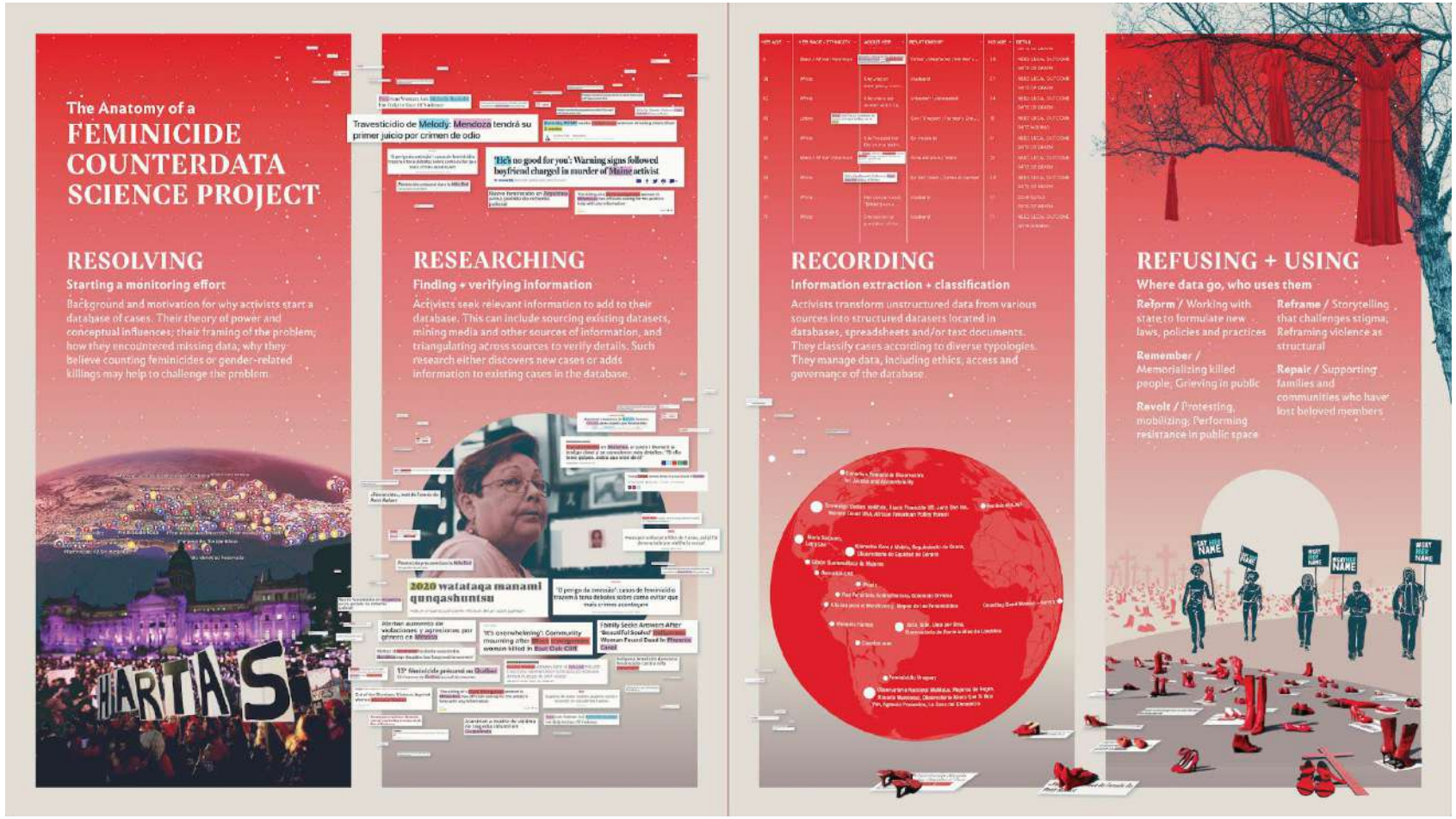
Dashboard for the public

https://sheldon.studio/covidash/

From data to the service

One team of data- journalists involved in project Uma-por-Uma, in the state of Pernambuco - Brazil, has combined the collection of data with a proximity service for families of the victims.



https://produtos.ne10.uol.com.br/umaporuma/index.php

Examples of Data-Driven Services

Dynamic Content Delivery

- **Netflix's Content Personalization**
  (it analyses **viewing history**, **preferences, and ratings**
  to suggest shows and movies)

User Behavior Analytics

- **Google Analytics**
- **Adobe Analytics**
  (these tools analyse website and app user behaviour, providing insights into how users interact with a digital product)

Personalized Design Recommendations

- **Canva's Design Suggestions**
  (by analyzing what users commonly choose it
  tailors the design options presented to individual users

Personalized Travel Recommendations

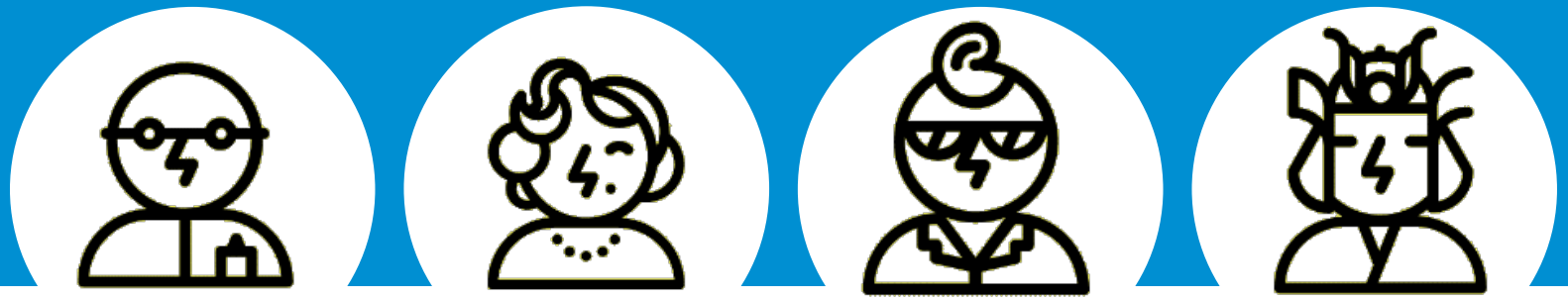
- **Tripadvisor**
  (data from user reviews, preferences, and past travel behavior are used to provide personalized travel recommendations, such as hotels, restaurants, and activities that align with individual tastes and previous experiences)

Personalized Learning Experiences

- **Coursera**
  (by analysing user progress, engagement, and interests, it suggest courses, learning paths, and resources that are most relevant to the learner's goals

Do you know other services data-driven services?

What is a service?



What is a service?

Source: Mager, Birgit: *Service Design – a review*. Hollins, Bill: *Design and its management in the service sector.*

Intangible value delivered to users through the **interaction of people, processes, technologies, and environments.**
It is not a physical product, but **the experience and outcomes** that meet specific needs of people (stakeholders, users). Services are often co-created, meaning they rely on both the provider and the user to produce the desired result.

Key elements of a service in service design are:

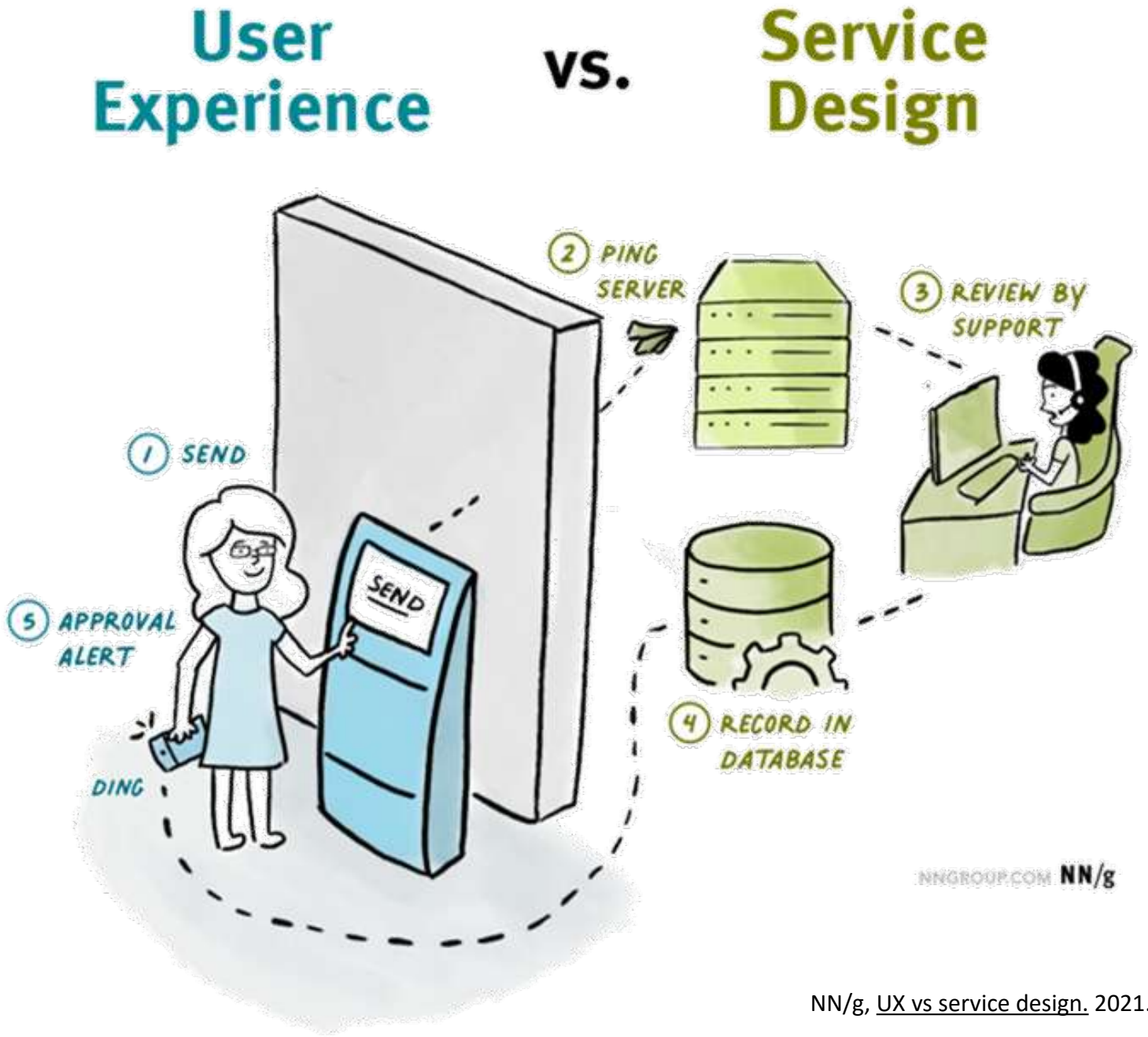
- **Touchpoints**
  (phygital points of of interaction between the service provider and the user)
- **Back end and Front end**
  (infrastructures and system for managing the process)
- **User Journey**
  (sequence of events a user experiences,from discovery to post-service support).

Human variability and context play a much bigger role in influencing our experience, even of the same service**.**

Service is a collection of experiences

Service design is focused on **how** that user experience is internally created.

User experience is focused on **what** the end user encounters.

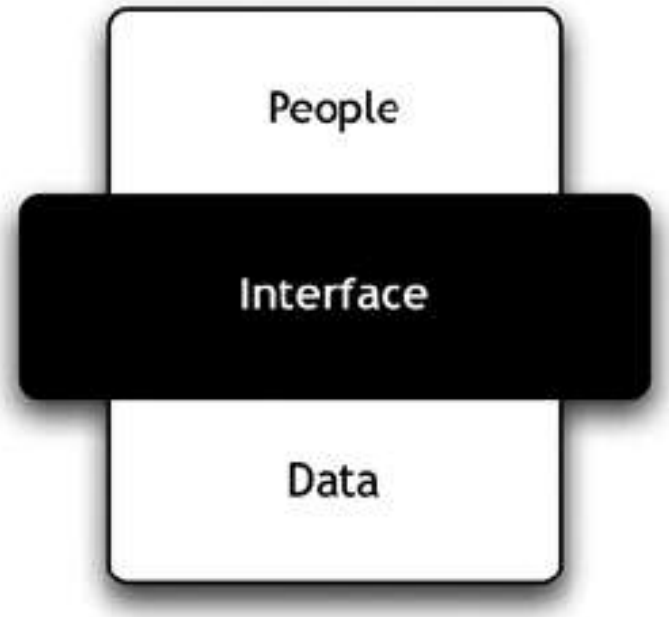


NN/g, UX vs service design. 2021.

We make experience through interfaces (over time, through touchpoints)

An interface is the representation making data and information available as sensorial phenomena, tailored for the human perception, cognition and action.

The interface is a communication tool, applying conventions and rules enabling the person to experience the system/service (through its representation).



Don't forget **people**.
Always decide and define the **output**.

Experiencing data

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From a human-centred perspective, data is...

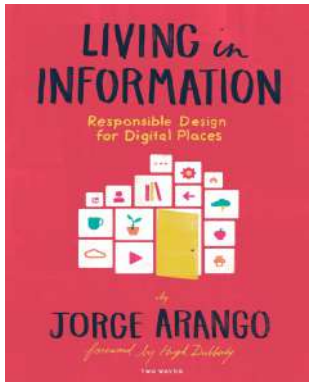
Phenomena that occur and that begin to exist as data **if and when** someone decides to **observe, count and classify** them.

Data answer questions and **serve goals**.

Data is something that we use to reduce uncertainty and make better predictions and decisions.

The data exists in relation to the subjects that **produces** it, **collects**, and then **uses** it, whether it is a single individual or a research community.

Data is a **construction** and reflects the relevance given to what it is decided to be measured.



To learn more: : Jorge Arango. Living in Information. Responsible Design for Digital Places. 2018

To learn more: Lucio Cassia et al., Un dato di fatto.

Data interplay with the Human Activity

Human activity is described as a hierarchical system
where **each activity includes** a **set of actions**
which in turn includes a **set of operations**.

ACTIVITY:
reasoned practices which **determine**
a spectrum of possible actions

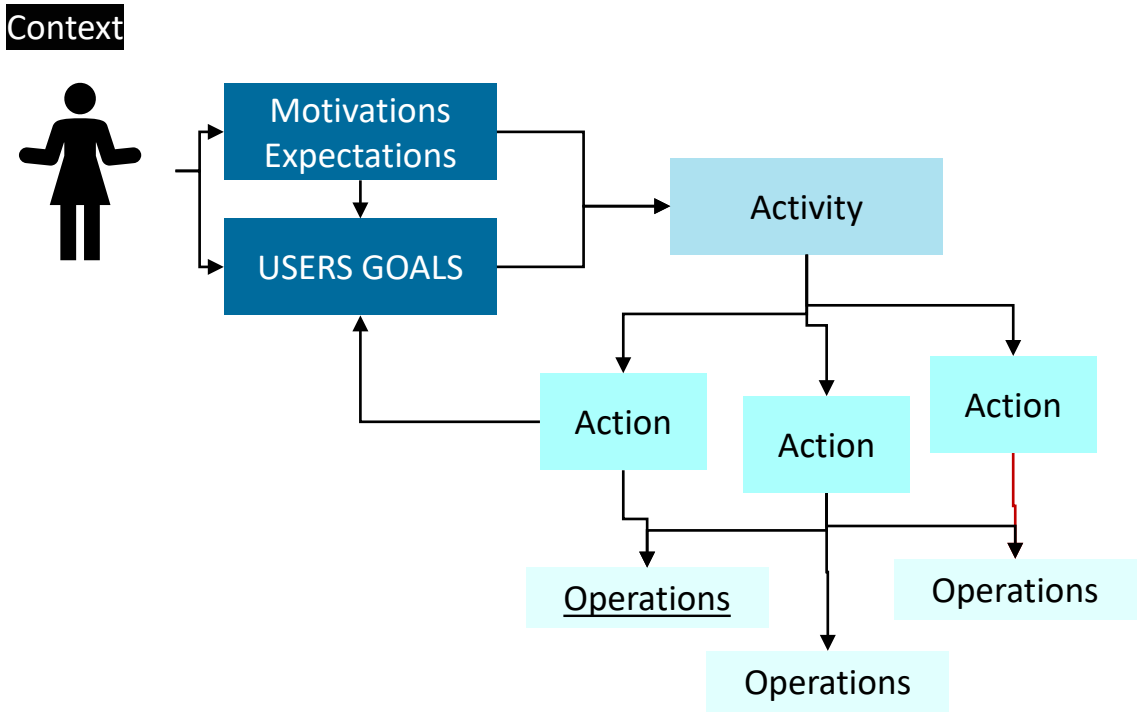
› Activities always
respond to motivations

ACTIONS:
also described as Tasks,
are purpose-oriented conscious
and planned behaviors

› Actions refer to objectives

OPERATIONS:
specific motor chains,
determined at a lower level,
often performed automatically
(sign activity, signal discrimination, ...)

› Operations are influenced
by conditions.



Leont'ev, A.N. Activity, Consciousness, and Personality., 1978
Norman, D. Cognitive artefacts. In J. Carroll, ed., Designing Interaction: Psychology at the Human Computer Interface.
New York: Cambridge University Press, 1991

MOTIVATIONS

GOAL

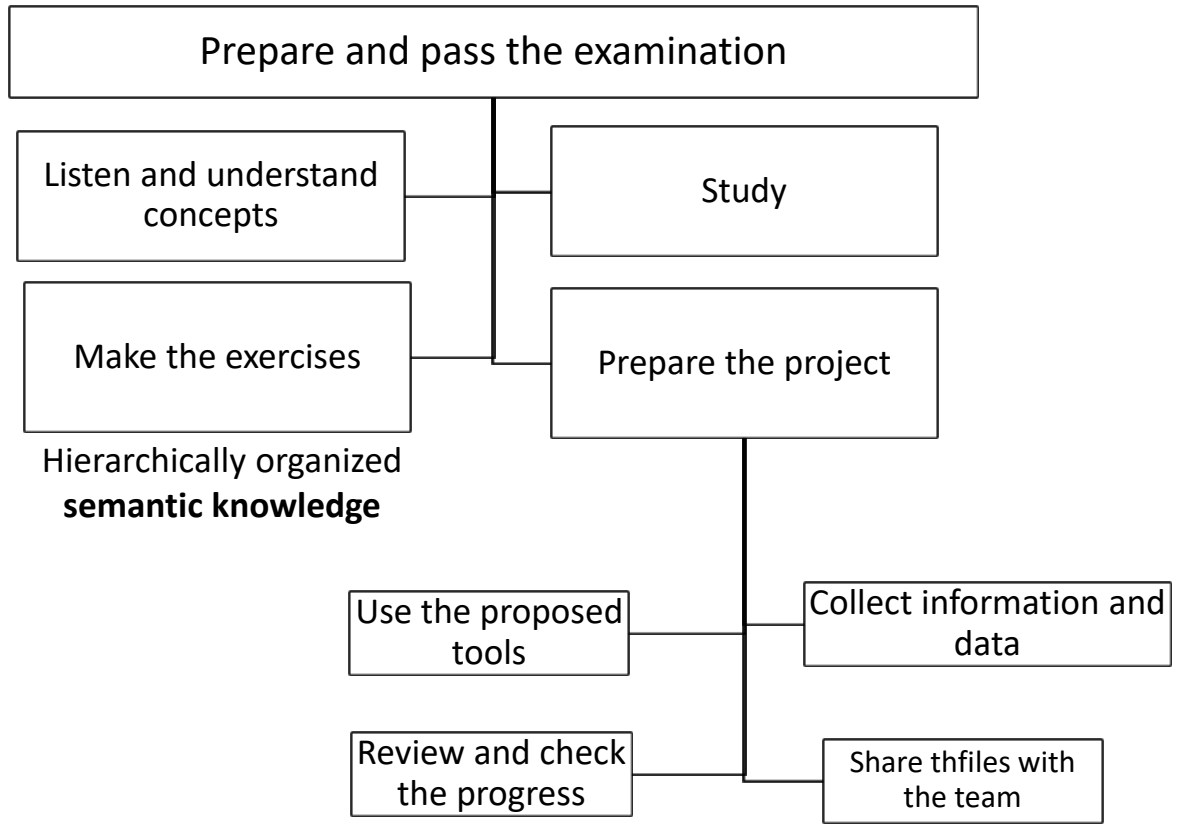
Activity

Actions

Sub-actions

Operations

- Start a career as a Data scientist
- Reach the Master's degree



Hierarchically organized
semantic knowledge

Procedural knowledge
(different per tool and varying over time with the practice

Data fruition: from the motivation to the action

Hierarchical structure (from generic to specific level)

Goal

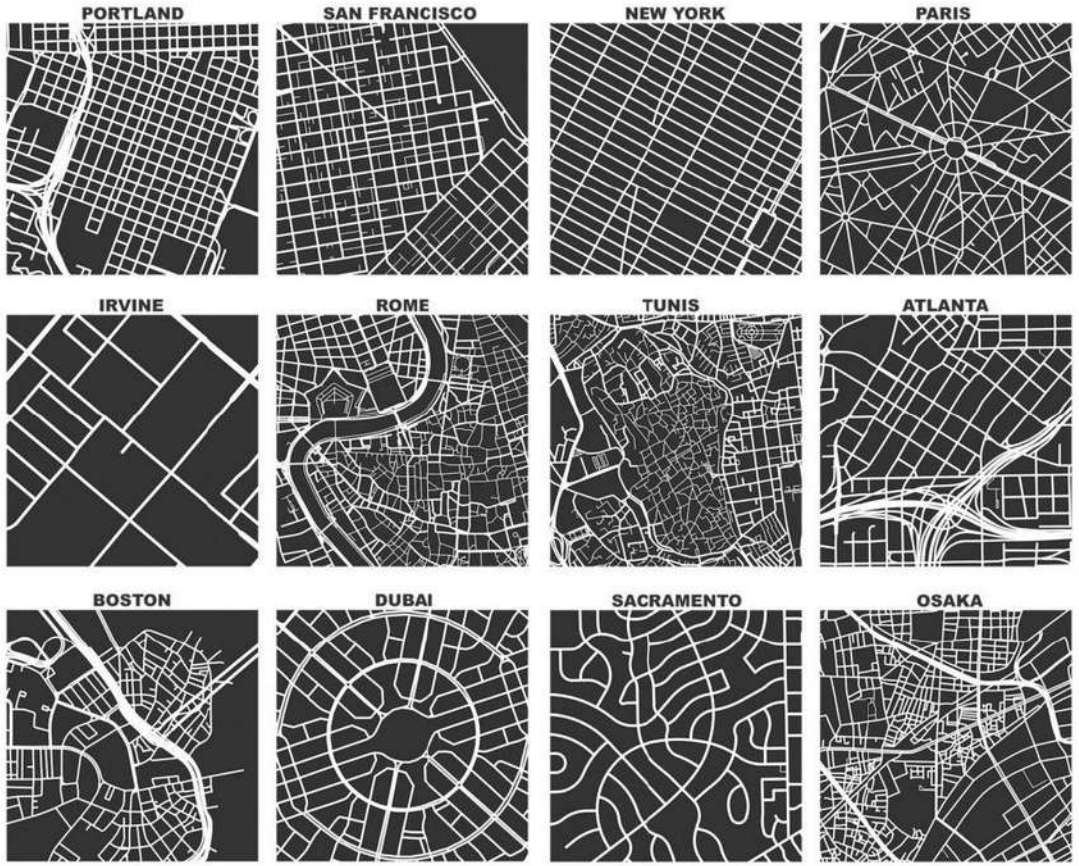
Activities

Actions

Operations (click to see details)

Source: https://openpnrr.it

Human-data interaction is task-specific



Processing and visualization of data must respond to a clear goal, even when it is exploratory.

In the EXAMPLE:
Quantify the **similarity between neighbourhoods** for supporting
- The urban planning
- The real estate market

DRIVING QUESTIONS
«What features should be displayed to facilitate comparison of neighbourhoods? What characteristics make two neighbourhoods «similar»?
E.g. Layout of roads

Source: Measuring Urban Similarities in Los Angeles using Open Data, ArcGIS, and Sklearn

Interacting with data, we are fully engaged

The use of data and information involves several of our cognitive systems

- **REASONING AND LOGIC**:
  making assumptions and decisions, coordinating our movements in the various activities we carry out and verifying the consequences of our actions we use data continuously

- **EMOTIONS**:
  is the experience that is solicited by what we browse and that influences our ability to interact and our cognitive fluidity

- **ATTENTION:**
  the ability to understand context (peripheral attention) and select stimuli allow us to act appropriately

- **PERCEPTION:**
  the data we come into contact with are impulses that reach our nervous system, through the sensory organs, especially sight, but also hearing, touch, self-perception

2 cognitive functioning modalities

FAST THINKING (system 1)
It's based on procedural memory.
It is reinforced by the repetition that fixes the motor behavioural patterns (habits, automatic operations).

In this situation,
INTUITION generates impressions on perceived or thought objects. Actions are quick, economical, not always conscious.

Micro-interactions

SLOW THINKING (system 2)
Very expensive mode, that we activate it for solving complex problems and decisive choices.
It is influenced by previous experience, reflexive observation, and heuristics (empirical rules tested)
It generates judgements, is a slow, costly, intentional process.
In this situation,
REASONING generates judgments, which are: slow, expensive, intentional

To learn more. Kahneman, D. Pensiero Lento, Pensiero Veloce. Mondadori, 2011

Decision making: Skill-Rule-Knowledge Framework

Automatic

Skills

Less challenging behaviours in terms of **cognitive resources** and active control, these established routines are based on stable patterns called skill-driven behaviours.

Rules

More complex activities requiring the active involvement of the person that spends more cognitive resources to apply rules.

Knowledge

Finally, when the situation is new or critical
(high severity of **consequences** in case the situation is not properly managed) or complex (that is, a very large number of **variables or alternatives** to consider), additional cognitive resources such as problem-solving and decision-making, support knowledge-based behaviors, are required to get to the solution.

Aware

Rasmussen, J. Information Processing and Human-Machine Interaction: An Approach to Cognitive Engineering. New York: North Holland, 1986.

Inner and external knowledge

Especially in the digital realm, every system is an **external knowledge device**, containing much of the information useful to experience and that the person does not need to store.

The interfaces are designed to enable the individual to access in a simple and explicit way the information needed during an activity.

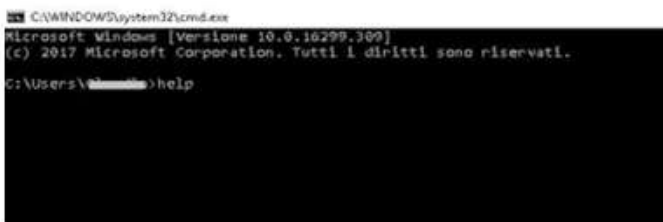
A list of options in a menu is an external knowledge device:

- The menu allows the user to recognize the options and make a selection without having to memorise or remember anything.

Command line interfaces ask the user to recall commands, and recall them when needed

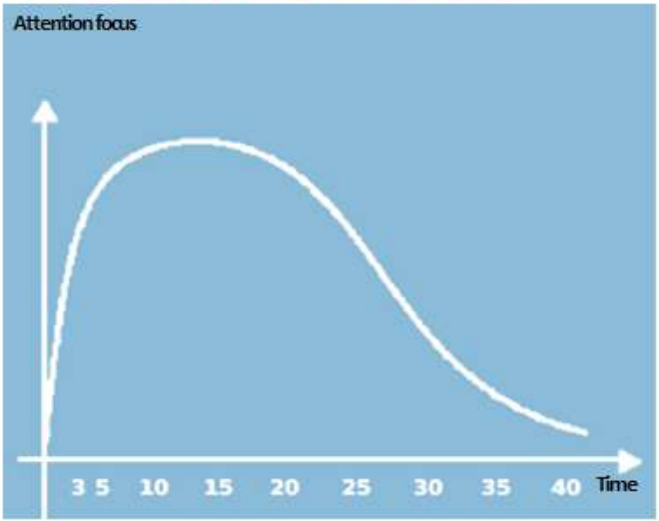
RECOGNITION OVER RECALL

Digital information wall



Budiu, R. Memory Recognition and Recall in User Interfaces (2014)

Attention, a precious resource

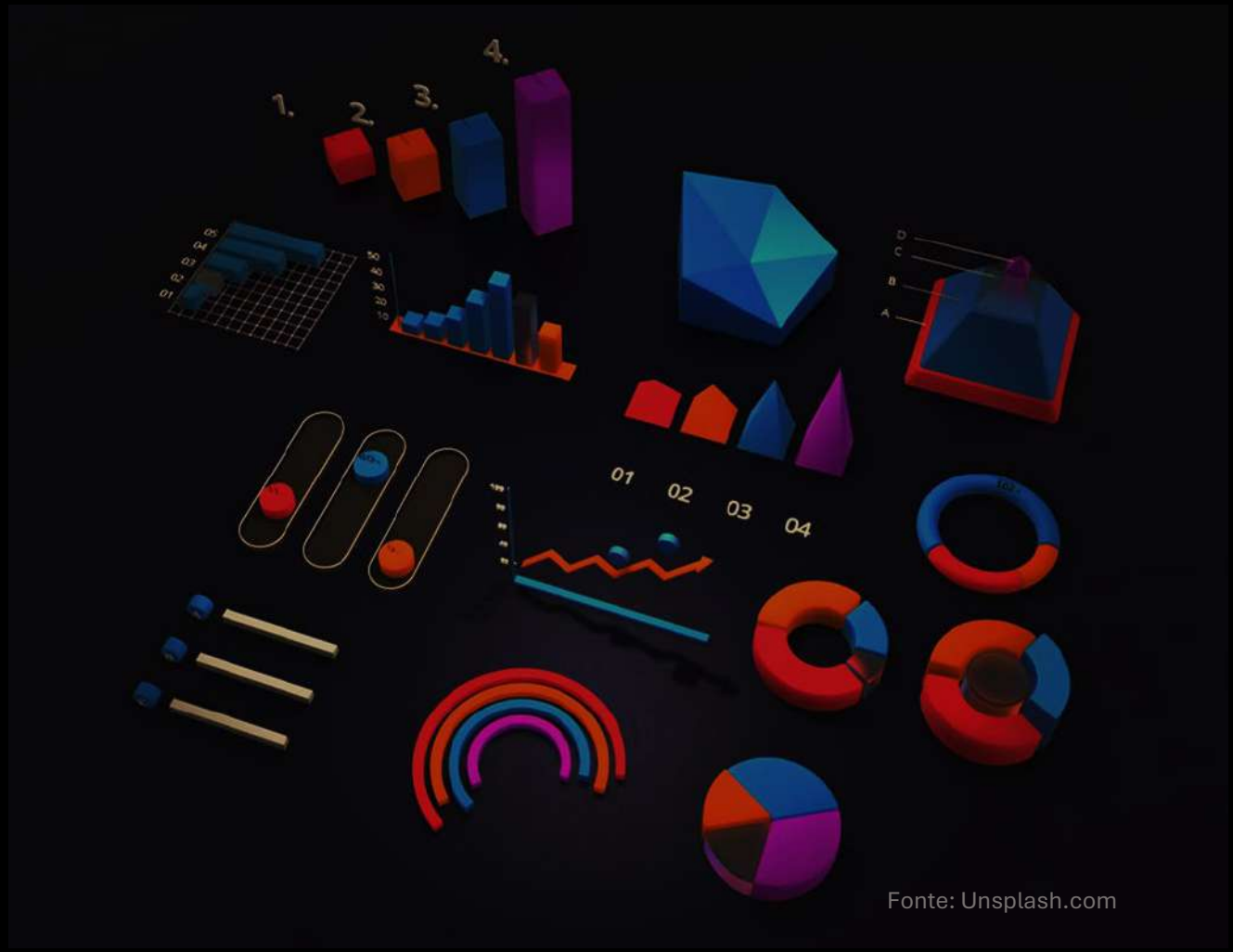


Our cognitive system has a fixed amount of attentional resources and the amount of resources allocated on multiple simultaneous tasks (typical of the mobile interaction) determines the quality and speed of processing of the respective tasks.

Information consumes cognitive resources.
The abundance of information generates a poverty of attention and induces the need to allocate that attention efficiently among the many sources of information that can consume it».

Source: Herbert Simon, Nobel Prize for Economics (1978). Designing Organizations for an Information-Rich World in: Martin Greenberger, Computers, *Communication, and the Public Interest, Baltimore*. MD: The Johns Hopkins Press. 1971, pp. 40–41.

Designing with/through data



Fonte: Unsplash.com

Widen the perspective

IDEO

Data science is a discipline of human-centered design.

" When data science, interaction design, and engineering experts come together, we're able to introduce radically new experiences and systems. "

DEAN MALMGREN
PARTNER, IDEO CHICAGO

Google Design

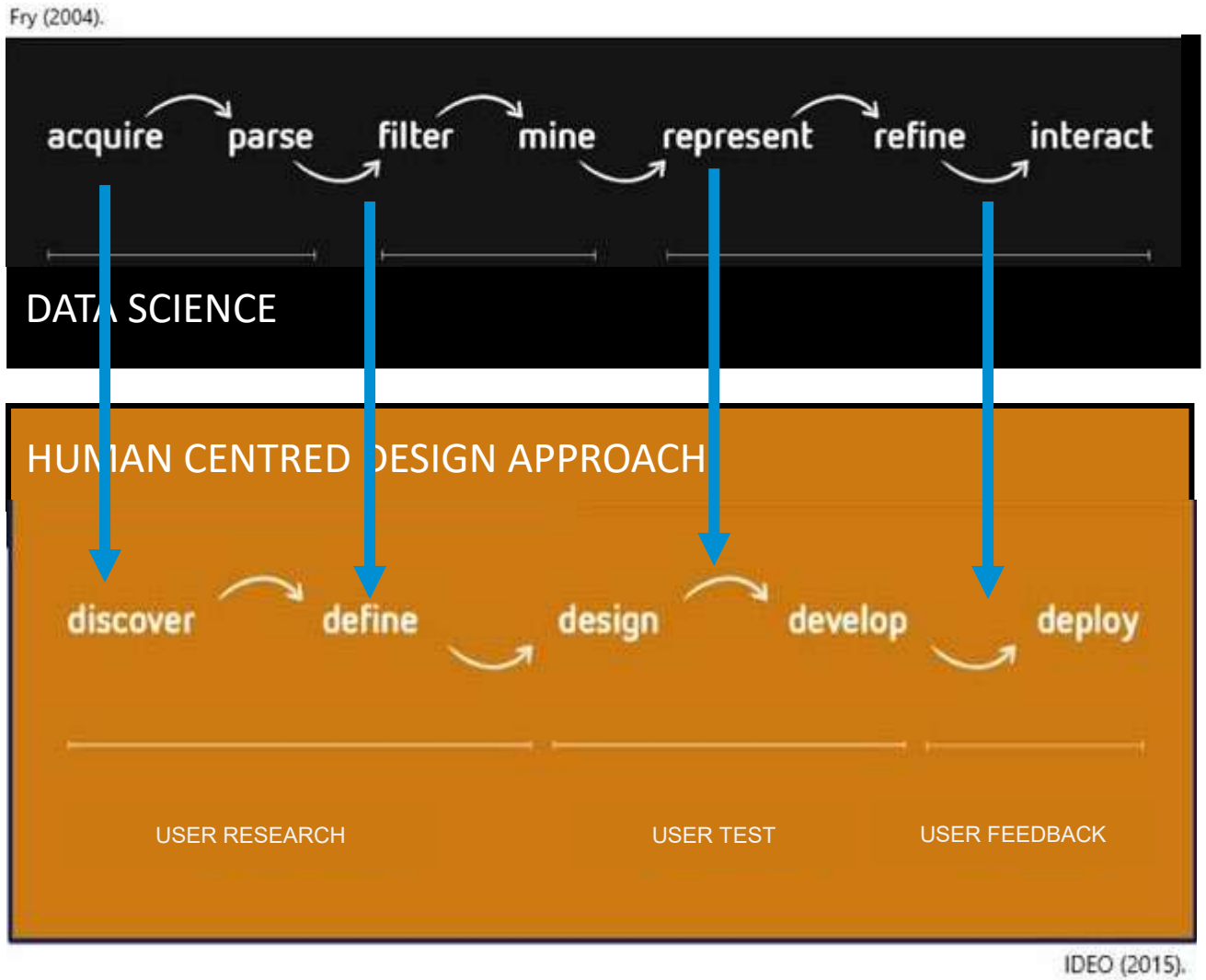
"Designers must be embedded in engineering and coding teams to keep the AI and machine learning efforts real—to keep them part of the world."

Paola Antonelli
MoMA's Senior Design Curator

"Not keeping into consideration the **relationship between the digital tools** we create/develop/manage **and human behaviours.**
Keep on leaving those **relations misunderstood and uncontrolled**, might have **unintended consequences** and encourage the development of **very negative phenomena** for individuals, communities and populations."

Source: Dovremmo studiare meglio gli effetti dei social network sul comportamento collettivo – Il Post

The human centred design || data science



The Human Centred Design approach

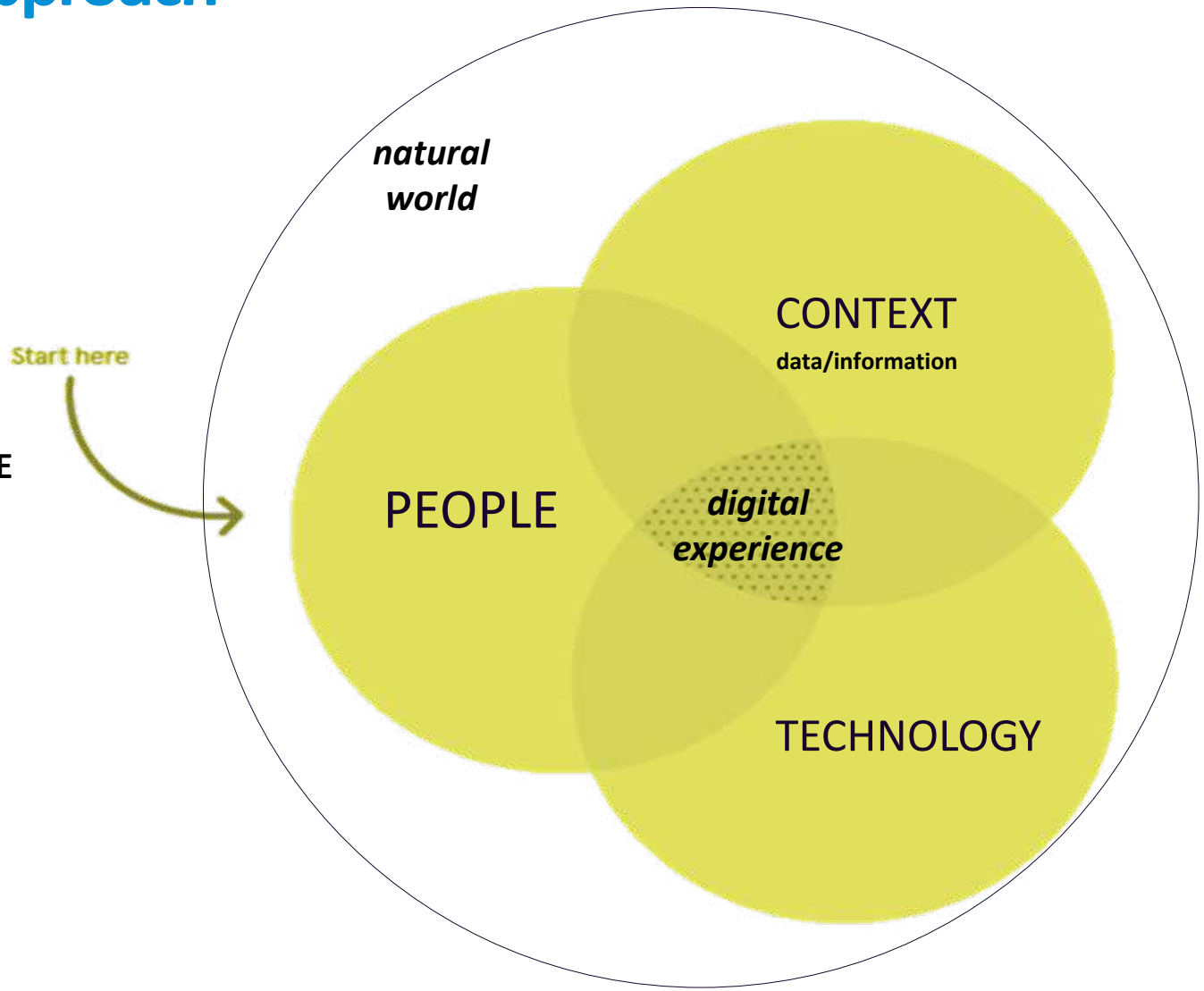
The **Human Centered Design** (HCD) is a design approach defined by the psychologist Donald Norman's seminal work.

It reinterprets the human-computer interaction (HCI) in a psychological key, widening the **focus** from the product/system to the **people who use it.**

In this perspective, EVERY SYSTEM INCLUDES PEOPLE interacting with it a specific context.
Here, data and information works as SOCIAL CONSTRUCTS that human beings generate, use, exchange, and enrich them.

The approach is the common background of many methodologies worldwide applied in the fields of software development (**Agile, Lean, Scrum**), design (**Design Thinking, UXD, Sprint** ...), education, social innovation, …

It is also formalised in several ISO Standards.

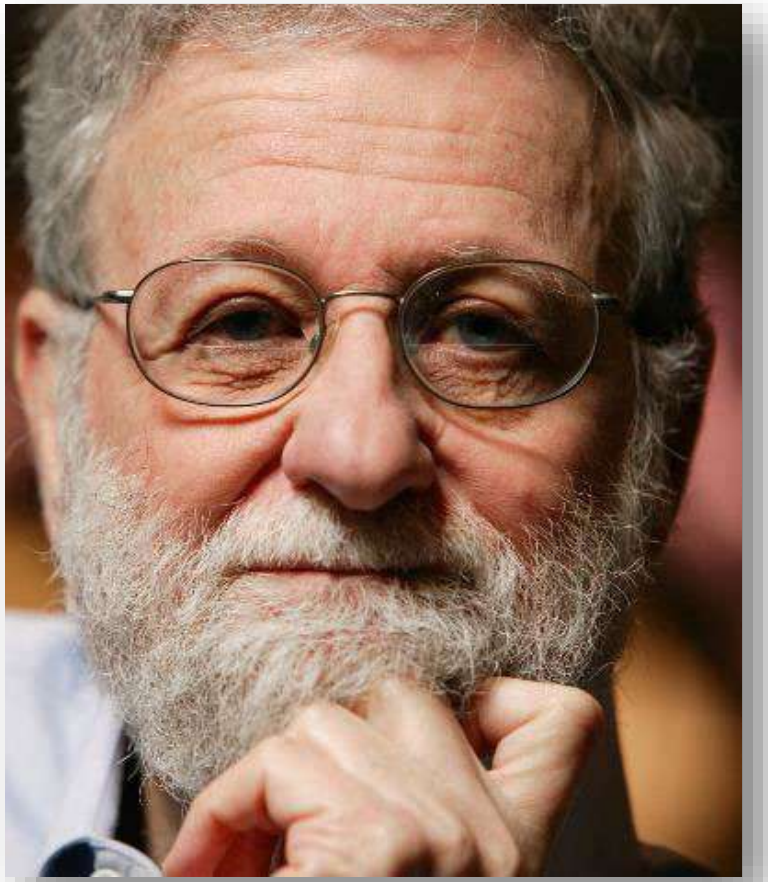


Source: Norman, D.A. & Draper, S.W. User centered system design. New perspectives on human-computer interaction, 1996

“Artifacts pervade our lives, our every activity.
Technology, potentially, makes our daily life more comfortable and pleasant…
But at the same time, ***it adds complexity and complication”.***

TECHNOLOGY PARADOX

Complexity and difficulties are inevitable
when increasing the number of features.
A ***good design can minimize it***”.



Source: Norman, D.A. The Design of Everyday Things, Basic Books, 1988; 2019

Human Centred Approach mindset

HUMAN CENTRICITY

People are an integral part of the system. The design and development process must incorporate the needs and perspectives of **direct and indirect beneficiaries**.

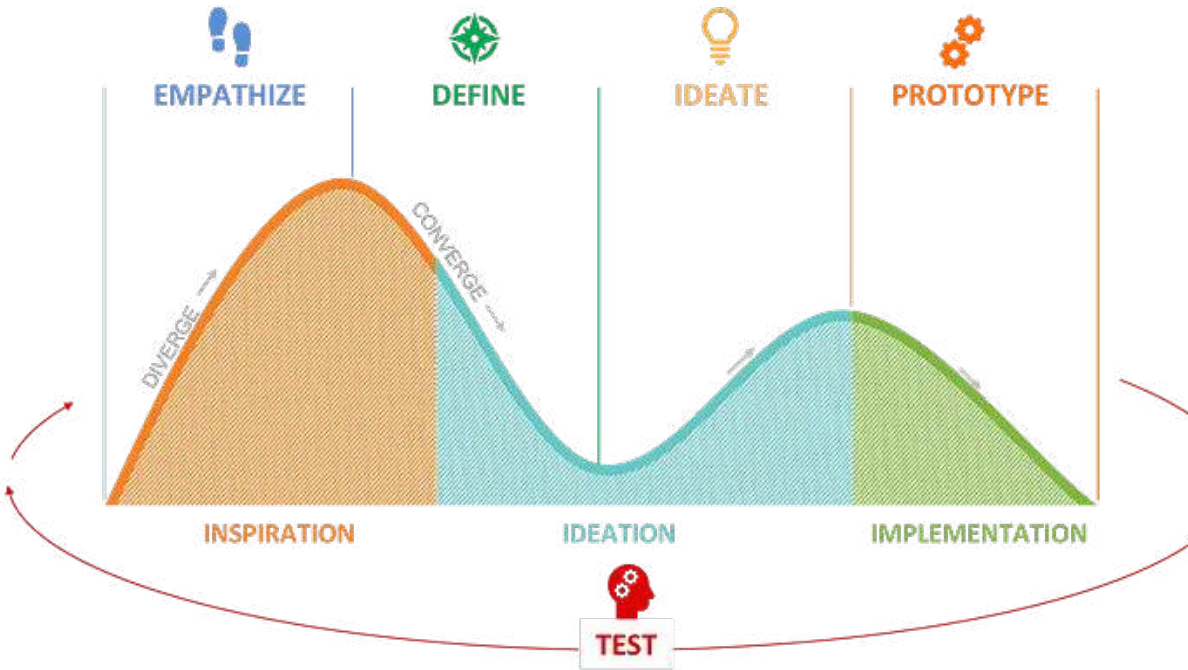
ITERATION AND FEEDBACK

Start by design, then develop. Test, fail early and often. Learn from errors and design again.

Show, don't tell and test during the development, to create space to make **mistakes**, learn from different perspectives, progressively improve, and take better decisions.

DATA-DRIVEN APPROACH

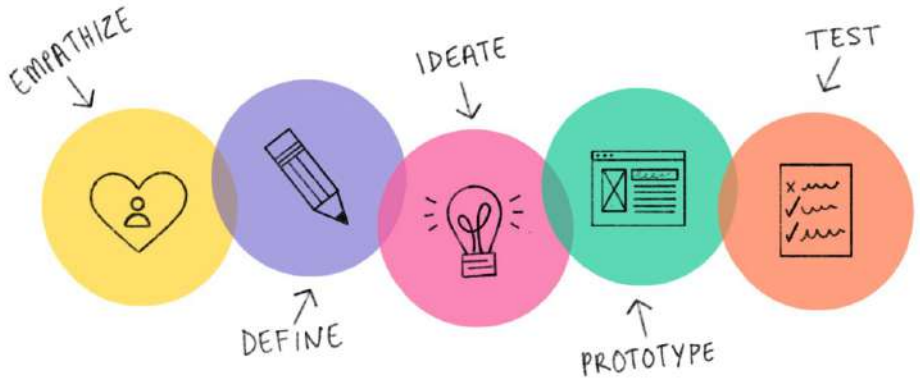
Be consistent and stick to the real context, and collect data from the field. Combine big and small data (qualitative) to know the ecosystems in dept. Keep in consideration the **human variability** factors, to be inclusive and exhaustive.



Human-Centered Design - Design Thinking

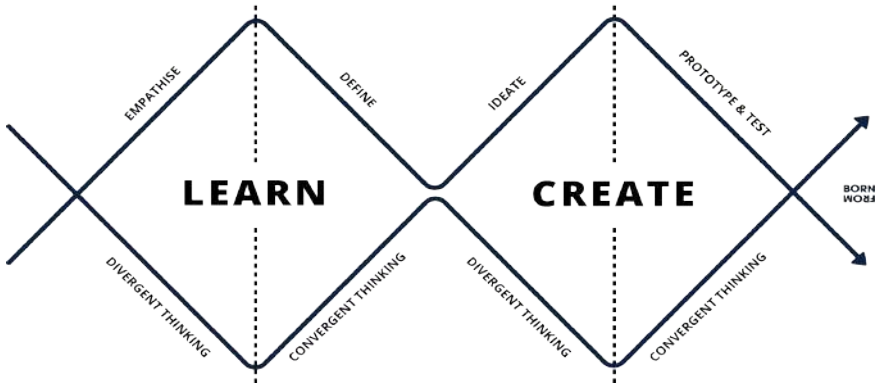
Source: Donald A. Norman, The psychology of everyday things,1988; 2019

1 approach, many methods

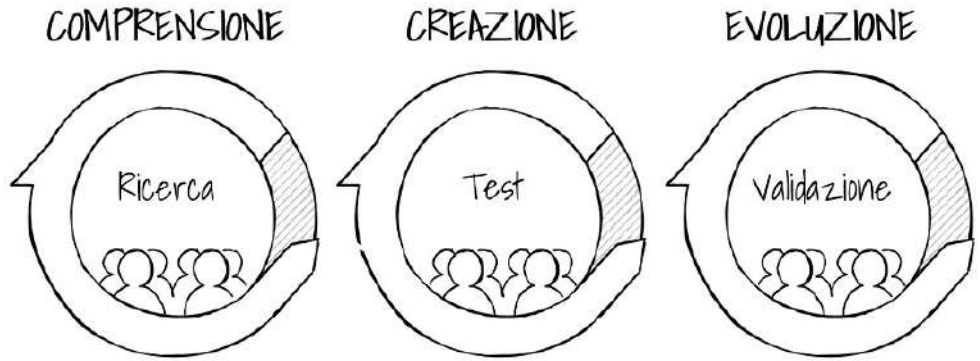


D.school, Human centred design

Human Centered Design Field Guide, 2015. IDEO

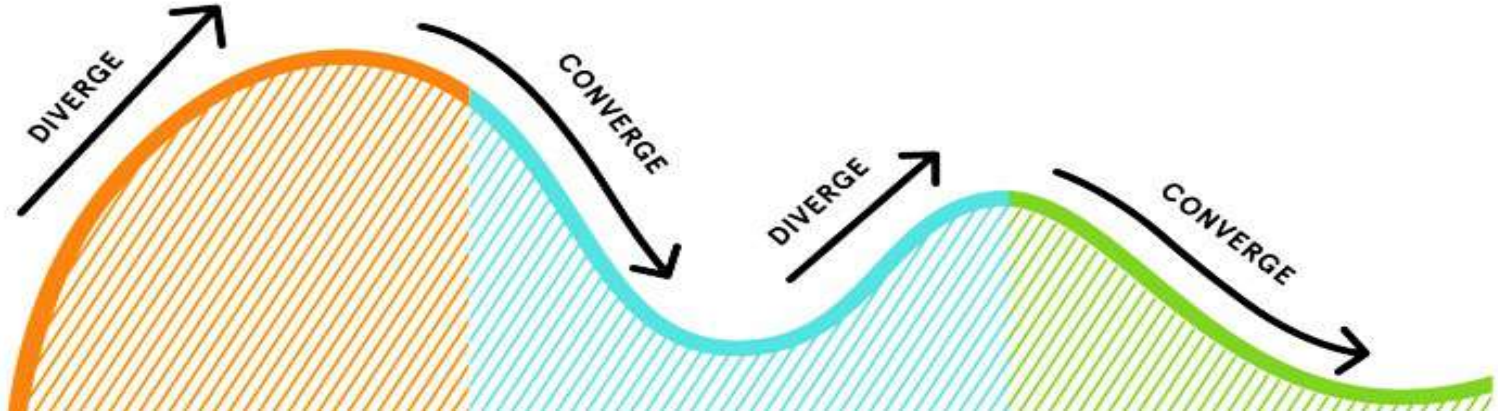


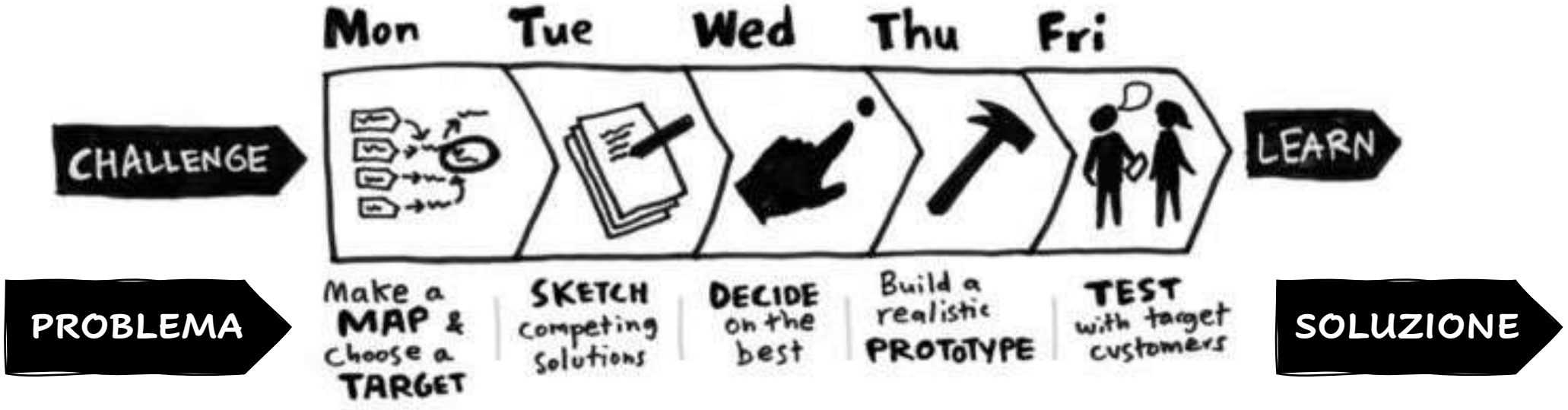
https://www.designcouncil.org.uk/our-resources/the-double-diamond/
designcouncil.org.uk



Bottà, D. UX Design design. Hoepli, 2019

From Design Thinking to Design Sprint





Knapp, J. Design Sprint, 2014

Experience (UX), a common field of action

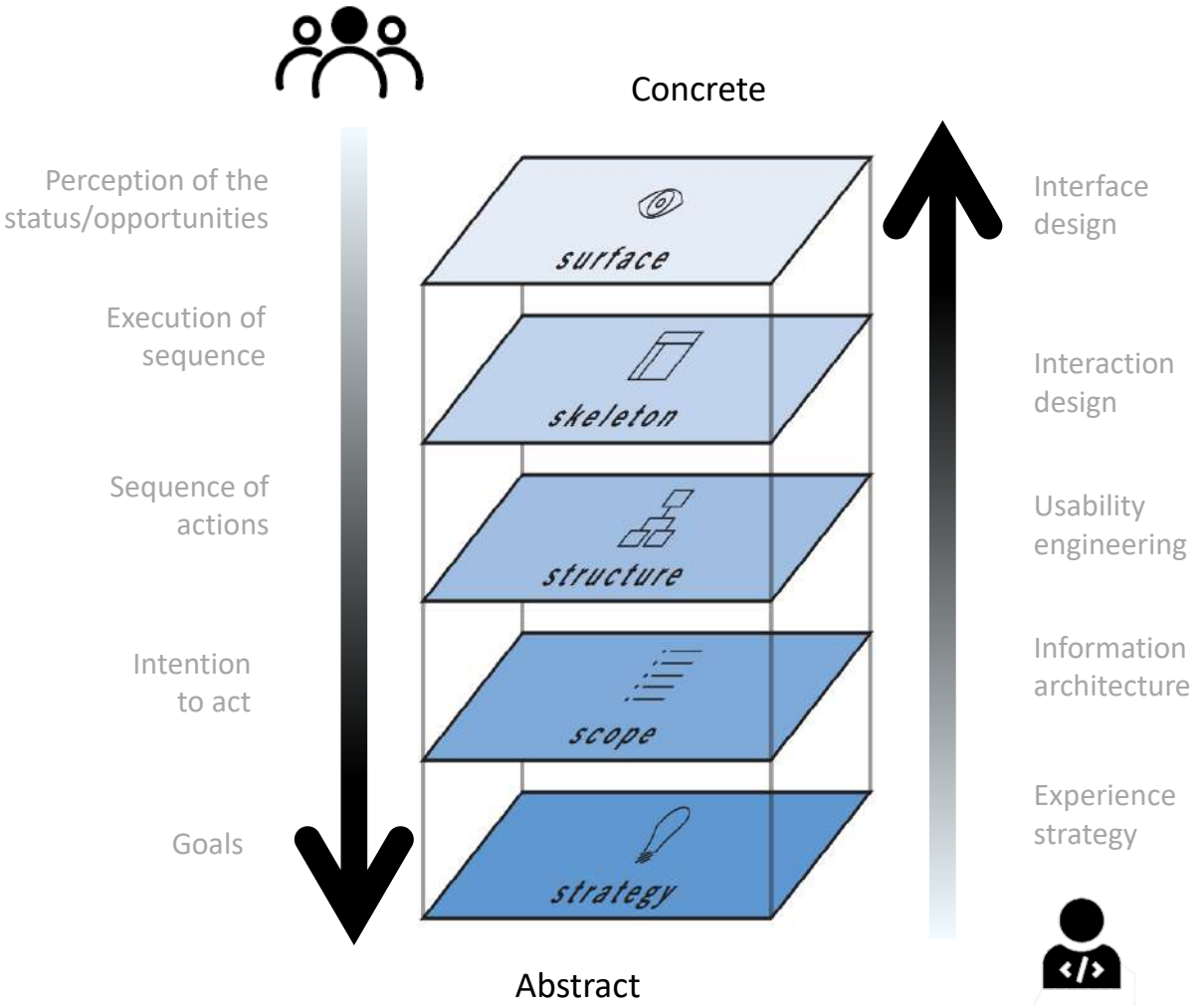
Users and designers share the same path,
that run in the opposite direction.

ISO 9241:2019

UX as Usage

Who benefits proceeds
FROM CONCRETE TO ABSTRACT

It concerns the quality and fluidity of the whole experience over time: **expectation, use, memory**, that can be reached and maintained thanks to the compatibility with the individual, cognitive, emotional, contextual characteristics of the specific users.



UX as Design

Des/dev
FROM ABSTRACT TO CONCRETE

UX Design is the process for **ideating, designing and validating** aspects of the user experience.

Human Centred AI Design principles and requirements

#1 Put people first

The user's role, as well as the goal, have to be clear.
To deliver positive experiences,

- Address user needs
- Consider human variability
- Prevent and manage possible errors

#2 Design for trust and transparency

- Check the quality of the information
- Make visible sources and possible conflict of interest (Social Trust)
- Prevent biases

#3 Make your solution Explainable

The user should always know how the system came to this conclusion or recommendation.

- Explain how the system works
- Review data (especially highly sensitive personal data) in use.
- Explain cause-effects relations right after the user action

#3 Provide feedback and control

Let the user take informed decision. Provide alternative and support choices.

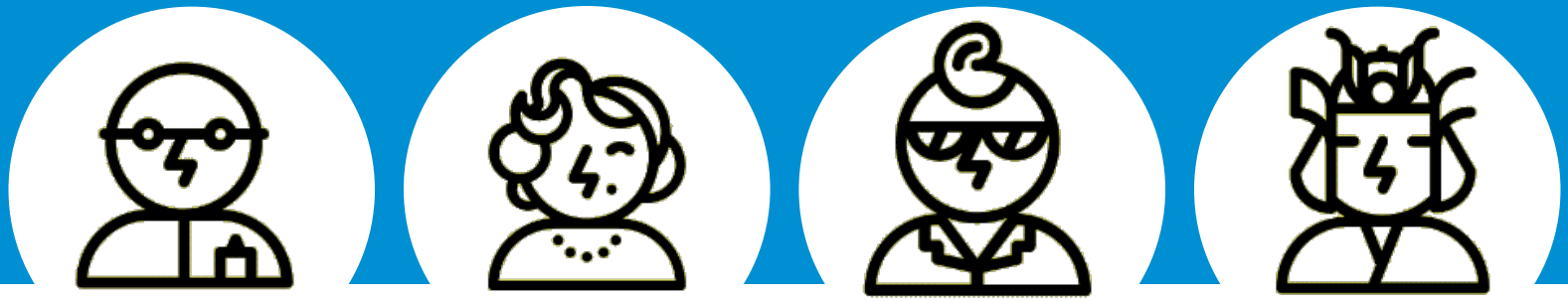
Don't presume the desirability of AI

Respect privacy and the collective good

Consider the unintended consequences of AI as design opportunities

UC Collective, Designing for AI — a UX approach, 2020

Your projects



Human Centred Design - Early Steps

1 STAKEHOLDERS MAP

- Which is the **domain**?
- Who are the **key actors** involved in or impacted by this project/service?
- What are their primary **roles and interests**?
- What is the level of **influence and power** each actor has over the success or failure of this project/service?

2 PERSONAS

- **Who are the primary users** of this product/service, and what are their key demographics, behaviours, and characteristics?
- What are the users' main goals, needs, and pain points, and how do they influence their interactions with the product/service?
- What are the **typical scenarios or contexts** in which users interact with the product/service?
- What **data they will provide/produce/receive**?

3 USER JOURNEY

- What are the **key steps** users go through when interacting with our product/service, and what are their goals at each stage?
  - How do the users will reach the solution?
  - Which channels will be used?
- What are the **critical touchpoints and interactions** influencing the user's journey, and how can we optimise these to create a seamless and positive experience?
- We can now define the SMART goals of the service

Elements to define and communicate

- **THE VALUE PROPOSITION**
- **THE SMART GOALS**

of your project

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