

# Applied Data Science Project

## HUMAN CENTRED DESIGN [L06]

Introduction: principles and tools

Antonella Frisiello



# I introduce myself



## Antonella Frisiello

Psychologist

Researcher in Digital Ergonomics and Human-Centred Design  
AI, Data & Space | LINKS Foundation

Adjunct professor in UX @ PoliT0  
[antonella.frisiello@polito.it](mailto:antonella.frisiello@polito.it)

**Psychologist, Ergonomist and Human Factors expert,**

I'm interested in the human dimension of technology.

I've been working in research and innovation field, leading activities related to the psychological and social aspects that influence adoption and interaction with new technologies, applying the Human-Centred approach to design, develop and assess **innovative and people-centred services.**

# Module Content

Wed 5<sup>th</sup> October '22

h13-14:30

L6 - The Human Centred Design approach.

Introduction (motivations, principles and tools)

Thu 6<sup>th</sup> October '22

h13-16

L7, L8 - Design for the real context:

the stakeholders' map (hands-on)

Wed 12<sup>th</sup> October '22

h13-14:30

L13 - Focus on the users: the personas

17<sup>o</sup> October '22

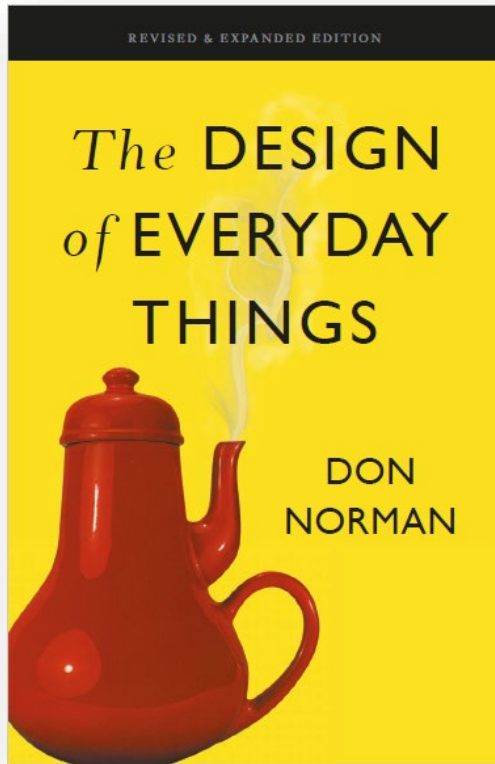
h16-19

L16 & L17 - Envisage the experience:

the Journey map (hands-on)



# Suggested readings



Norman, D.A.  
The Design of Everyday Things



Google's People + AI Guidebook



The resources linked  
in the footer of the module slides.



Noessel, C.  
Designing Agentic Technology.  
AI That Works for People.

# Widen the perspective

## Google Design

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“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



## 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



“Not keeping into consideration the **relationship between the digital tools** we create/develop/manage **and human behaviours** and 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.”

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

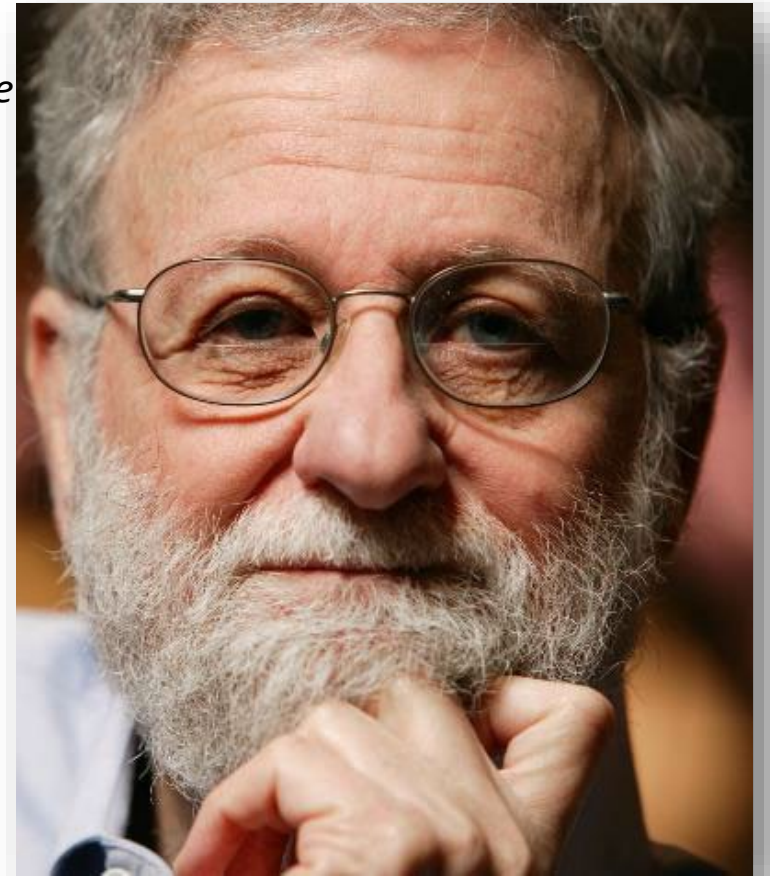


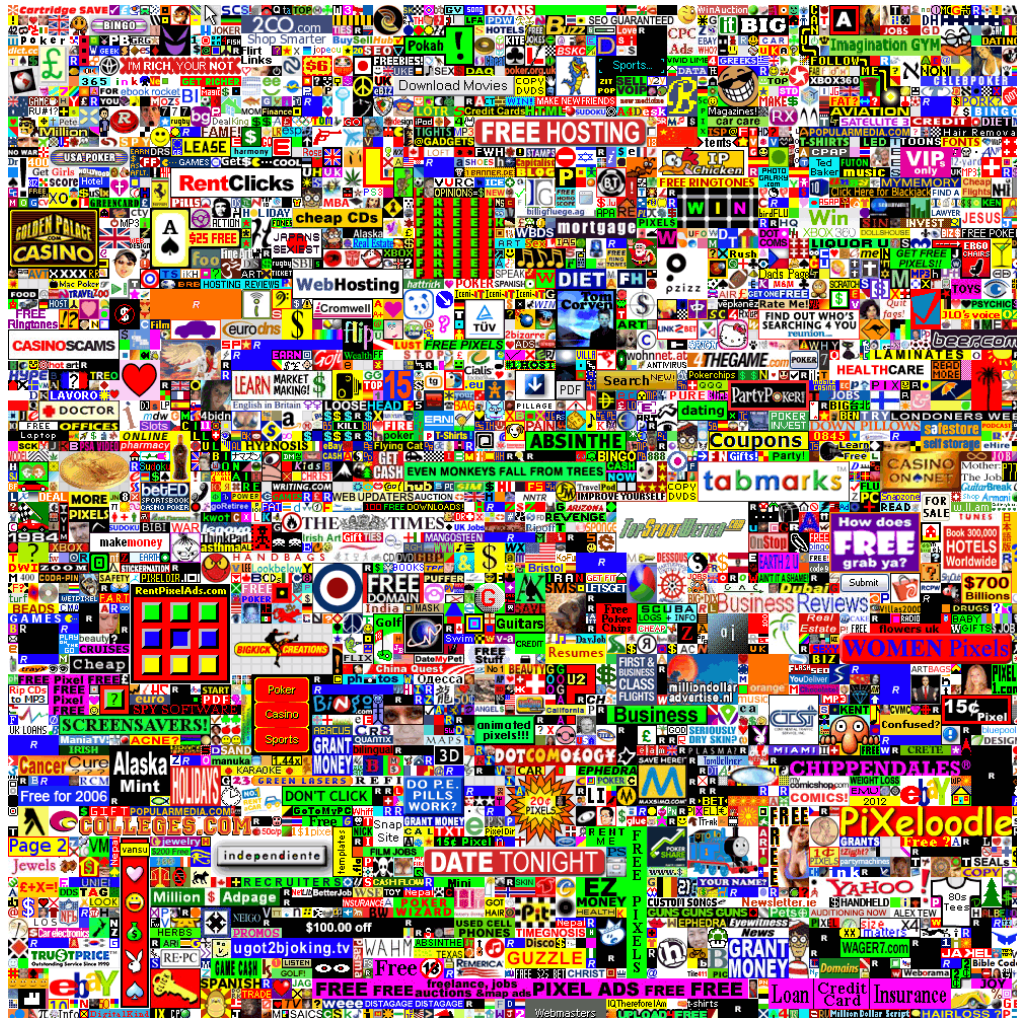


*“Artifacts pervade our lives, our every activity.  
Technology, potentially, makes our daily life more comfortable and pleasant... But at the same time, **it adds complexity and complication**”.*

## TECHNOLOGY PARADOX

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





[www.milliondollarhomepage.com](http://www.milliondollarhomepage.com)

*“Features used by only 10% of users or used only 10 % of the time are added and get in the way of the remaining 90% of features.*

*They clutter an otherwise clean interface. They interfere with the features used most often.”*

**WE DON'T WANT TO BE “FEATURISTS”.**



# HCD – BASICS





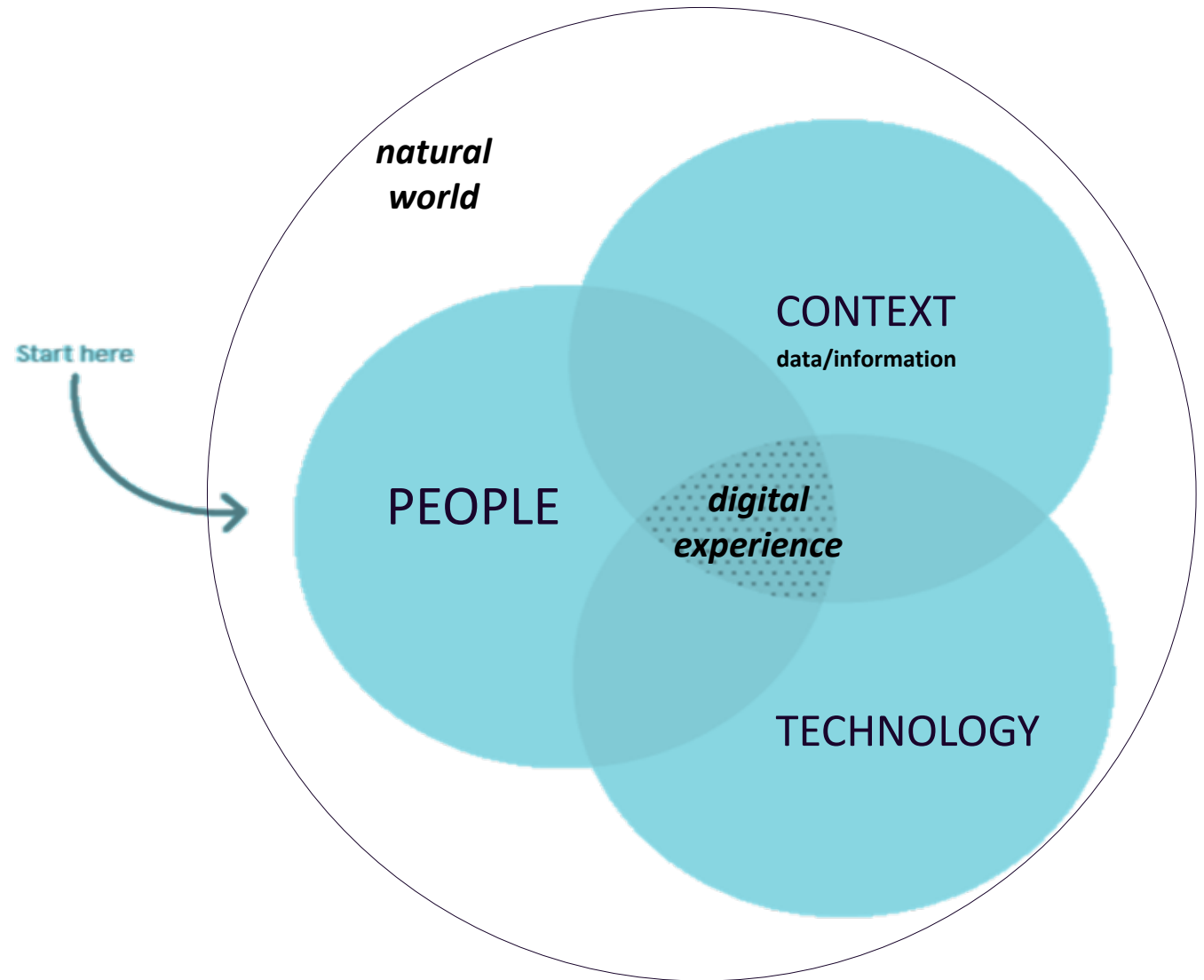
# The HCD approach

The **Human Centered Design** (HCD) is a design approach that is born and keeps being a reference in several fields, including all the branches of innovation technology.

Defined in the seminal work of psychologist **Donald Norman**, it reinterprets in a psychological key the **human-computer interaction** (HCI), widening the **focus** from the product/system to the **people who use it**.

**In this perspective, EVERY SYSTEM INCLUDES PEOPLE interacting with it and eventually among them.**

**Data and information are SOCIAL CONSTRUCTS since they are generated by human beings, that use them, exchange them, enrich them, ....**



# Funding principles

## HUMAN CENTRICITY

People are an integral part of the system. They must be part of the design and development to include their needs and perspectives as direct and indirect beneficiaries.

## ITERATION AND FEEDBACK

Design before development. Then test and design again. Test during the development, to create space to make mistakes, learn from different perspectives, progressively improve, and take better decisions. (error spaces and learning)

## DATA-DRIVEN APPROACH

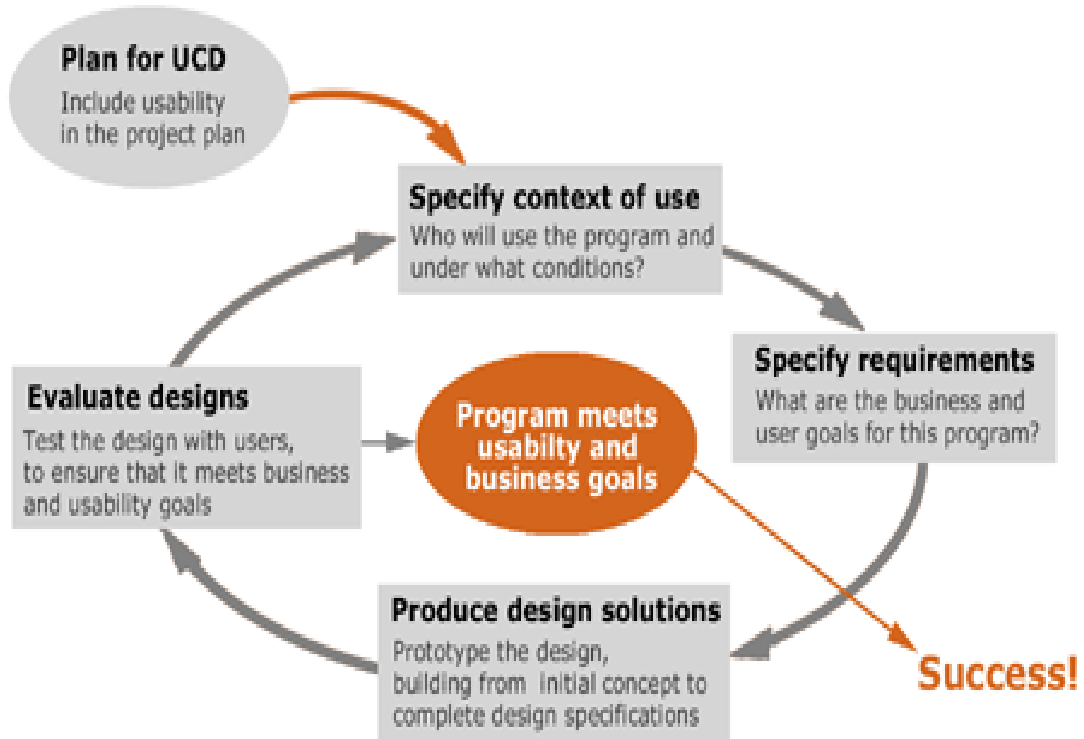
Be consistent, collect data from the real world. Use small data (qualitative) to know in dept. Keep in consideration the Human variability factors, to be inclusive and exhaustive.

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 formalized in several ISO Standards.



# The final aim (WHAT)



NORMA ITALIANA	Processi di progettazione orientata all'utente per sistemi interattivi	UNI EN ISO 13407
		GENNAIO 2000

Human-centred design processes for interactive systems

The standard provides guidance for **user-oriented design activities during the whole life cycle of the interactive systems.**

It focuses on the design process management and provides guidance to reach and assess the ultimate goal of the user-centred design process: usability, more recently updated in terms of user Experience (UX).

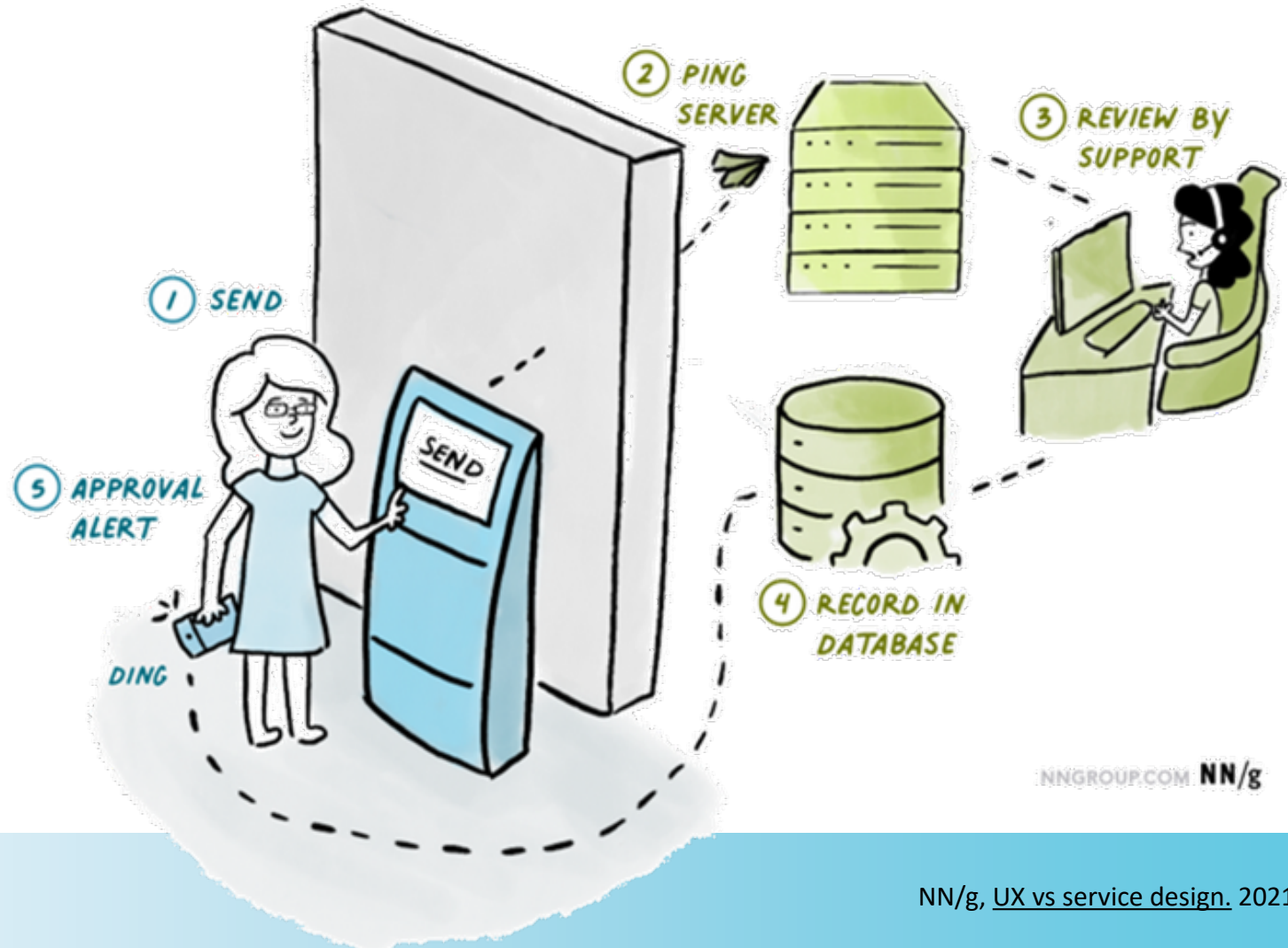
# User Experience

vs.

# Service Design

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

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



# USER EXPERIENCE

ISO 9241-210 (2020)

The user experience or UX includes aspects of **quality** and **fluency** of the entire experience flow (**expectation, use, memory**), compatibly with the users' cognitive, emotional and contextual specificities.

BEFORE USE

Beliefs, emotions, anticipating thought, background, expectations, habits,...

DURING USE

Efficiency, effectiveness and satisfaction pursuing the goal.

AFTER USE

Memories, learnings, and emotional connection that remaining for a while/over time

USABILITY

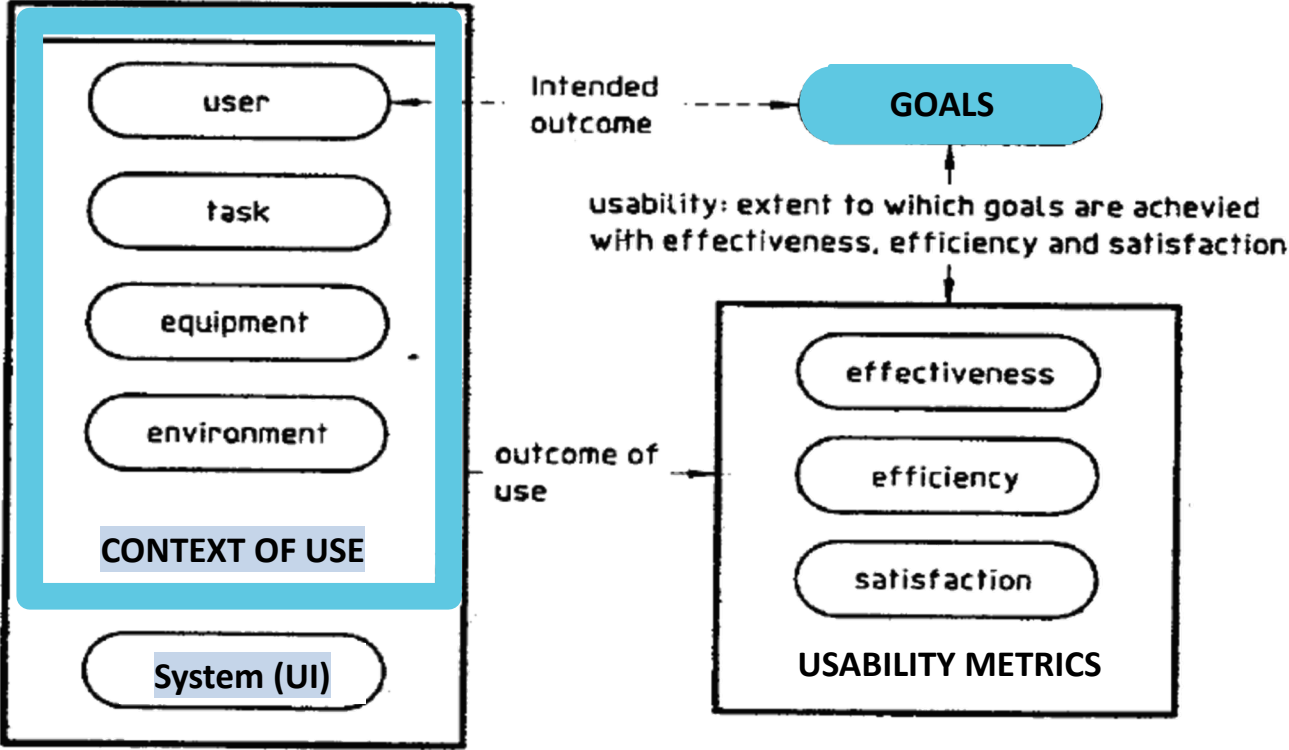
ISO 9241-11 (1998)



# USABILITY

ISO 9241-11 (1998)

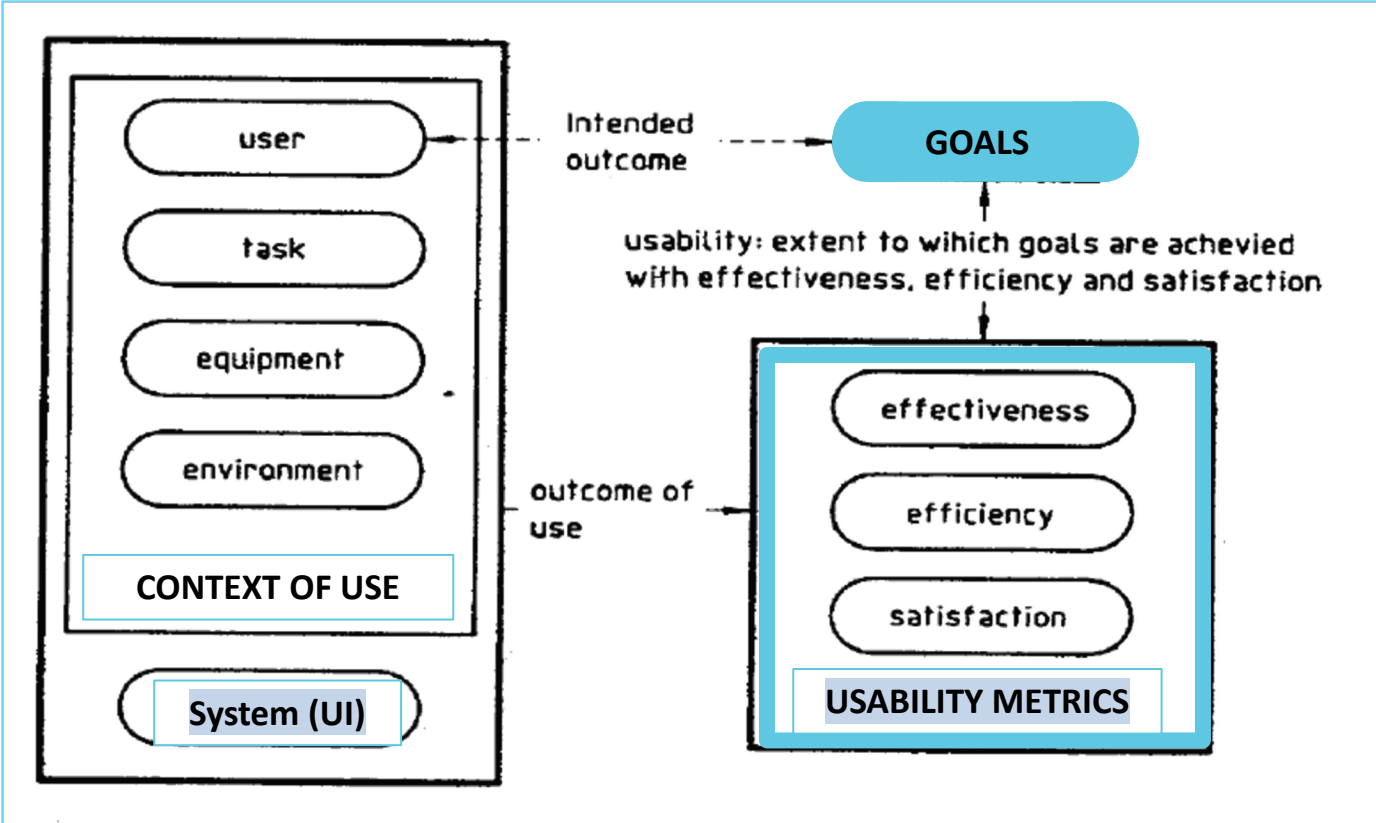
The extent to which a system/product can be used by **specified users** to achieve **specified goals** with **efficacy, efficiency, and satisfaction** in a **specified context of use**.



# USABILITY

ISO 9241-11 (1998)

The extent to which a system/product can be used by **specified users** to achieve **specified goals** with **efficacy, efficiency, and satisfaction** in a **specified context of use**.



# UX metrics



## Efficacy

The extent to which a person correctly and completely achieves the goal, through the system.

→ Goals completeness, Accuracy



## Efficiency

The amount of resources spent by the person to reach a goal.

→ Execution time, Nr. and types of errors, Nr. of steps, clicks, Repeated tasks



## Satisfaction

The degree of comfort/absence of frustrations related to the use of the system. It is also influenced by aspects such as visual style and human-machine dialogue quality.

→ errors, appreciation, lack of frustration,...

They are offered through properties such as:

- Feedback
- Transparency
- Visibility
- Consistency
- Reversibility
- Controllability
- Flexibility

# Efficacy

The measure of **accuracy and completeness** of the achieved results.

The system is effective if allows one to carry out the established task **comprehensively and accurately**.

## METRICS:

Total or partial achievement  
by all the fixed targets  
% of involvement and use

It's not enough to count downloads or access....



2 examples



Soggiorni | Voli | Volo + hotel | Noleggio auto | Attrazioni | Taxi da/per l'aeroporto

Home > Italia > Piemonte > Torino > Risultati della ricerca

**Cerca**  
Destinazione/nome struttura:  
Torino  
Check-in: venerdì 24 dicembre 2021  
Check-out: lunedì 31 gennaio 2022  
Soggiorno di 38 notti  
2 adulti - 0 bambini - 1 camera  
Viaggio per lavoro  
Cerca

**Torino: 1.101 strutture trovate**

Le nostre scelte top | Case e appartamenti prima | Stelle (ordine decrescente) | Stelle (ordine crescente) | ...

La commissione pagata e altri fattori potrebbero influenzare il posizionamento di una struttura nei risultati di ricerca. Scopri di più

**NH Torino Santo Stefano** ★★★★★  
Centro Storico di Torino, Torino · Mostra sulla mappa · 0,5 km dal centro  
Situato nel centro di Torino, l'NH Torino Santo Stefano dista appena 150 metri dal Duomo di Torino, e offre spaziose camere con WiFi gratuito e una terrazza all'ultimo piano con vista panoramica sulla...  
Favoloso 8,7 (3.154 recensioni)  
Posizione 9,7  
Visualizza tariffe

**Hotel Alpi Resort** ★★★  
Centro Storico di Torino, Torino · Mostra sulla mappa · 1 km dal centro  
L'Hotel Alpi Resort, situato a 10 minuti di cammino dal famoso Museo Egizio di Torino e dalla Mole Antonelliana, sarà lieto di accogliervi alla reception, aperta 24 ore su 24.  
Buono 7,9 (3.616 recensioni)  
Visualizza tariffe

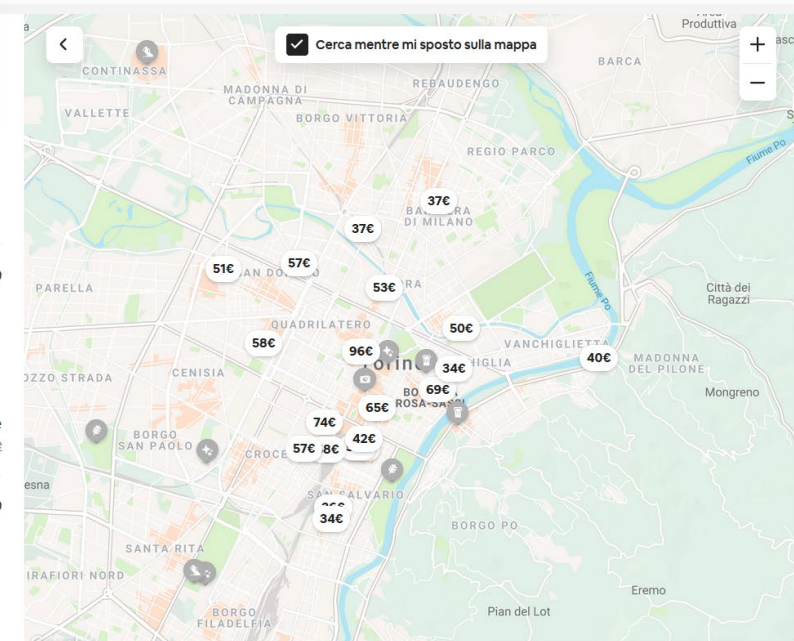
**Torino: alloggi**

Cancelazione gratuita | Tipo di alloggio | Prezzo | Prenotazione immediata | Più filtri

Torino: date più richieste. Le ricerche per queste date sono aumentate (144%) rispetto alla media degli ultimi 6 mesi.

**SUPERHOST**  
Intero alloggio: unità in affitto a Torino  
**CAVI Incantevole Mansarda nel centro di Torino**  
2 ospiti - 1 camera da letto - 1 letto - 1 bagno  
Wi-fi - Cucina - Riscaldamento  
★ 4,68 (19 recensioni)  
36€ ~~34€~~ / notte  
232€ in totale

**SUPERHOST**  
Intero alloggio: unità in affitto a Torino  
**Appartamento indipendente 50mq**  
2 ospiti - 1 camera da letto - 1 letto - 1,5 bagni (anche di servizio)  
Wi-fi - Cucina - Lavatrice - Riscaldamento





# Efficiency

The measure of individual **cognitive resources** employed in achieving the goal.

The more efficient the system, the more it reduces the mental load of the user.

## METRICS:

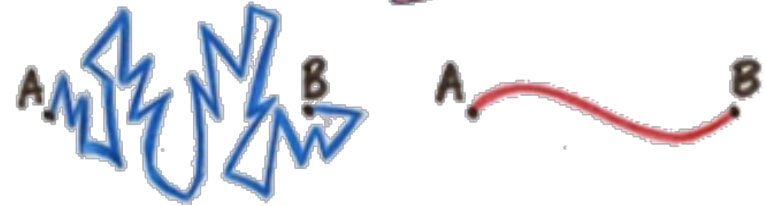
number of errors the user makes in completing a task

time spent to reach the goal

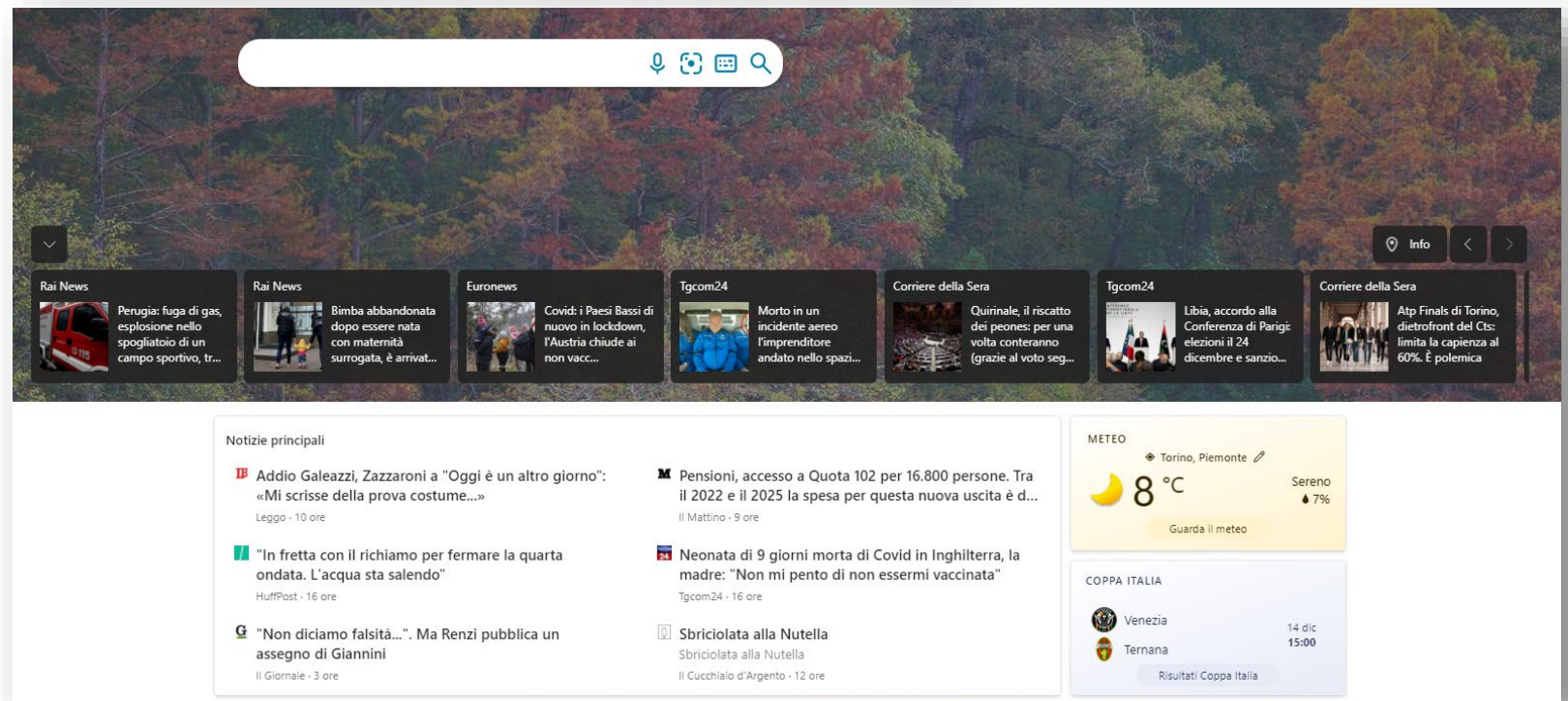
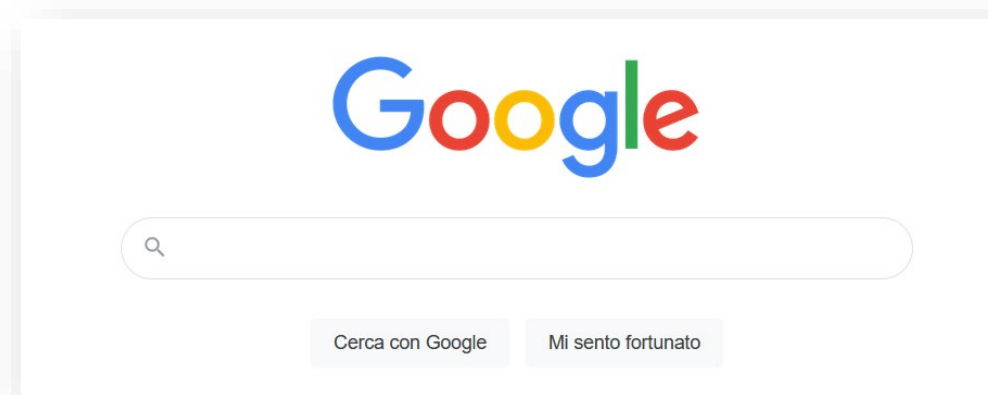
(the faster, the more efficient)

Errors

## Efficacy VS Efficiency



## 2 examples



# Learnability

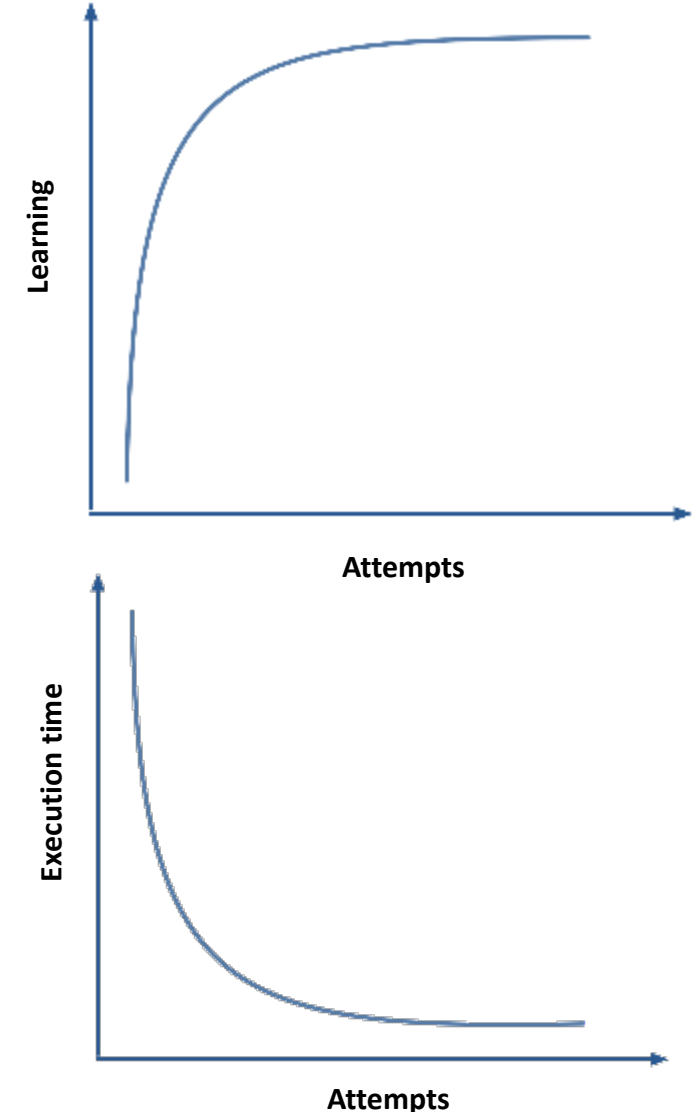
It is defined as the ease of use of a product/service **at the first attempt**:

- If the persons succeed in quickly figuring out how to perform the tasks interacting with the system interface when it's not familiar it is easy to learn, then intuitive for that target users.

## METRICS:

number of attempts and errors

This dimension depends on the context and type of service/system:  
when a **training period** is needed to approach complex systems, this dimension is not a good usability variable to assess.



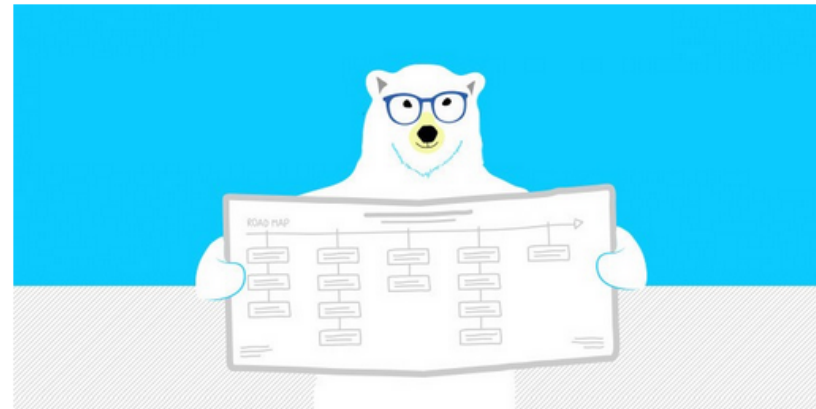
UX Bear



Groaaaaar! (Polar bearish for hi)

Looks like this is your first time here. 🐻

I'm UX Bear, your user experience friend from uxdesign.cc. I talk to industry professionals and share my insights here with you. I hope I can learn from you too! 🐻



Me planning the roadmap of UX Chat — uxdesign.cc

You wanna talk about what happened in design lately or get to know me better?

Get to know you

Design 🐻

Calls to action drive the user to know **what** they can ask **how to** interact with the system

# Memorability

It concerns the quality of memories about how-to-interact with the system over time.

It is detected by observing occasional users who return to use the product after a certain period (e.g. assessment of the same task, in subsequent tests repeated by the same users at a distance of time. ).

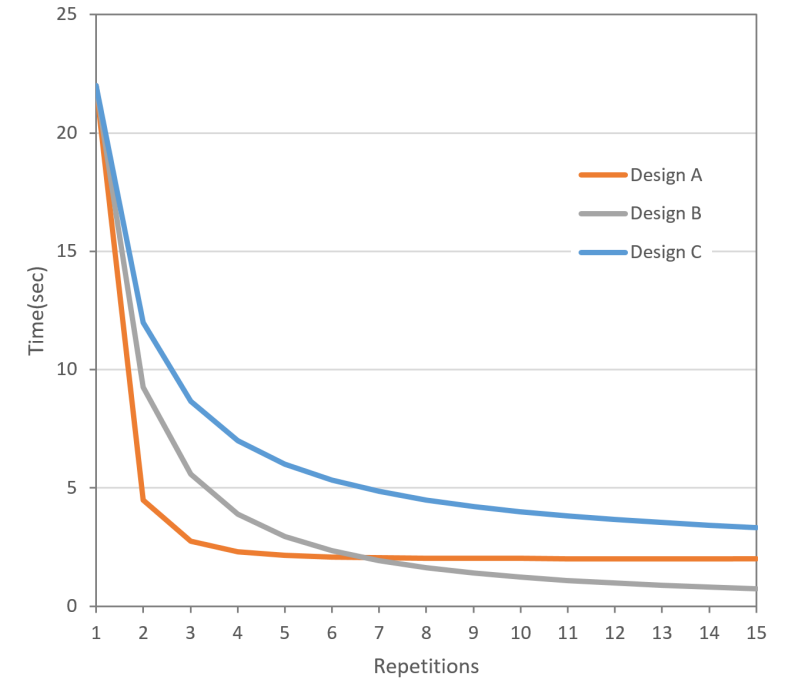
This dimension also informs us about

- **the probability of making mistakes (and which ones)**
- **How pleasant and satisfying the use**

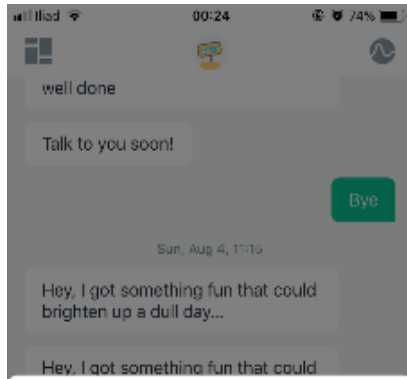
## METRICS:

**Comprehension** (ease of learning of functions). How long does it take the user to learn how to use a function?

**Efficiency**. How long does it take for the user to learn how to perform the specified task efficiently?







here are your tools  
quick chats for step-by-step guidance



Help me feel better

Type a response

hey anto

what we've talked about

- The Power
- All-or-Nothing
- Practicing Gratitude
- Will I Feel Better?

your mood over time

THU 13 JUN	SAT 15 JUN	SAT 6 JUL	SUN 7 JUL	TUE 30 JUL	THU 1 AUG	THU 2 AUG
☹️	😊	😊	😊	😞	😞	😞

Check in to find patterns in your mood and learn more about yourself

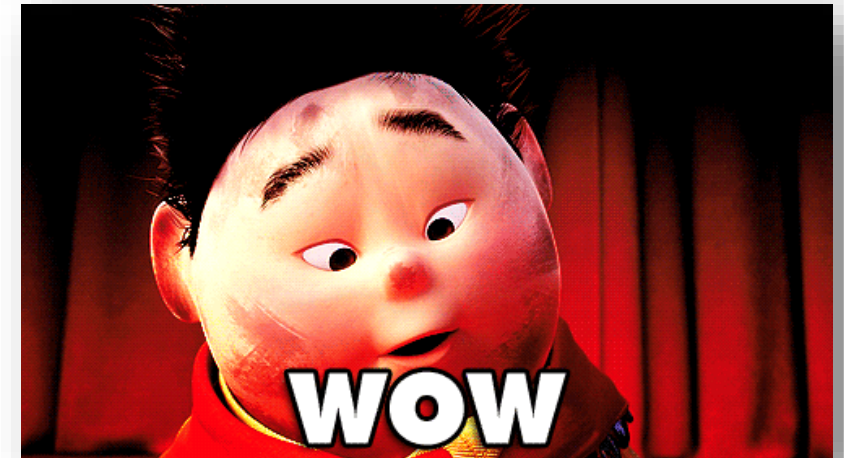
Check in

# Satisfaction

It is the most complex dimension to reach and evaluate.  
It concerns the LEVEL OF COMFORT and GRATIFICATION that the user experience offers.

A system can work very well but it is not enough.  
IT MUST BE EASY TO USE, PLEASANT AND ENGAGING.

*«Cognition is understanding,  
Emotion is interpreting the world»*





u up? then text  
844-823-5621

Emotional connection search through the visual  
before than the UI

## insomnobot-3000

A friendly, easily distracted bot  
designed to keep you company when you  
just can't fall asleep.

Extra chatty between 11pm-5am.

Created by Casper



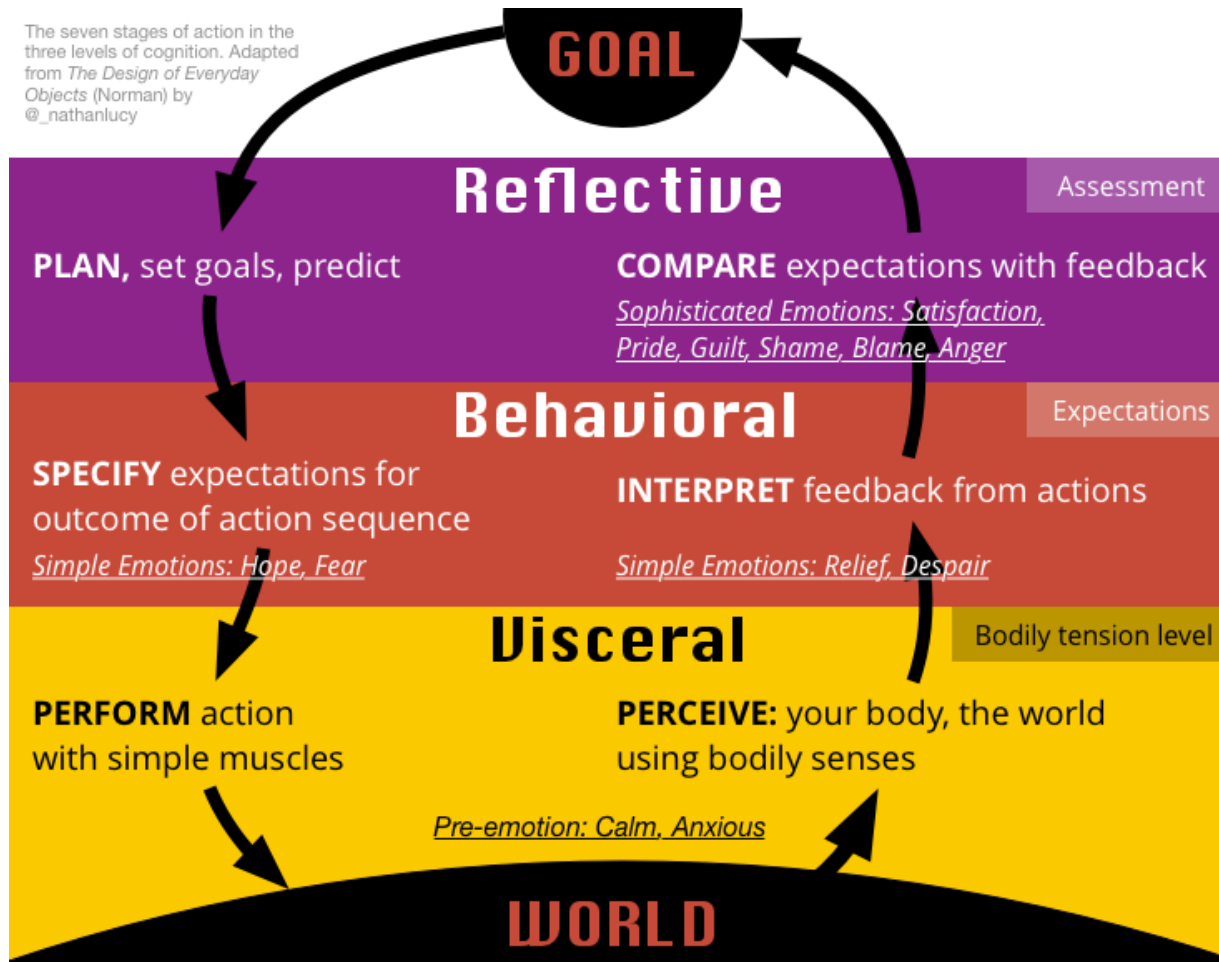
antonella.frisiello@polito.it

<http://insomnobot3000.com/>



# Satisfaction layers

The seven stages of action in the three levels of cognition. Adapted from *The Design of Everyday Objects* (Norman) by @\_nathanlucy



<http://www.nathanlucy.com/blog>





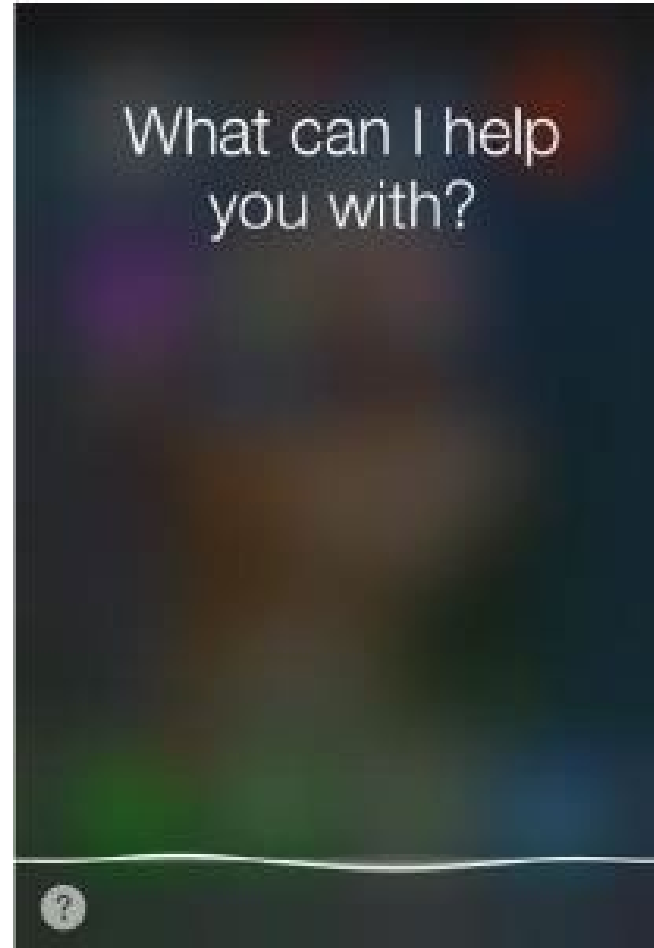


# Zero UI

The zero-interface is not a new idea, but with the integration of AI, it has found a new wave. Also known as NATURAL interfaces, they enable the interaction a full direct manipulation (seamless input and output)

- Voice assistants on smartphones and smart-speakers
- Game technologies that are controlled with the movements of the whole body

*As we move away from the screens, our interfaces have to become more **automatic, preventive and predictive.***

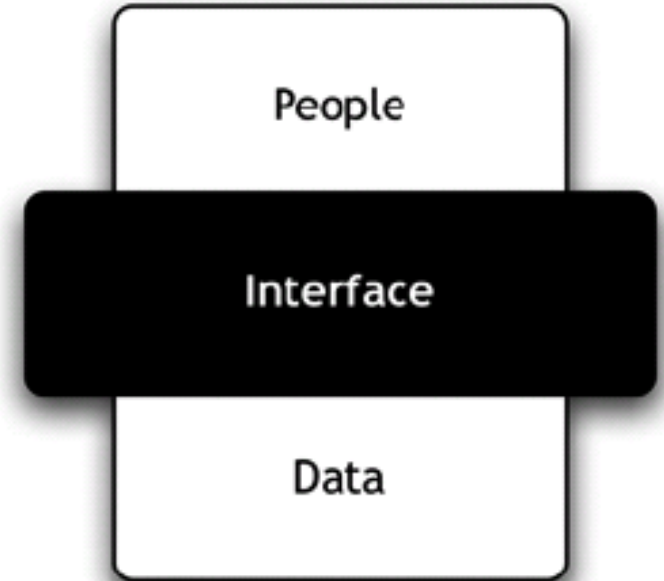


# The interface is...

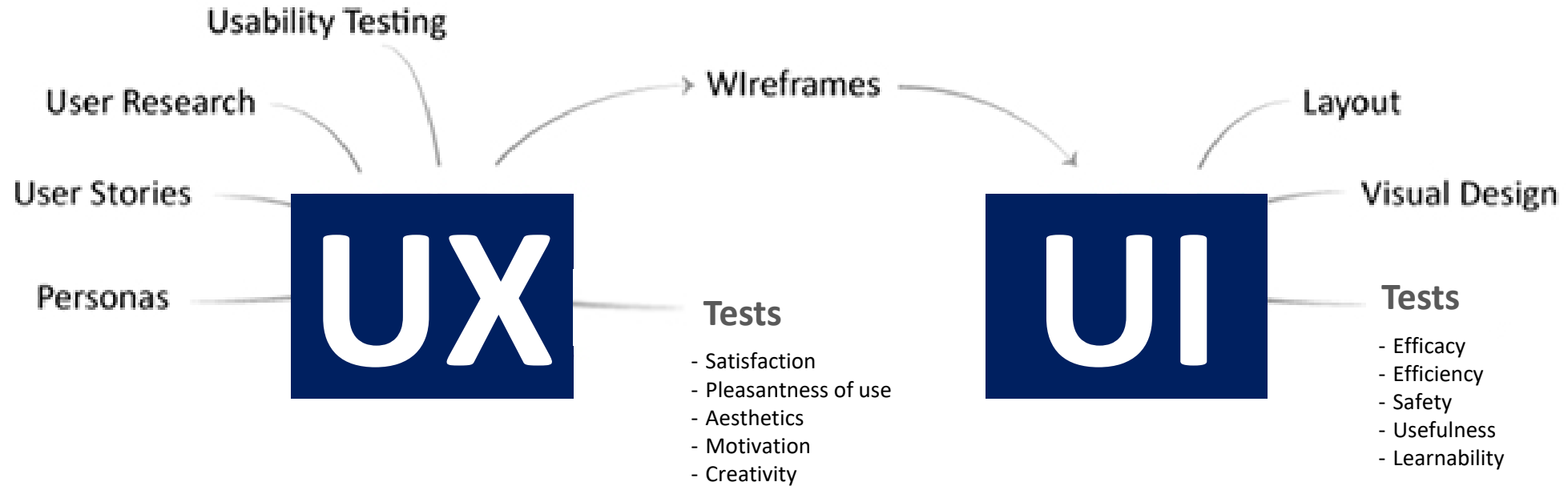
The **representation** of the **system functionalities** (connected to the physical system), allowing the user to **turn intention to action**.

An artefact able to **translate information in sensorial phenomena**, tailored for **the human perception, cognition and action**.

Communication tool, applying a code, that is a **conventional and shared set of rules** enabling the person to experience the system/service (through its representation).



# An interdisciplinary process





## Don Norman: The Term UX



# Algorithmic Experience

In comparison to traditional Human-Computer Interaction (HCI), **the human experience with algorithms** (Human-AI Interaction-HAI) differs in several aspects:

AI systems can:

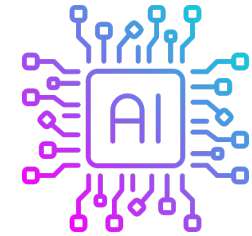
- show **human-like behaviour**, e.g., in communications systems such as chatbots
- **enable intelligent interaction**, such as **voice input or facial recognition**
- **adapt** the interaction to the user by continuously learning from the user's behaviour
- not only be an assisting tool but **collaboratively work** with humans

AI systems can

- act with certain degrees of **autonomy**, e.g., humanoid robots in health support
- exhibit **contextual understanding**, e.g., neural machine translation
- demonstrate **classification problem solving** capabilities beyond human level, e.g., in the medical domain
- generate **non-deterministic and unexpected outputs**, e.g., co-creating musical content

AI systems are:

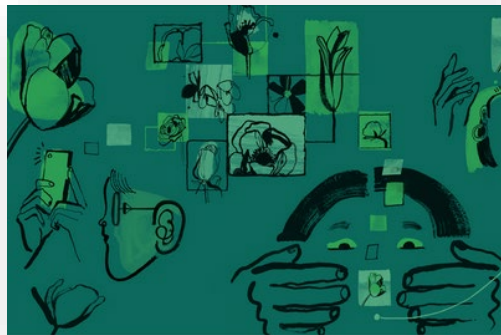
- “black box” systems, where the machine learning technology and the learning process are **opaque to the users** and the AI output **not re-traceable** and **not or at least hard to verify**.



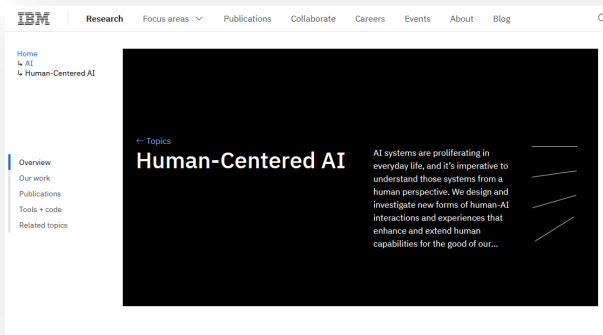
# The Human-Centred AI

A collaborative approach to the design of AI-based solutions, including social sciences and humanities, ethics, psychology and behavioural science.

The Human-Centred AI promote **methods** and benefits **of HCI to novel frontiers**, to improve the design and development of systems capable to support people in making more informed decisions, more effective analysis (understandable and explicable), and living better digital experiences.



Google's People + AI Guidebook



HCAI IBM guide



HCAI IDEO tools



# HCAI Design principles and requirements

## #1 Putting the human first

The user's role, as well as the goal, have to be clear.

To deliver good interaction concepts and address user needs, it is all about the insights we have generated and will generate during the design process.

- Individuals' variability
- Errors

## #2 Design for trust and transparency

- **Information Trust** as the quality of the information, experiences and uncertainty
- **Social Trust** as honesty of relationships
- **Cognitive Trust** as expected knowledge of reliability and competence.

## #3 Explainability

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

- Discover and ask how the system works
- Review data (especially highly sensitive personal data) in use.
- Explanation right after the user action, about cause-effects

## #3 Feedback and control

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

- Discover and ask how the system works
- Review data (especially highly sensitive personal data) in use.
- Explanation right after the user action, about cause-effects

1. Data is not truth

2. Don't presume the desirability of AI

3. Respect privacy and the collective good

4. Unintended consequences of AI are opportunities for design

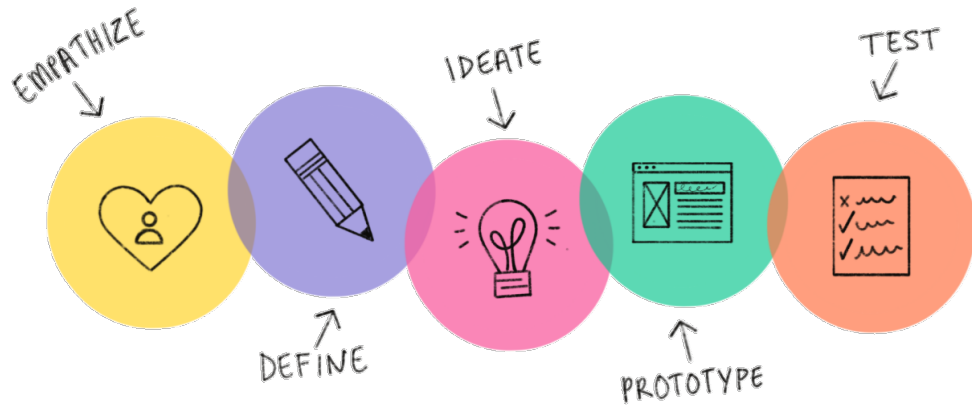
UC Collective, Designing for AI — a UX approach, 2020



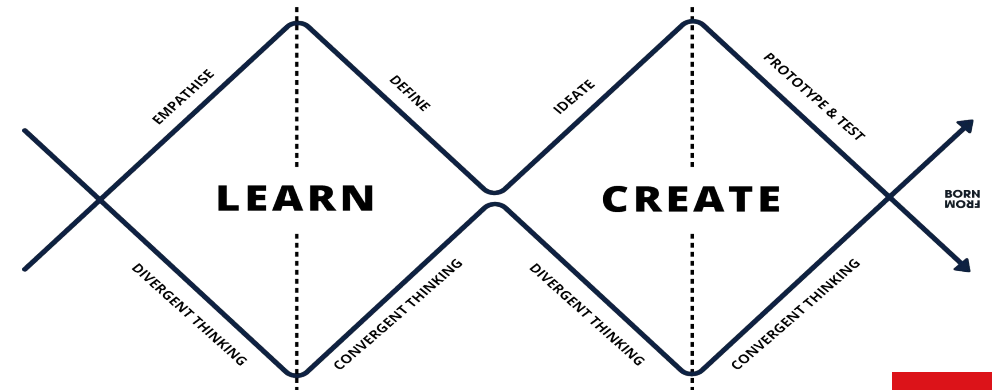
# HCD – PROCESS and TOOLS



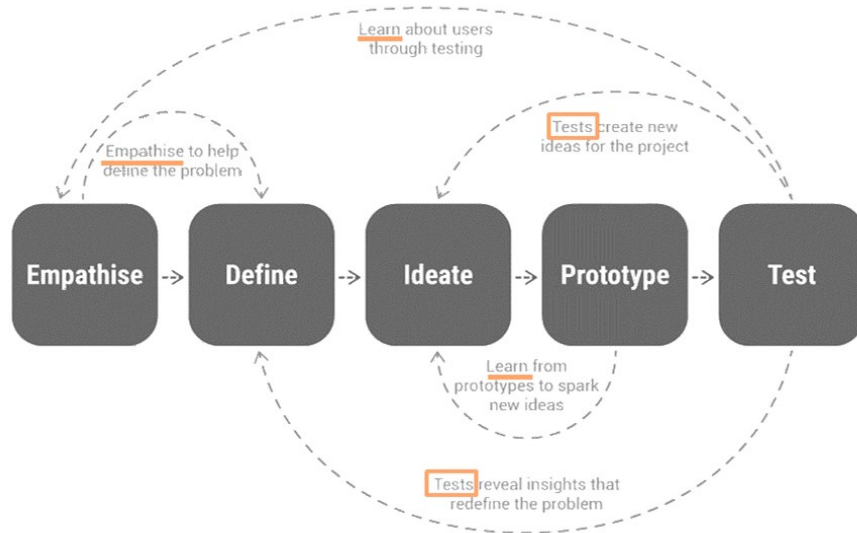
# 1 method, many approaches



D.school, Human centred design



Design Thinking, 2005



Human Centered Design Toolkit, 2011. IDEO



INTERACTION-DESIGN.ORG



# Steps and tools

*The macro-process scales up the core process: in every step, you will learn, ideate and test.*



**H**

## Study, Visit, Listen, Observe, Ask

- Define the problem
- Map the context
- Know user characteristics and needs



**C**

## Create, compare, draw

- Design big vision and details before starting to develop
- Design the interaction
- Test alternatives



**D**

## Develop, Test, Refine, test, Describe, Evolve

- Test the development
- Test with users
- Also design the support

Tools to:  
Know, Design, Share, Refine

**DATA COLLECTION**

+

**DATA DISPLAY**

<p>SURVEY INTERVIEWS CONTEXTUAL INQUIRY N/ETHNOGRAPHY SERVICE SAFARI</p>	<p>STAKEHOLDERS MAP PERSONAS EMPATHY MAP</p>
<p>REQUIREMENTS CO-SKETCHING DIAGRAMMING</p>	<p>JOURNEY MAP INFO-ARCHITECTURE WIREFRAMES FAKE DOORS</p>
<p>HEURISTIC EVALUATION EXPERT ASSESSMENT COGNITIVE WALKTHROUGH USER TEST</p>	<p>UI DESIGN PoC WORKING PROTOTYPES USER GUIDE</p>

# Our focus



H

## Understand and Specify the context of use

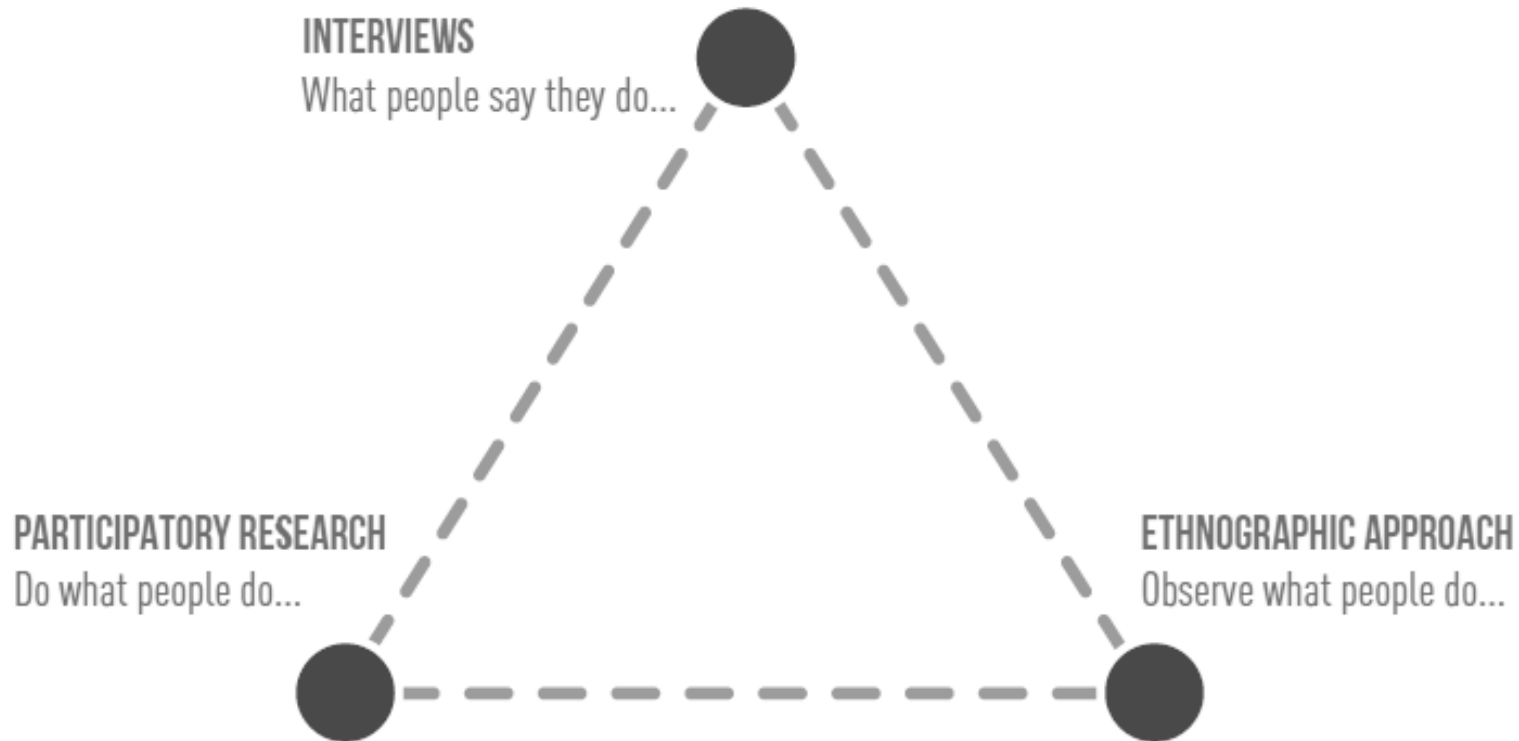
- Characteristics of people that will use the system
- Tasks that people can do (operations, actions, activities in relation to objectives)
- Ambient or instrumental conditions (hw and sw)
- Needs and wants

USER  
RESEARCH

What info do we need?

Users	Tasks	Equipment
<b>User types</b> Primary Secondary and indirect users  <b>Skills and knowledge</b> Product skill/knowledge System skill/knowledge Task experience Organizational experience Level of training Input device skills Qualifications Language skills General knowledge  <b>Personal attributes</b> Age Gender Physical capabilities Physical limitations and disabilities Intellectual ability Attitude Motivation	Task breakdown Task name Task frequency of use Task duration Frequency of events Task flexibility Physical and mental demands Task dependencies Task output Risk resulting from error Safety critical demands	<b>Basic description</b> Product identification Product description Main application areas Major functions  <b>Specification</b> Hardware Software Materials Services Other Items

# Data triangulation



**User research** generates an in-depth understanding of the real needs of people and all the actors involved in the system.

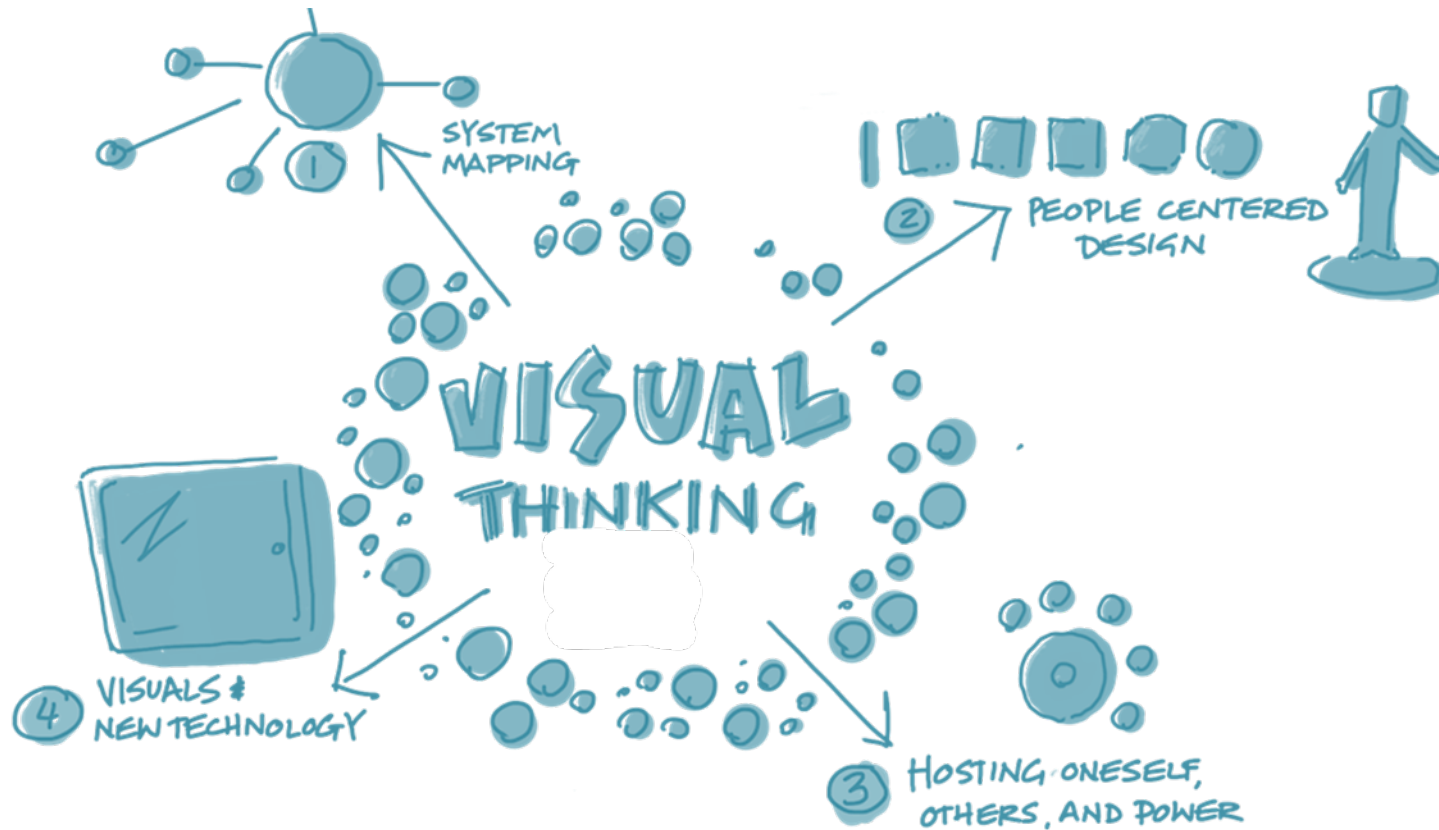
To get a good enough understanding of the problem, ideally,  
**Big data (quantitative research) and Small data (qualitative research)** should be combined.





# Visual thinking

It is a process in which thought, communication and coordination is stimulated and facilitated by visual representations: schemas, images.



## DATA DISPLAY TECHNIQUES

STAKEHOLDERS MAP

PERSONAS

USER JOURNEY

# Hands-on (preparation)

## USER RESEARCH

## DATA DISPLAY TECHNIQUES

STAKEHOLDERS MAP

PERSONAS

USER JOURNEY

1. Identify an **area of interest**. It can be the project you'll develop during the course or service you're interested to dig in a use-centred perspective.

### EXAMPLES OF POSSIBLE AREAS

- Health (e.g., Vaccine booking sites/apps, Sites/Apps psychological help)
- Emergency
- Safety
- Education

2. Start a **desk analysis** to collect information about the area of interest:

### EXAMPLES OF POSSIBLE DATA SOURCES

- Demographic dataset
- Reports
- Research papers
- Newspaper articles

These elements will be the base of the hands-on activities of the next lessons of this module.

# Questions



**Antonella**

**Frisiello**

[antonella.frisiello@polito.it](mailto:antonella.frisiello@polito.it)