

# Human-centered design involving people with disabilities: a few research avenues based on methodological considerations

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Valenciennes



# Outline

## 1. Methodological context

## 2. From Human-Centered Design to Disabled User & Ecosystem Centered Design

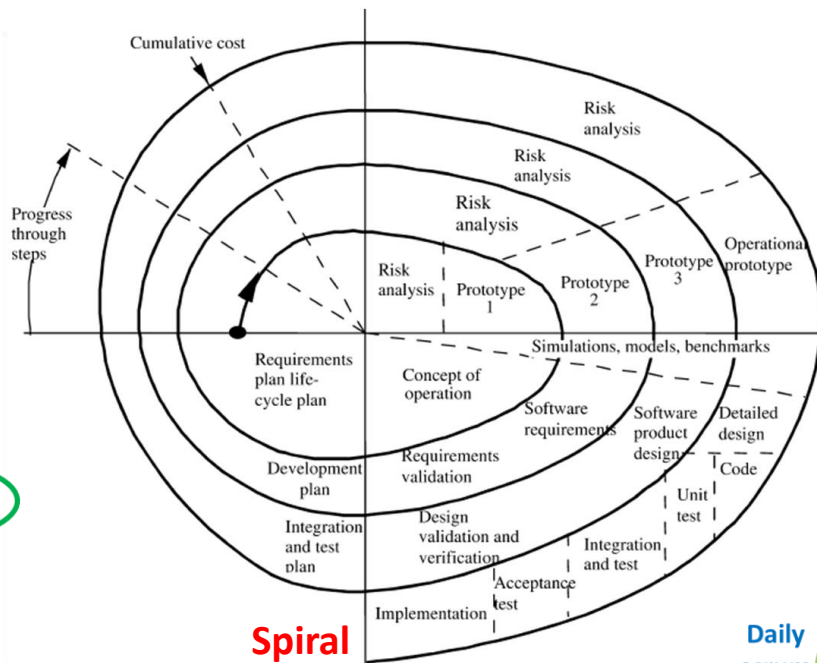
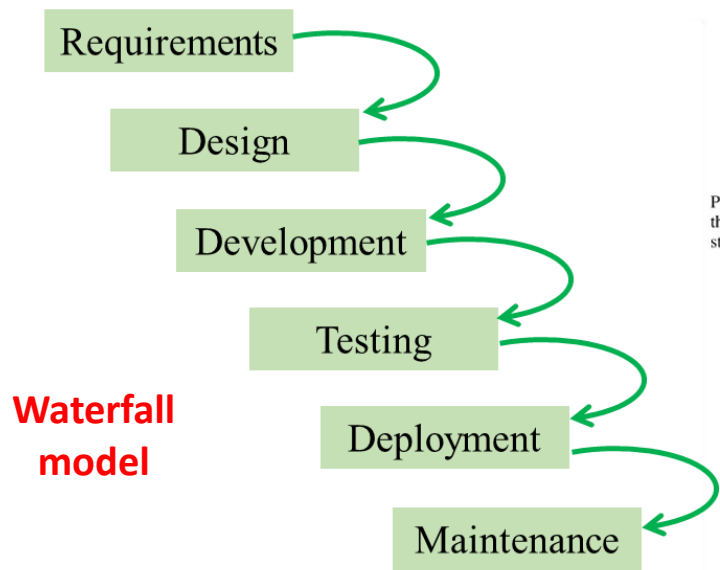
## 3. Adapting processes and methods

## 4. Disability awareness within companies

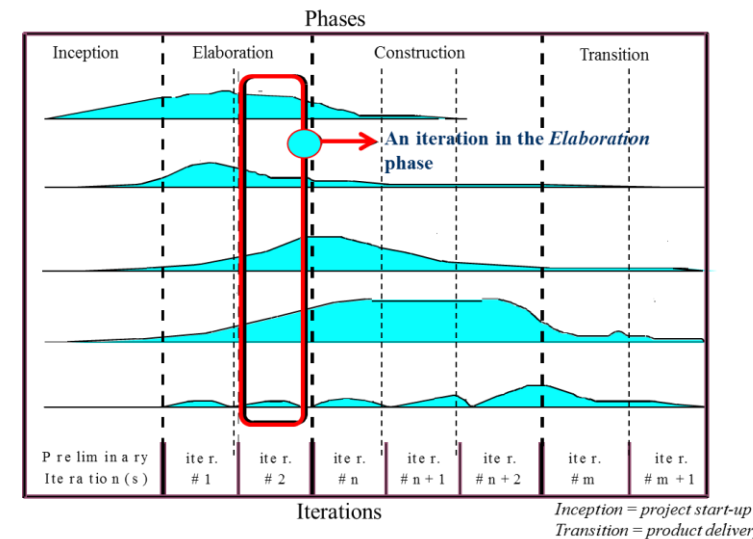
## 5. Conclusion & research ways

# Methodological context

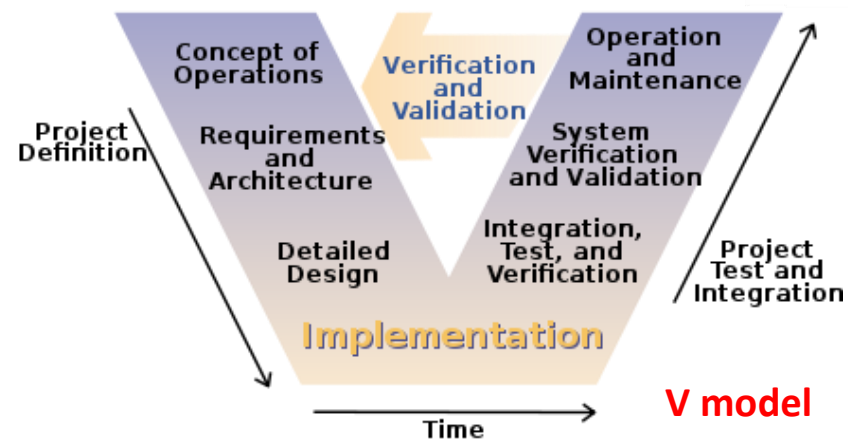
- Well-known development models from Software Engineering



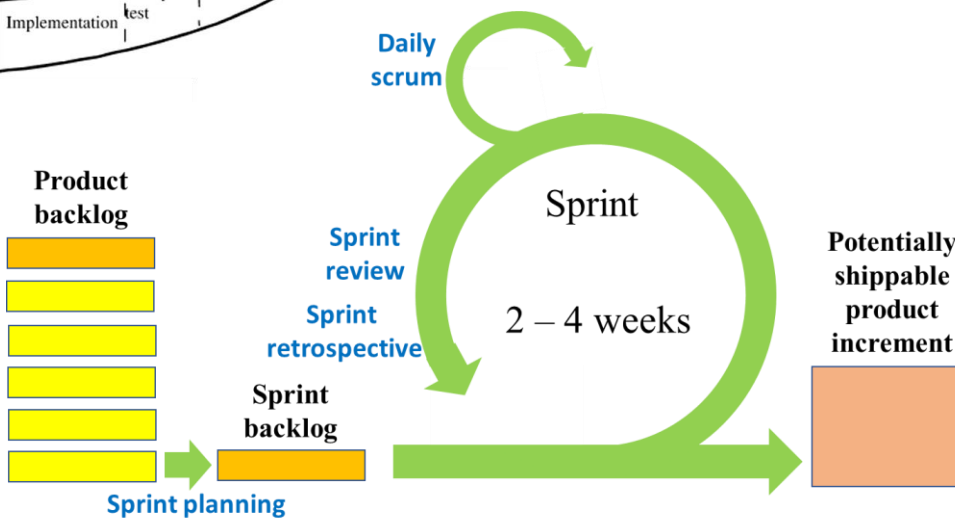
- Requirements
- Analysis
- Design
- Implementation
- Test



**Unified Process (wih UML)**



**V model**



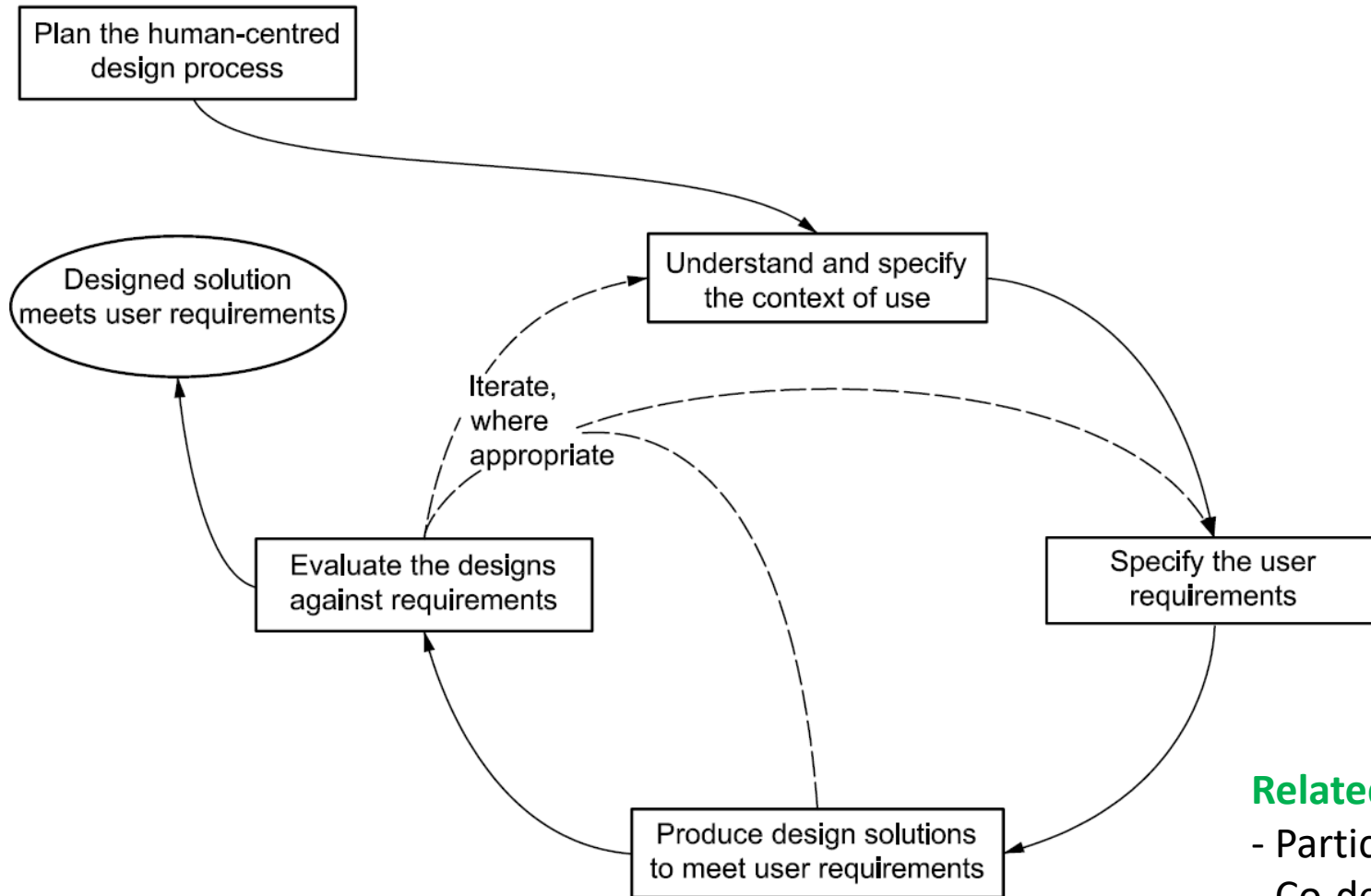
**Agile approach with SCRUM**

**Generic models, no HCI considerations**

...

# Methodological context

- **Human-centred design** approach:



Encouraging **user involvement** in the process

Among the questions:

- **What are the methods?**
- **Who are the users?**
- **What are their characteristics?**

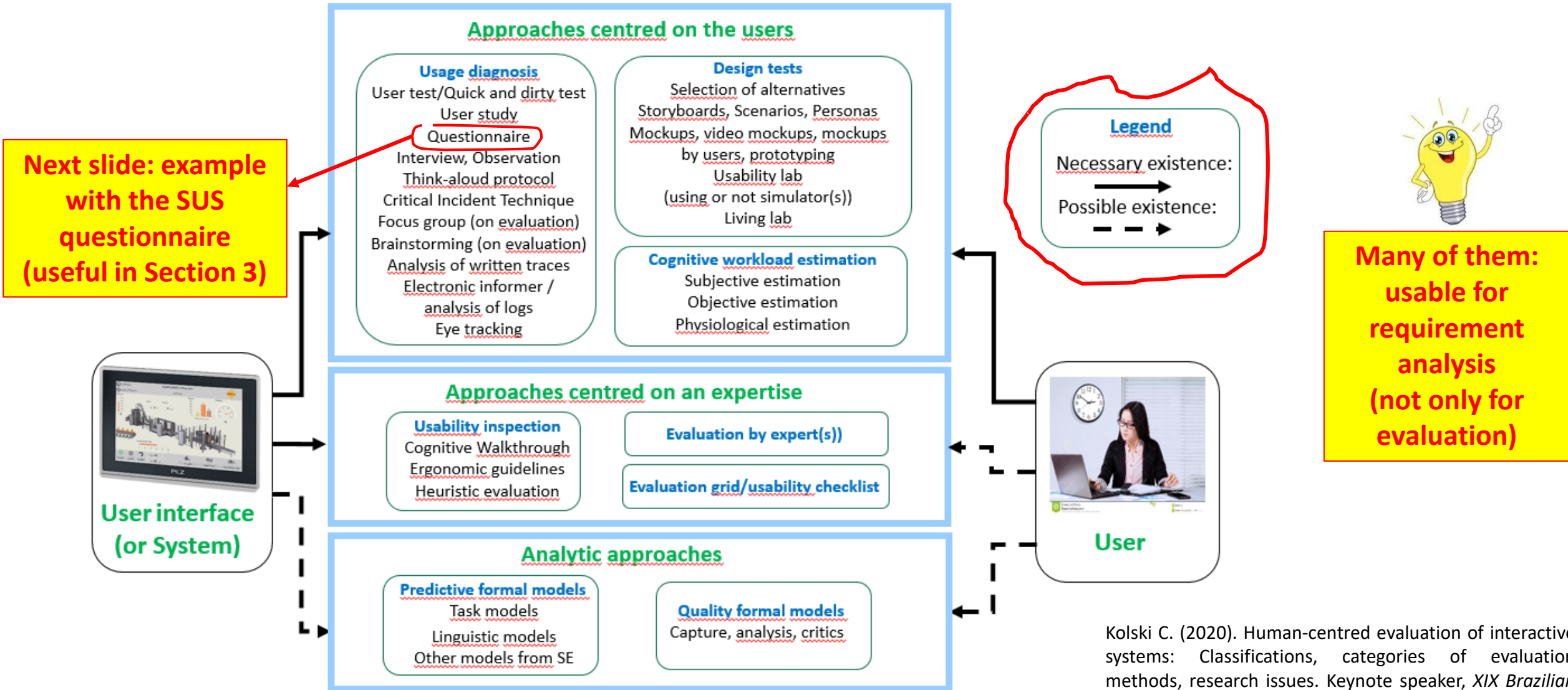
**Related concepts:**

- Participatory design
- Co-design

ISO: Ergonomics of human-system interaction — Part 210: Human-centred design for interactive systems. ISO 9241-210:2019, ISO, Geneva, 2019

# Methodological context

- For instance: Methods for **interactive system evaluation**



Kolski C. (2020). Human-centred evaluation of interactive systems: Classifications, categories of evaluation methods, research issues. Keynote speaker, XIX Brazilian Symposium on Software Quality, Virtual Event, Brazil.

# Methodological context

- **S.U.S. (System Usability Scale)**: example of questionnaire for evaluating the **user satisfaction** (Brooke, 1996); simple, ten-item attitude Likert scale giving a global view of subjective assessments of **usability**

	Strongly disagree				Strongly agree
1. I think that I would like to use this system frequently	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2. I found the system unnecessarily complex	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. I thought the system was easy to use	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. I think I would need the support of a technical person to be able to use this system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
5. I found the various functions in this system were well integrated	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. I thought there was too much inconsistency in this system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
7. I would imagine that most people would learn to use this system very quickly	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. I found the system very cumbersome to use	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. I felt very confident using the system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
10. I needed to learn a lot of things before I could get going with this system	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Odd-numbered items  
(1, 3... 9)

Even-numbered items  
(2, 4... 10)

## Scoring SUS:

- For **odd-numbered** items: subtract one from the user response

- For **even-numbered** items: subtract the user responses from 5

=> This scales all values from 0 to 4 (with 4 being the most positive response)

Add up the converted responses for each user and multiply that total by 2.5

=> This converts the range of possible values from 0 to 100 instead of from 0 to 40.

$$\begin{aligned}\text{Score} &= 2.5 * \\ &(3+4+1+1+2+1+2+3+4+2) \\ &= 2.5 * 23 = \mathbf{57.5}\end{aligned}$$

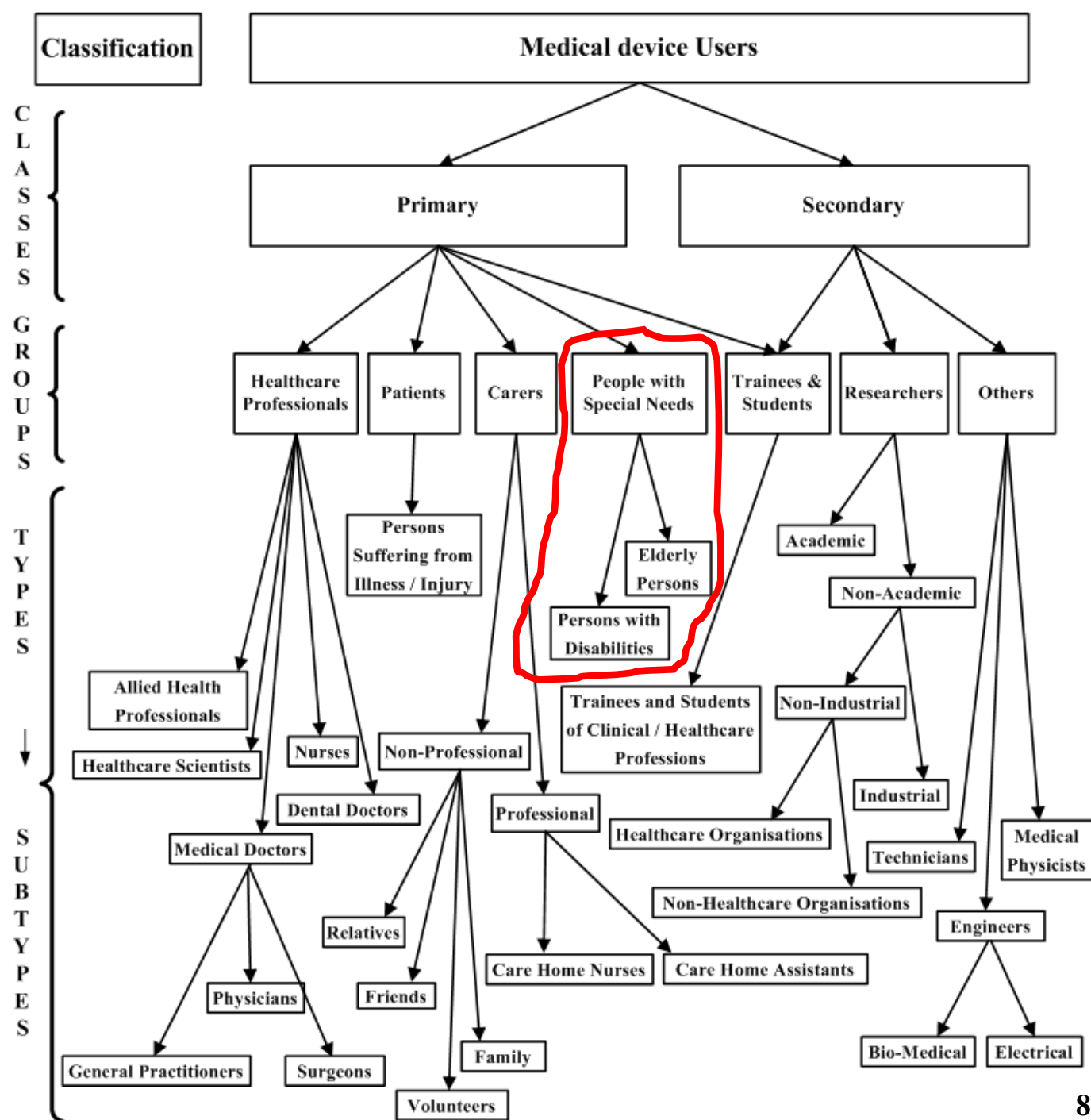
A SUS score **above a 68** would be considered above average and anything **below 68** is below average.

- Crucial and recurring question: « **who is the user?** »  
(in fact: « *who are the users?* »)

Classification from a study concerning categories of medical device users:



**Whatever the application domain, never forget a category during the design and evaluation stages!**





# Introduction



## - User characteristics:

aspects to be taken into account (if relevant) in the design and evaluation stages

(adapted and translated from: Robert, 2003)

### **Socio-demographic data :**

- number, age, male/female, language, geographic situation

### **Impairments/handicaps :**

- physical: upper extremities, lower limbs
- sensorial: visual, auditory, etc.

### **Sociological data:**

- historical, social, cultural, politics, economic

### **Education and skills:**

- Education level: bachelor's degree, master's degree, PhD...
- Speed in reading
- Skill in using the keyboard

### **Work and experience:**

- job category (physician, pilot, nurse, dental technician...)
- knowledge about the task: novice, intermédiaire, expert
- Work location: home, office, at the customer's, on displacement, etc.

### **Knowledge and system use:**

- knowledge on the computing system: novice, intermediary, expert
- knowledge on other same systems
- Type of use: continuously, occasional
- frequency of use: low, middle, high

### **Knowledge in computer science:**

- general knowledge: low, middle, high
- platforms: PC, Macintosh, workstation, tablet...
- Operating systems: Unix, Windows, MacOS, Linux...
- Tools for the web: web browser, electronic mail, search engine, etc.
- Software category: CAD, office, etc.

### **Psychological aspects:**

- attitude: positive, negative, neutral
- motivation: low, middle, high

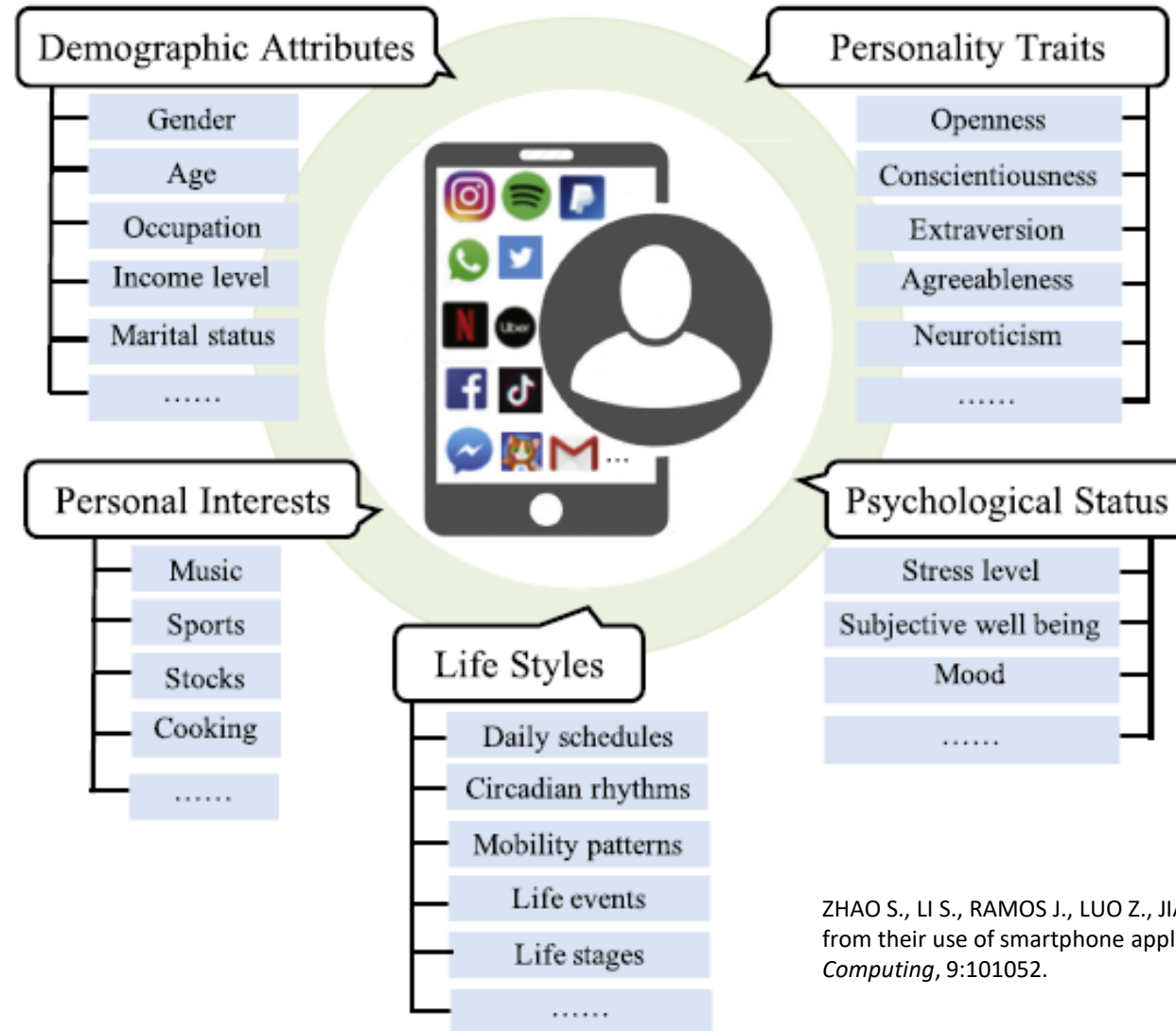
**Interesting, but to be completed, categories are lacking (for instance: intellectual disability)**

Robert J.M. (2003). Que faut-il savoir sur les utilisateurs pour réaliser des interfaces de qualité ? In G. Boy (Ed.), *Ingénierie cognitive, IHM et cognition*, Editions Hermes-Lavoisier, Paris, pp. 249-283.



# Methodological context

- **User profiling information**, according to Zhao et al. (2019), relative to smartphone use cases



**Interesting, but nothing about disabilities**

ZHAO S., LI S., RAMOS J., LUO Z., JIANG Z., DEY A.K., PAN G. (2019). User profiling from their use of smartphone applications: A survey. *Pervasive and Mobile Computing*, 9:101052.

# Methodological context

- **Possible structure for personas:** fictitious characters, based on composite archetypes, and encapsulating 'behavioural data' gathered from ethnography and empirical analysis of actual users (Cooper, 1999); adapted in **HCI**

Persona Components	Description
Identity	Include a first and last name, age and other demographic information.
Status	Whether the user is a primary, secondary, tertiary, or anti-user of the application. Typically, only primary and in some cases, secondary users are included.
Goals	Besides goals related to the application, it includes personal and professional goals as well.
Knowledge and Experience	Knowledge and experience including education, training, and specialized skills. This should not be limited only to the application.
Tasks	Frequency, importance and duration of most important tasks related to the application.
Relationships	Include information about user associates, since this could give insight on other stakeholders.
Psychological profile and Needs	Include information about cognitive and learning styles, as well as needs such as guidance and validation of decisions.
Attitude and Motivation	Include information about the user's attitude to information technology and level of motivation to use the system.
Expectations	Information about how the user perceives the system works, and how the user organizes information related to his/her task, domain or job.
Disabilities	Any disabilities, such as color-blindness, related to mobility, eyesight (wears contacts), etc.
Photograph	Include a photograph which fits with the name.



Adapted from  
Courage & Baxter  
(2005)



**Interesting, but we  
need to go deeper  
(categories)**

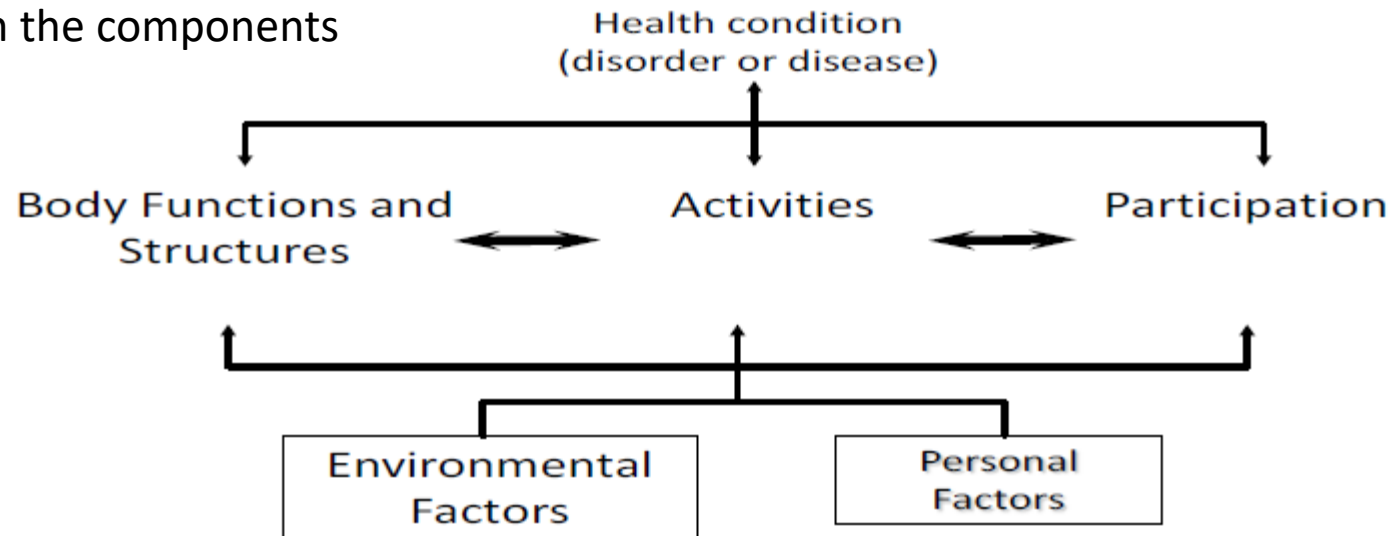
# Methodological context

## International Classification of Functioning, Disability and Health (ICF):

- Classification of health and health-related domains
- Approved for use by the **World Health Assembly** (WHO) in 2001: international standard to describe and measure health and disability
- As the functioning and disability of an individual occurs in a **context**, ICF also includes a list of **environmental factors**



Interactions between the components of ICF (WHO 2001):



Certain factors influence the **limitations of activity and social participation** of people with disabilities

=> for instance in... **human-centred design processes**

Source:

<https://www.who.int/standards/classifications/international-classification-of-functioning-disability-and-health>

# From Human-Centered Design to Disabled User & Ecosystem Centered Design

- Different **categories** of disabilities:

➤ **Mental disability (or intellectual impairment)**



➤ **Hearing impairment**

➤ **Visual impairment**

➤ **Motor disability** (including Cerebral Palsy)

Internal projects

➤ **Autism and Pervasive developmental disorder**

➤ **Psychological disability** (e.g. depression, Bipolar Disorder, Schizophrenia...)

➤ **Plurihandicap** (combination of motor and/or sensory impairments of the same degree)

➤ **Polyhandicap** (severe disabilities, necessity of permanent assistance)

➤ **Head trauma** (mild, moderate, severe with coma)

➤ **Degenerative diseases** (e.g. Myopathy, Mucovidosi, Alzheimer's disease, Parkinson's disease..)

➤ **Dys disorders** (dyslexia and dysorthographie (written), dysphasie (oral), dyspraxie (motor), dyscalculie (numerical)...) )

SAMDI Project

Mentionned in  
certain illustrations

ParkinsonCom  
Project

**Several disabilities:  
associated with  
communication  
disorders**

# Outline

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## 4. Disability awareness within companies

## 5. Conclusion & research ways

\*

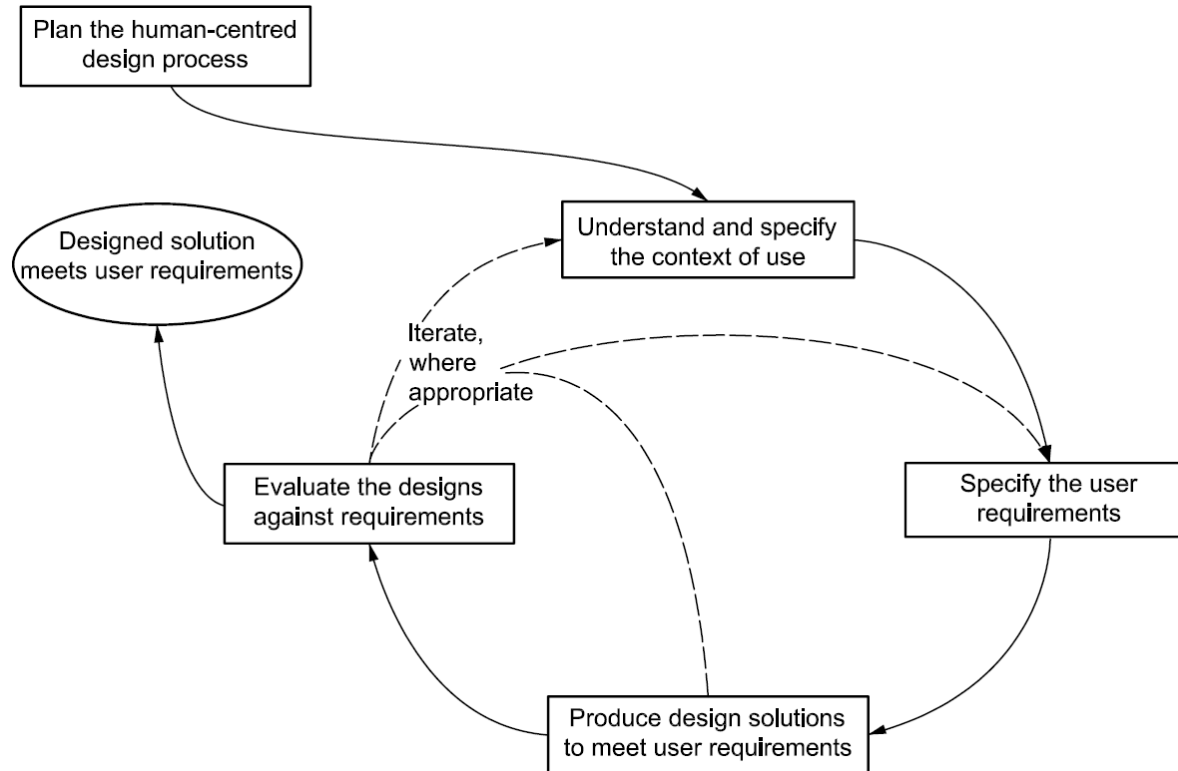
From:

Guffroy, M., Vigouroux, N., Kolski, C, Vella, F., Teutsch, P. (2017). From Human-Centered Design to Disabled User & Ecosystem Centered Design in Case of Assistive Interactive Systems. *Int. J. of Sociotechnology and Knowledge Development* 9, no. 4, pp. 28-42.


Kolski C., Vigouroux N., Guerrier Y., Vella F., Guffroy M. (2023). A first step towards an ecosystem meta-model for human-centered design in case of disabled users. *DISAB Workshop*, co-located with the 14th ACM SIGCHI Symposium on Engineering Interactive Computing Systems (EICS 2023), Swansea, UK, june .

# From Human-Centered Design to Disabled User & Ecosystem Centered Design

- **Human-centred design** approach:



- Different **categories** of disabilities:

- **Mental disability (or intellectual impairment)**  SAMD Project
- **Hearing impairment**
- **Visual impairment**
- **Motor disability** (including **Cerebral Palsy**) Internal projects
- **Autism and Pervasive developmental disorder**
- **Psychological disability** (e.g. depression, Bipolar Disorder, Schizophrenia...)
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Mentioned in certain illustrations

Several disabilities: associated with communication disorders

**What to do in case of (more or less deep) communication disorders?  
How to involve them in the HCD activities?**

# From Human-Centered Design to Disabled User & Ecosystem Centered Design

- Social environment of people with disabilities:
  - Referred to as the **ecosystem** by [Guffroy et al., 2017; 2018; Guerrier et al., 2020]
  - This ecosystem: composed for example of family and/or professional caregivers, friends, therapists or colleagues, and this in relation to **a set of activities** of the disabled person
  - **Various contexts**: at home, at work, in mobility...



The disabled person (with communication disorders) is not necessarily the one you had in mind...

=> Most disabilities are **invisible**



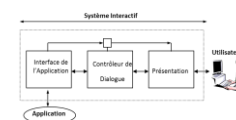
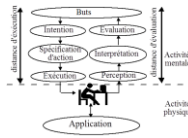
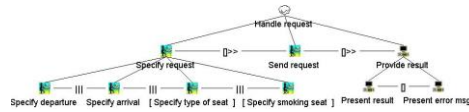
# From Human-Centered Design to Disabled User & Ecosystem Centered Design

- Many studies interested in this question of the direct or indirect participation of ecosystem members:
  - **Participatory design approaches** involving ecosystem members:
    - in the **design**, e. g. [Frauenberger et al., 2017]
    - or in both **design** and **evaluation**, e.g. [Nasr et al., 2016]
  - In general, a so-called **co-design approach** can involve also members of the ecosystem, e.g. [Ambe et al. 2019]
  - Other authors position their approach more globally according to **Human-Centered Design** and involve also members of the ecosystem in the **design** and **evaluation**, e.g. [De Barros et al., 2013] [Blanco et al., 2016] [Calmels et al., 2017] [Augusto et al., 2018]...

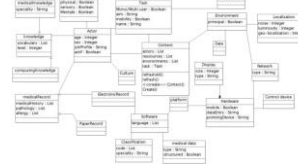
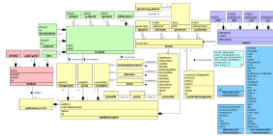
- ✓ For instance, in [De Barros et al., 2013]:
  - Family and professional caregivers, physicians, physical therapists, and Parkinson's patients
  - => involved throughout the HCD process of the target system  
(dedicated to **self-management of Parkinson's disease**)

# From Human-Centered Design to Disabled User & Ecosystem Centered Design

- Currently: era of modelling in SE & HCI: **task** model, **user** model, **domain** model, **dialogue** model, **adaptation** model...



- In parallel: several **meta-models** available in HCI domain in general:



➤ Address various aspects of HCI design

➤ For instance:

- Context-aware adaptation of UI** [Motti and Vanderdonckt, 2013],
- Processes for highly supporting flexibility of UI** [Céret et al., 2013],
- Context-aware adaptation of mobile applications** [de Farias et al., 2007],
- Interactive applications on tabletops** [Kubicki et al., 2013]...

- But, none of them addresses more or less explicitly **ecosystem considerations**

**No meta-model or model of ecosystem available in the HCI, SE & disability domains**

# From Human-Centered Design to Disabled User & Ecosystem Centered Design

## - Towards an **Ecosystem Meta-Model**:

Study of **HCD** projects involving disabled people with communication disorders  
[Guffroy et al., 2018; Guerrier et al., 2020]:

- People with **motor impairment and/or language disorders**  
Children with **Autism Disorders**  
People with **Cerebral Palsy**



(Project/Toulouse)  
(Project/Le Mans)  
(Project/Valenciennes)

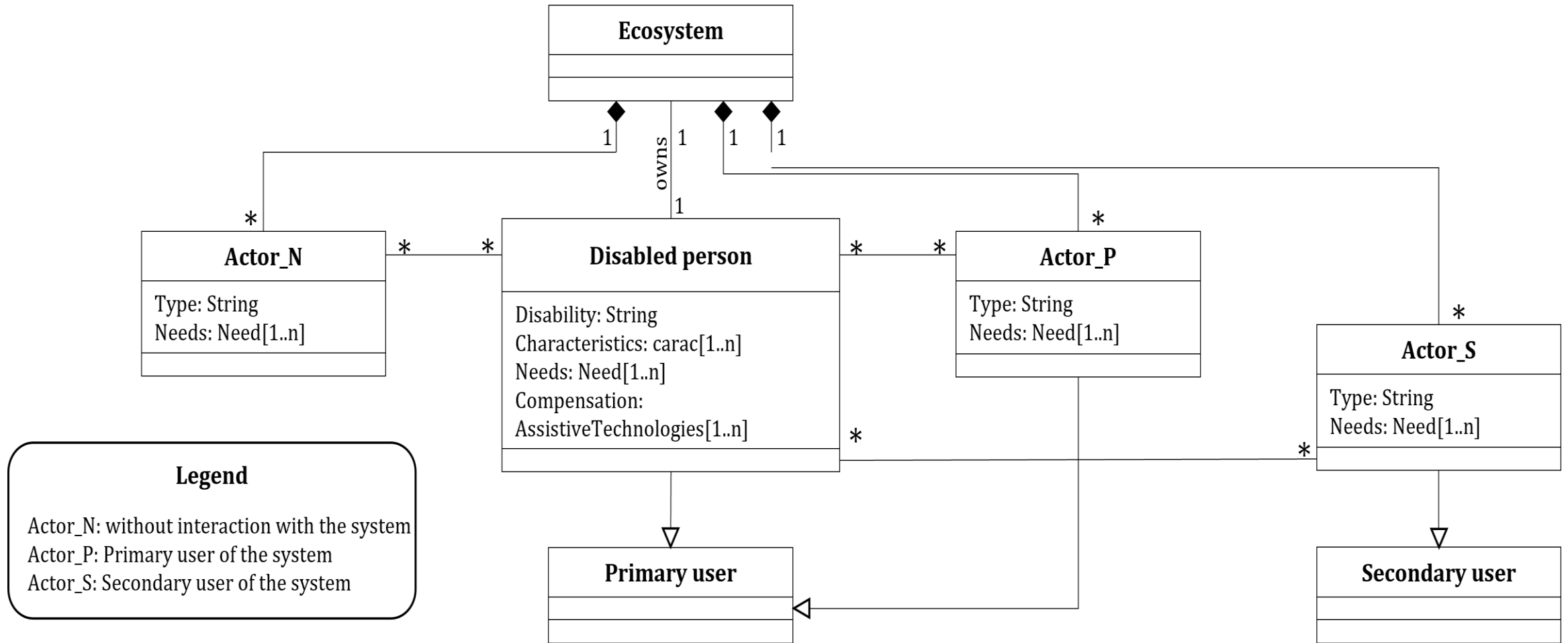
**Analysis** of their ecosystem

- We found that the **same types of actors** could systematically be identified, and therefore involved in the methodological approach
- Consequently, aim to propose a **meta-model**:

- ✓ As expressed by its *meta*- prefix, a meta-model: abstraction allowing to describe models (i.e. ecosystem models)

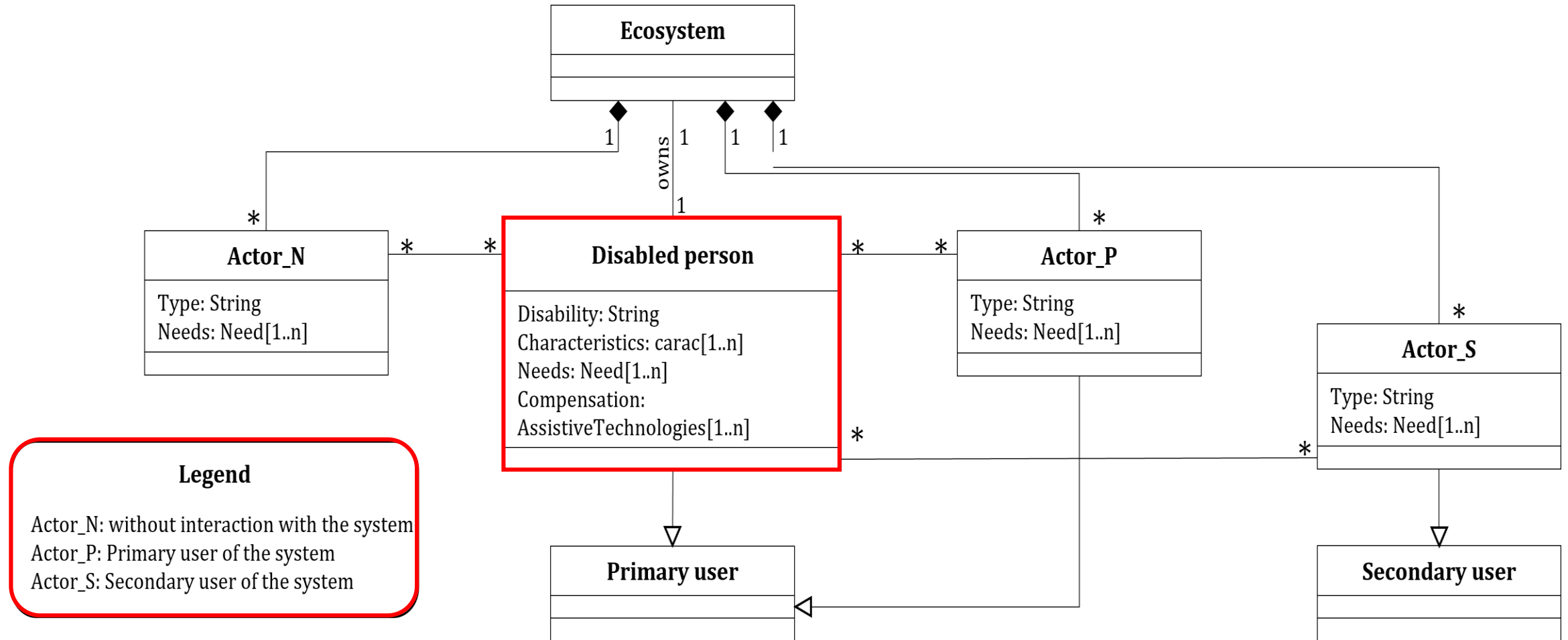
# From Human-Centered Design to Disabled User & Ecosystem Centered Design

- Towards an **Ecosystem Meta-Model**:



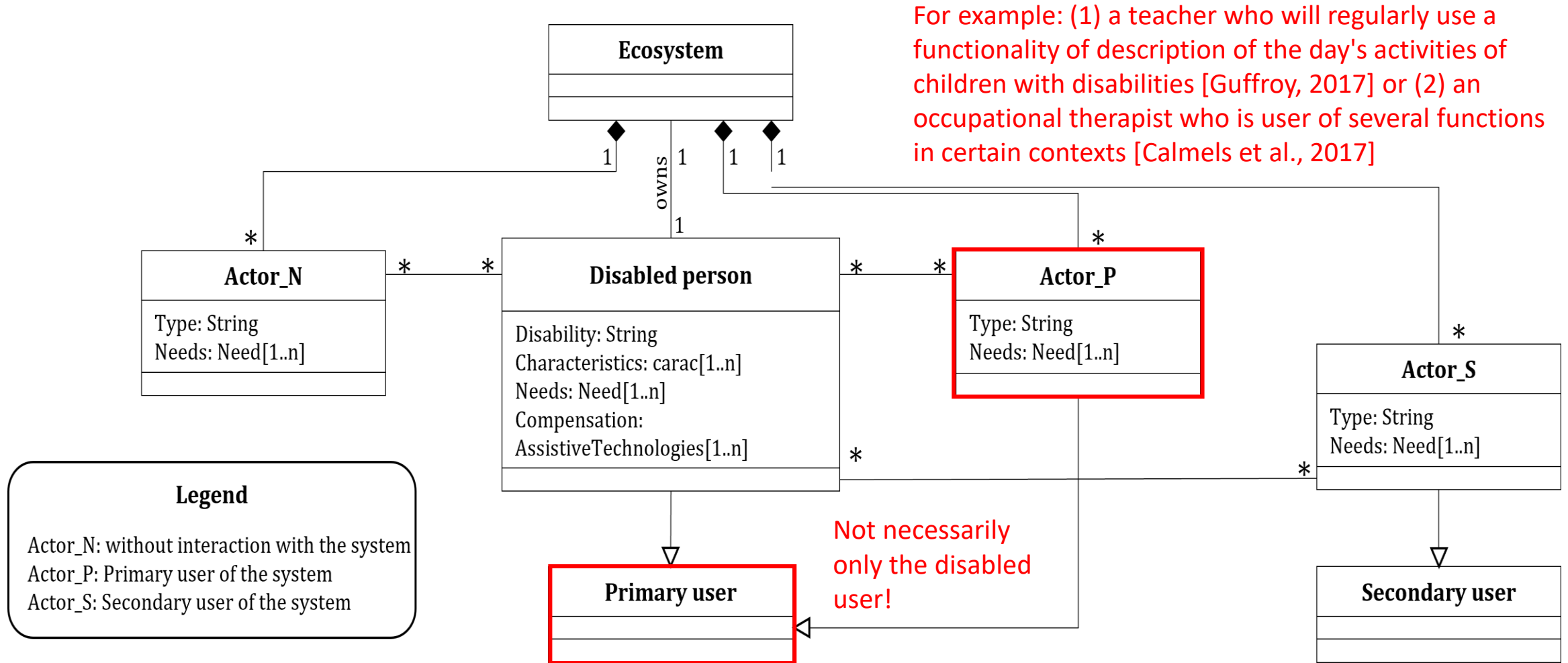
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- Towards an **Ecosystem Meta-Model**:



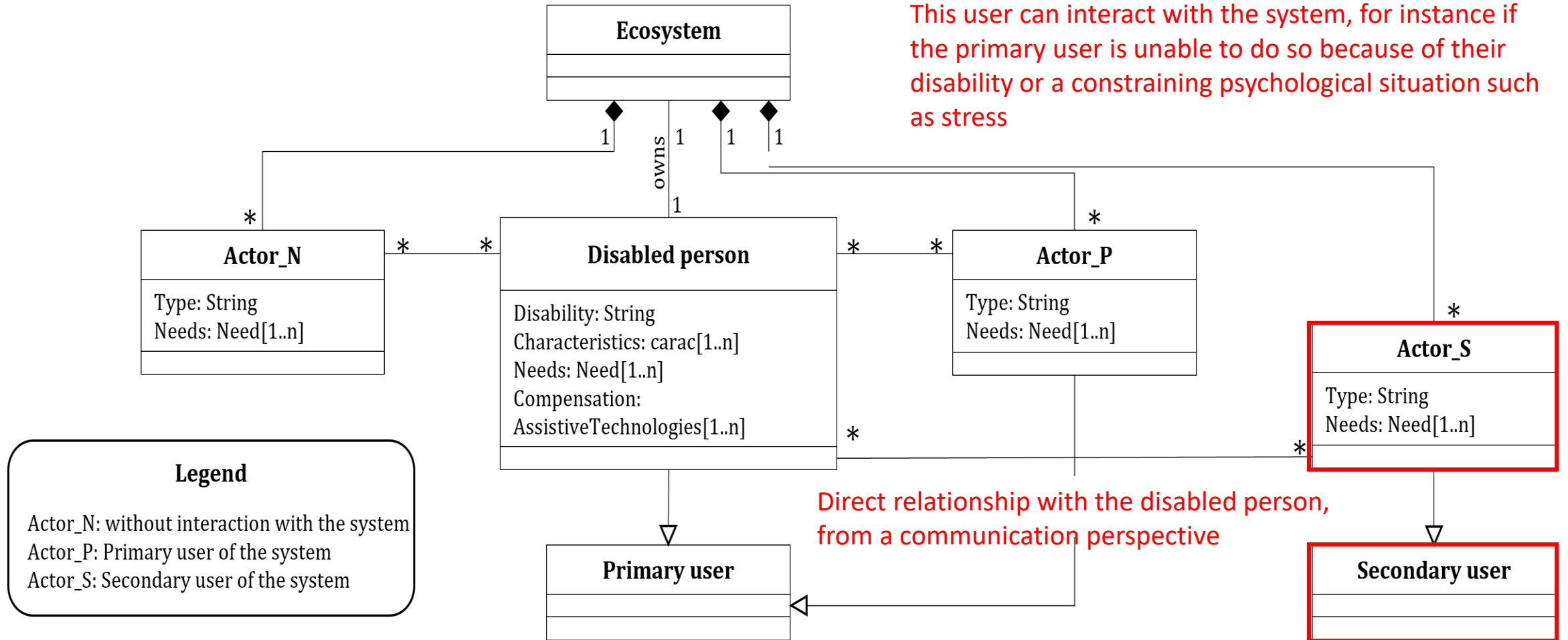
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- Towards an **Ecosystem Meta-Model**:



# From Human-Centered Design to Disabled User & Ecosystem Centered Design

- Towards an **Ecosystem Meta-Model**:



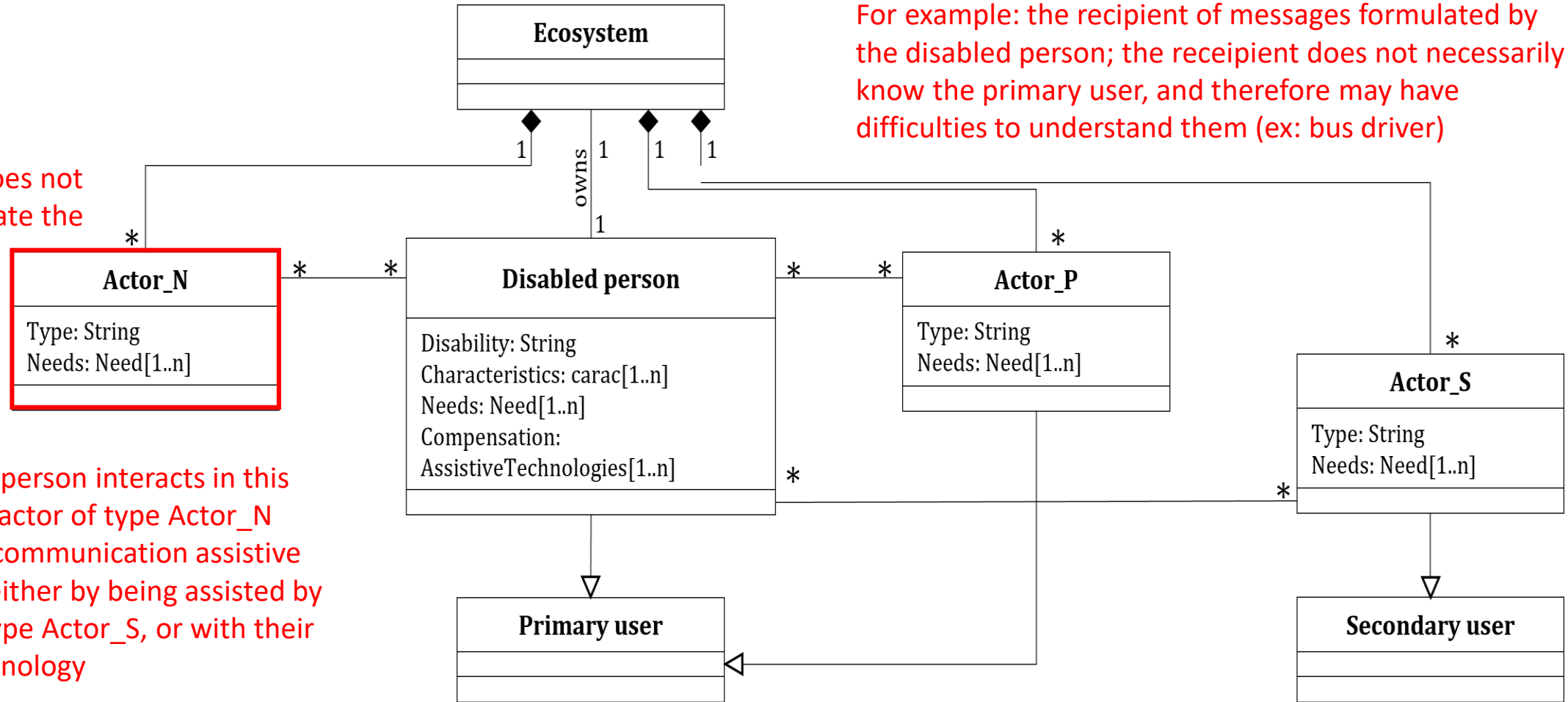
# From Human-Centered Design to Disabled User & Ecosystem Centered Design

- Towards an **Ecosystem Meta-Model**:

This actor: does not directly operate the system

The disabled person interacts in this case with an actor of type Actor\_N through the communication assistive technology, either by being assisted by an actor of type Actor\_S, or with their assistive technology

For example: the recipient of messages formulated by the disabled person; the recipient does not necessarily know the primary user, and therefore may have difficulties to understand them (ex: bus driver)





# From Human-Centered Design to Disabled User & Ecosystem Centered Design

## - Case study by Reverse Engineering:

- Target users: have an **athetosis-type cerebral palsy profile** [Rosenbaum et al., 2007]
  - **Involuntary movements** whose intensity can vary more or less strongly depending on the emotions
  - **Problems of precision** in movements may make it difficult for them to use physical keyboards
  - Speech problems due to **dysarthria** [Darley et al., 1969]
    - Problems: usually in articulating words (but not in formulating correct sentences)
- **HCD approach** with the aim of creating a communication assistive system for users with Cerebral Palsy [Guerrier et al., 2013, 2021]

- System called **ComMob** (Communication and Mobility)
  - To prepare dialogues;  
Pictograms organized in themes and categories;  
Selection of a set of pictograms to formulate sentences;  
Use of a virtual keyboard to complete them;  
Sentences read by a text-to-speech system



# From Human-Centered Design to Disabled User & Ecosystem Centered Design

- Case study by Reverse Engineering:



User interface of the module allowing to **formulate sentences** using pictograms (read by **text-to-speech**)



Person with cerebral palsy using a prototype of the **ComMob system** on PC

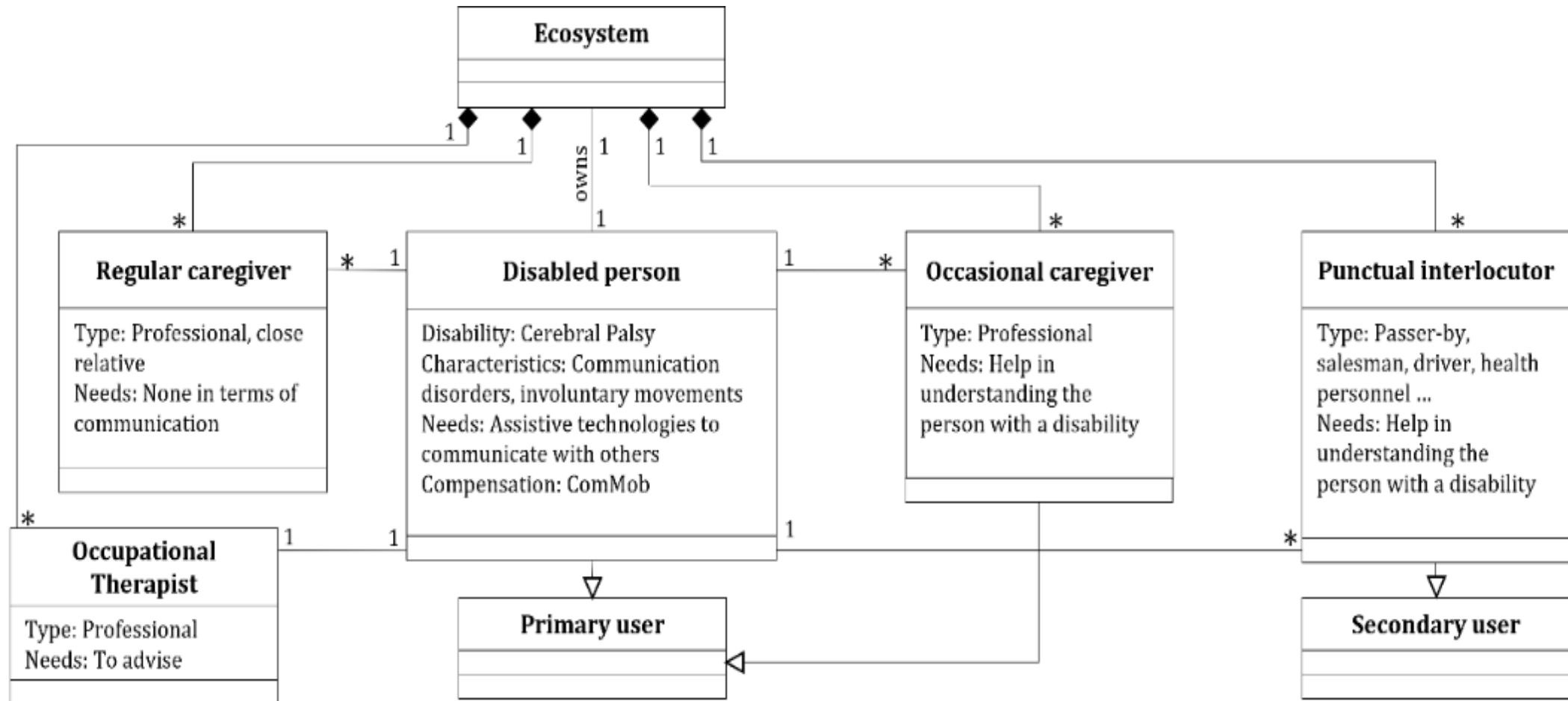


**Evaluation** of ComMob **in mobility**: information request concerning the location of the nearest tram station

[Guerrier et al., 2014, ICCHP]

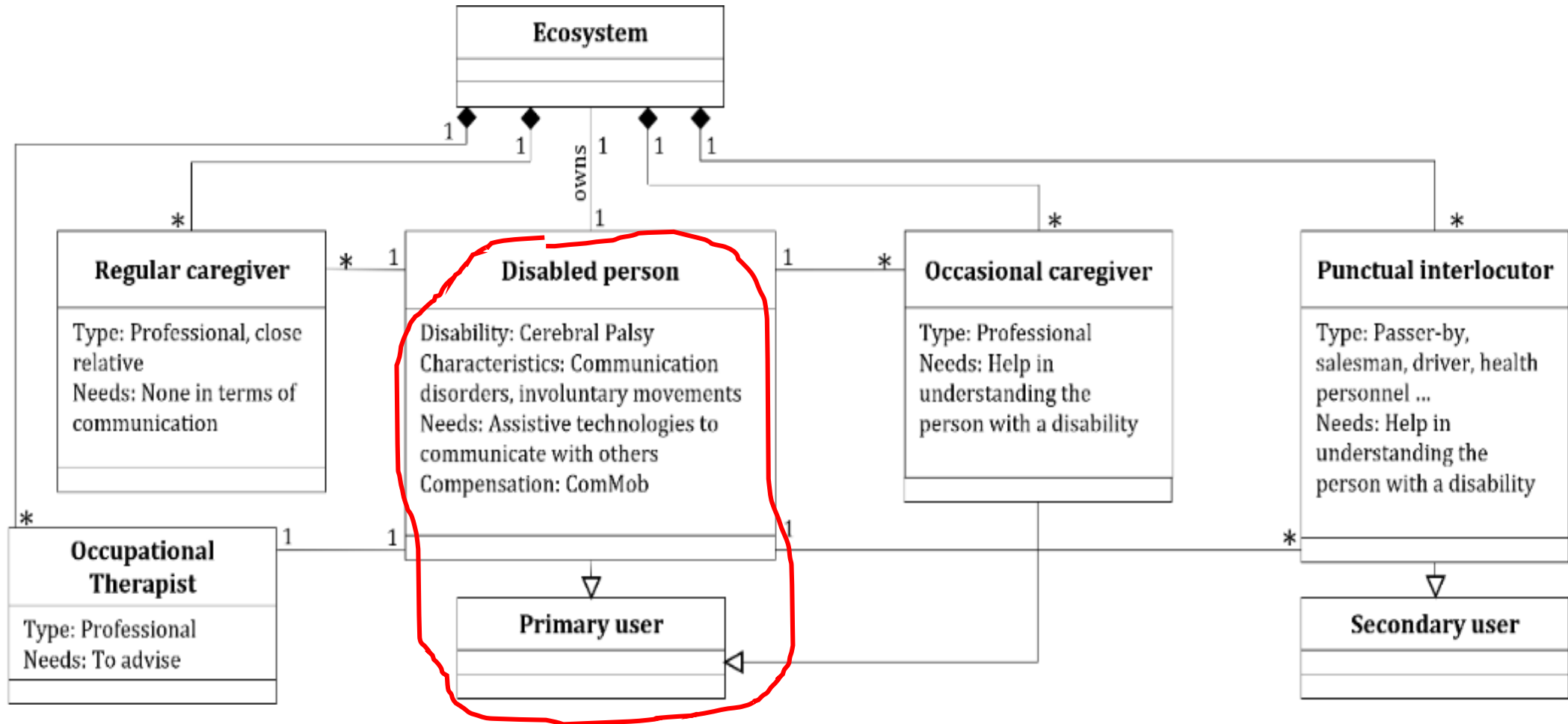
# From Human-Centered Design to Disabled User & Ecosystem Centered Design

- Case study by Reverse Engineering:



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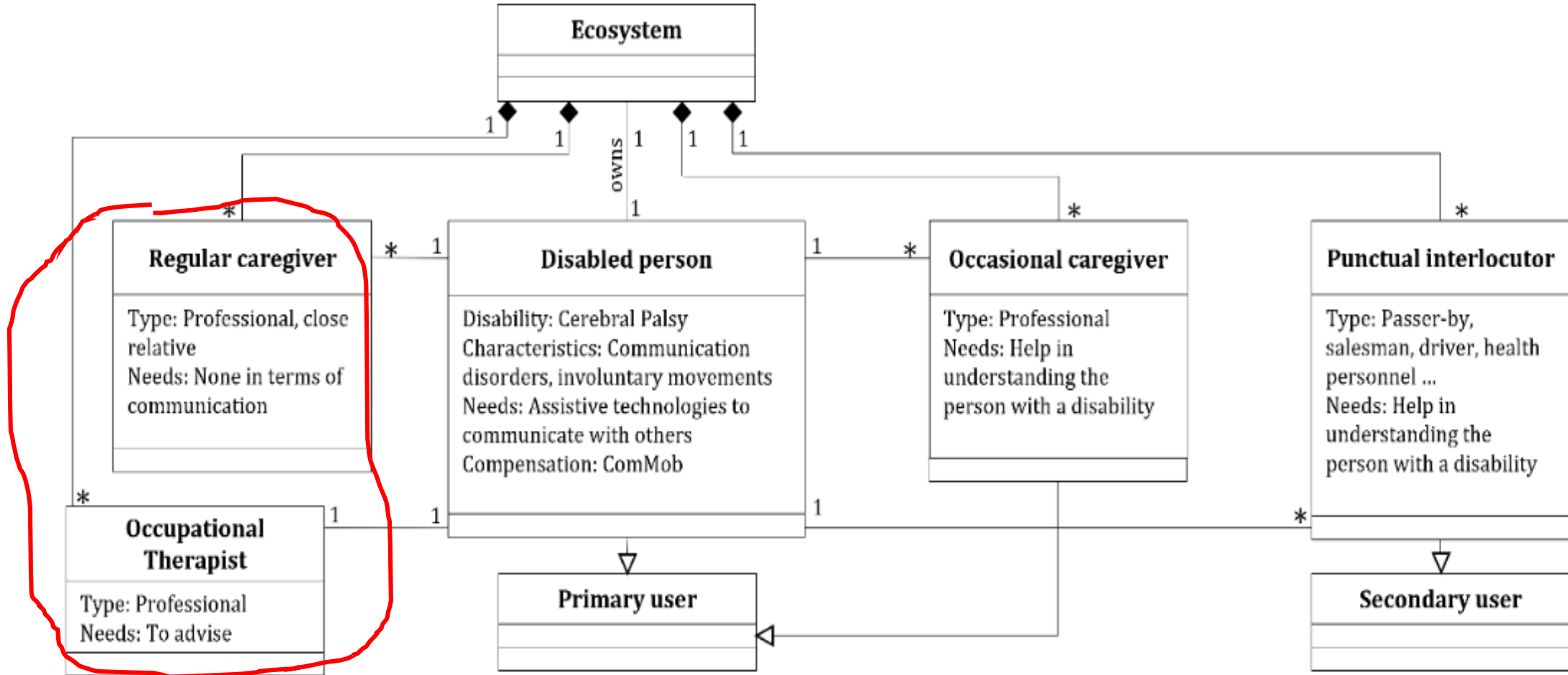
- Case study by Reverse Engineering:



Disabled people (main researcher, other people) and simulated disabled people [Guerrier et al., 2021] involved in the HCD process

# From Human-Centered Design to Disabled User & Ecosystem Centered Design

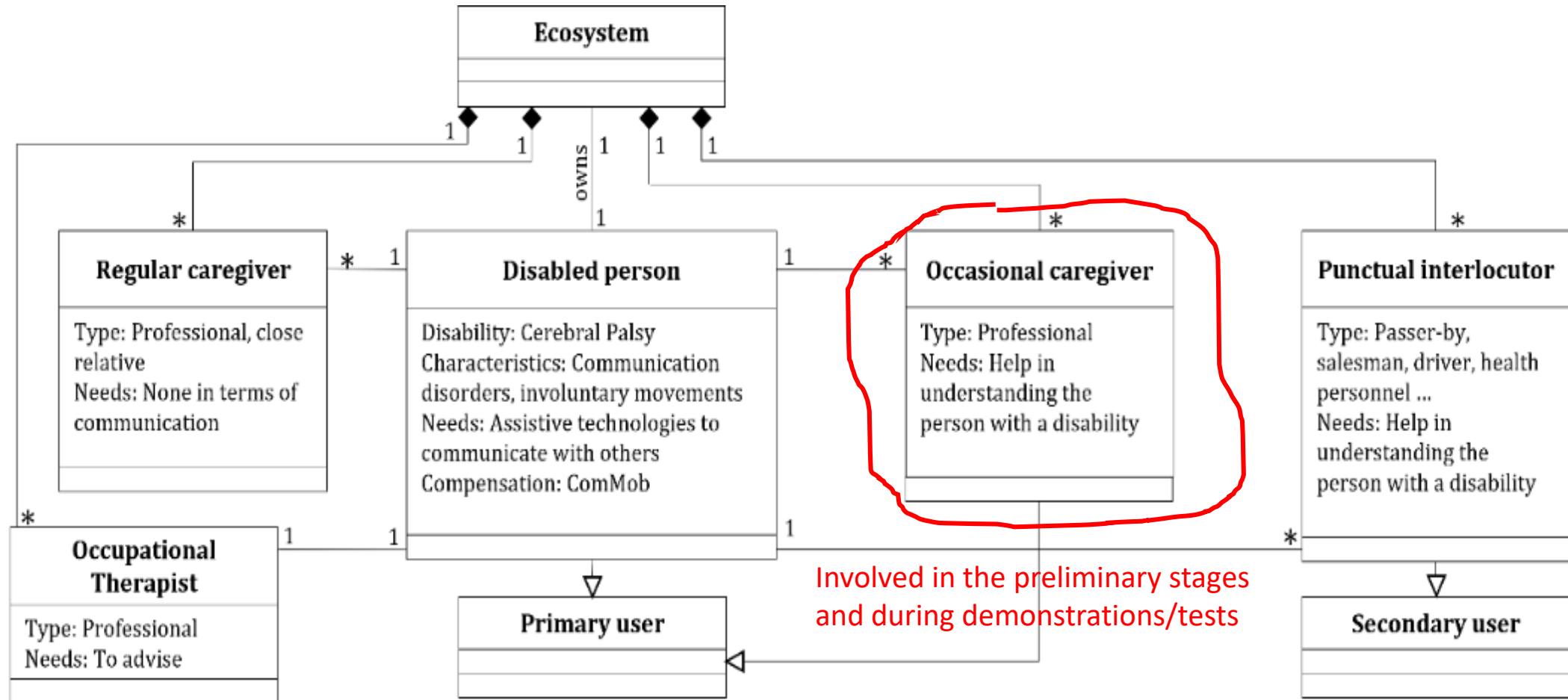
- Case study by Reverse Engineering:



Involved in the preliminary stages, and during demonstrations/tests

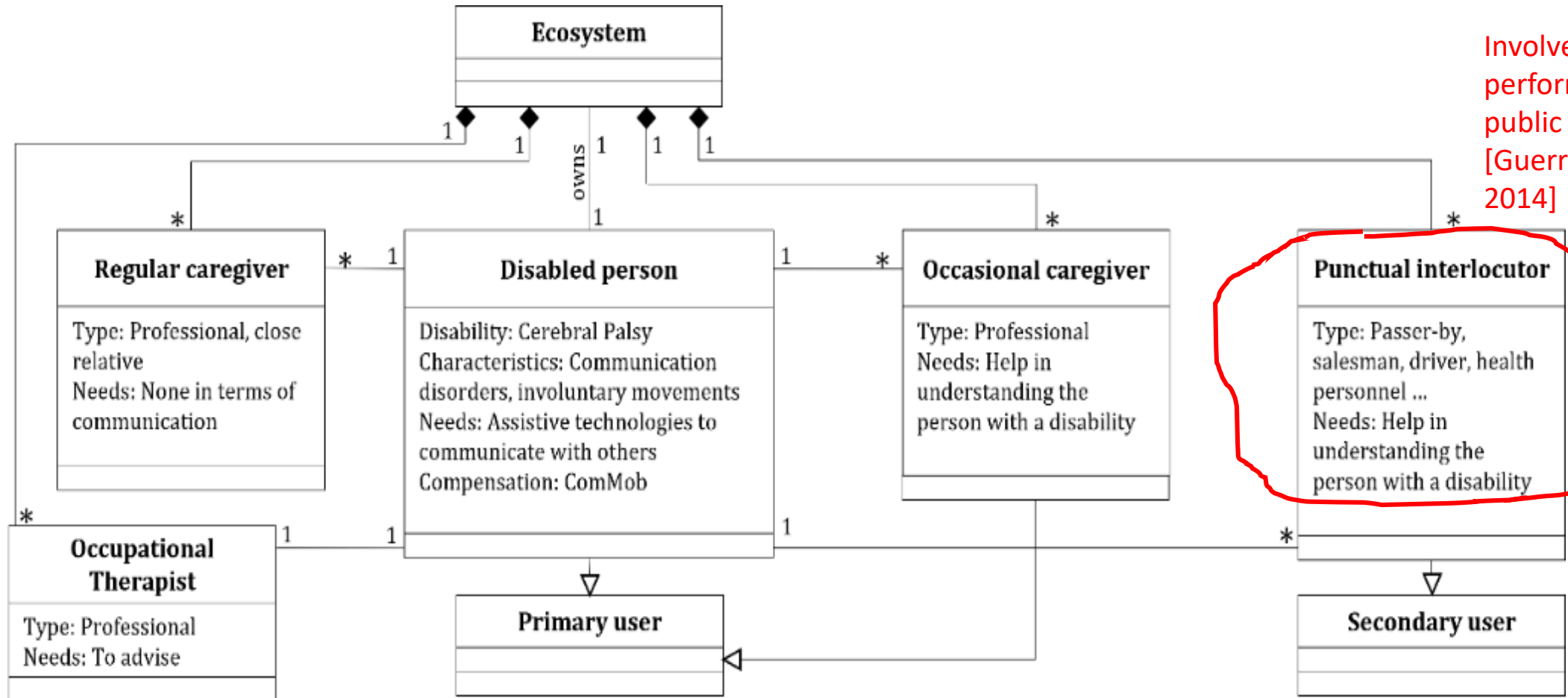
# From Human-Centered Design to Disabled User & Ecosystem Centered Design

- Case study by Reverse Engineering:



# From Human-Centered Design to Disabled User & Ecosystem Centered Design

- Case study by Reverse Engineering:



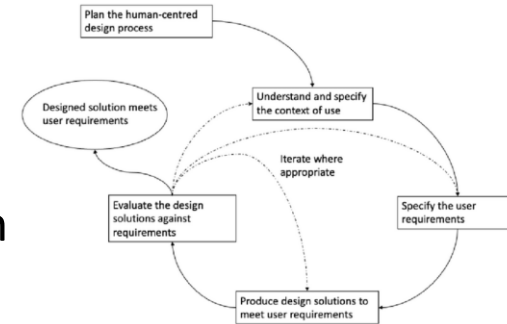
Involved in tests performed in a public place [Guerrier et al., 2014]

# From Human-Centered Design to Disabled User & Ecosystem Centered Design

## - Discussion:

### - HCD: widely used:

- However, when the end users are disabled people with **communication disorders**, this model: no longer applicable and no longer sufficient on its own
- Indeed, the user **cannot carry out alone** the activities that the HCD provides
- Necessity that actors of the **ecosystem** accompany the user
- Proposition of an **ecosystem meta-model**



- Members of the ecosystem: contribute and/or complete the collection of needs and accompany the user during the design and/or evaluation phases
  - Meta-model: **possible support** to study the different actors to involve in the project



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1. Methodological context
2. From Human-Centered Design to Disabled User & Ecosystem Centered Design
3. Adapting processes and methods
4. Disability awareness within companies
5. Conclusion & research ways



**A few  
representative  
examples!**

# Adapting processes and methods

- **Representative study** (Antona et al., 2009):

TABLE 15.1 Summary of User Requirements Elicitation Methods

User Requirements Elicitation Methods and Techniques	Disability				Age	
	Motion	Vision	Hearing	Cognitive/ Communication	Children	Elderly
1. Brainstorming	✓	✓	■	■	■	■
2. Direct observation	✓	✓	✓	✓	✓	✓
3. Activity diaries and cultural probes	■	■	✓	■	■	✓
4. Survey and questionnaires	■	■	■	☒	■	■
5. Interviews	✓	✓	■	☒	■	■
6. Group discussions	✓	✓	■	☒	■	■
7. Empathic modeling	✓	✓	✓	☒	☒	☒
8. User trials	■	■	■	■	■	■
9. Scenarios and personas	✓	✓	✓	✓	✓	✓
10. Prototyping	✓	✓	✓	✓	✓	✓
11. Cooperative and participatory design	✓	✓	✓	■	■	■
12. Art-based approaches					✓	✓

- ✓ Appropriate.
- Needs modifications and adjustments.
- ☒ Not recommended.

- Different categories of disabilities:
- Mental disability (or intellectual impairment)
  - Hearing impairment
  - Visual impairment
  - Motor disability (including Cerebral Palsy)
  - Autism and Pervasive developmental disorder
  - Psychological disability (e.g. depression, Bipolar Disorder, Schizophrenia...)
  - Plurihandicap (combination of motor and/or sensory impairments of the same degree)
  - Polyhandicap (severe disabilities, necessity of permanent assistance)
  - Head trauma (mild, moderate, severe with coma)
  - Degenerative diseases (e.g. Myopathy, Leucocidosis, Alzheimer's disease, Parkinson's disease...)
  - Dys disorders (dyslexia and dysorthographie (written), dysphasia (oral), dyspraxia (motor), dyscalculia (numerical)...)
- Mentioned in certain illustrations
- Several disabilities: associated with communication disorders

Extract from:

Antona, M., Ntoa, S., Adami, I., Stephanidis, C. (2009). User Requirements Elicitation for Universal Access. In: Stephanidis C. (Ed.), The Universal Access Handbook, pp. 1–14, CRC Press.

# Adapting processes and methods

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5. Interviews	✓	✓	■	☒	■	■
6. Group discussions	✓	✓	■	☒	■	■
7. Empathic modeling	✓	✓	✓	☒	☒	☒
8. User trials	■	■	■	■	■	■
9. Scenarios and personas	✓	✓	✓	✓	✓	✓
10. Prototyping	✓	✓	✓	✓	✓	✓
11. Cooperative and participatory design	✓	✓	✓	■	■	■
12. Art-based approaches					✓	✓

- ✓ Appropriate.
- Needs modifications and adjustments.
- ☒ Not recommended.

Not recommended?

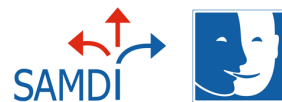
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# Adapting processes and methods

- **S.U.S. (System Usability Scale)**: example of questionnaire for evaluating the **user satisfaction** (BROOKE, 1996); simple, ten-item attitude Likert scale giving a global view of subjective assessments of **usability**

Examples adapted from the SAMDI project  
(mobility assistance system dedicated to users  
with intellectual deficiencies)



	Strongly disagree				Strongly agree
1. I think that I would like to use this system frequently	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. I found the system unnecessarily complex	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. I thought the system was easy to use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. I think I would need the support of a technical person to be able to use this system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. I found the various functions in this system were well integrated	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. I thought there was too much inconsistency in this system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. I would imagine that most people would learn to use this system very quickly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. I found the system very cumbersome to use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. I felt very confident using the system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. I needed to learn a lot of things before I could get going with this system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

1. I think that I would like to use this system frequently

Strongly disagree				Strongly agree
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
1	2	3	4	5

Likert: 1 value on 5: not understood  
Differences between the 5 values: not understood  
=> To propose another representation

Most of the questions: too complicated or too long:  
=> not understood  
=> to decompose into shorter sentences, using simpler words (certain words to define if needed)  
in France: FALC method (Translated by: Easy to read and understand)

Avoid alternance of positive sentences (odd-numbered) and negative (even) ones => not understood  
=> Only positive sentences

# Adapting processes and methods

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5. Interviews	✓	✓	■	☒	■	■
6. Group discussions	✓	✓	■	☒	■	■
7. Empathic modeling	✓	✓	✓	☒	☒	☒
8. User trials	■	■	■	■	■	■
9. Scenarios and personas	✓	✓	✓	✓	✓	✓
10. Prototyping	✓	✓	✓	✓	✓	✓
11. Cooperative and participatory design	✓	✓	✓	■	■	■
12. Art-based approaches					✓	✓

✓ Appropriate.  
 ■ Needs modifications and adjustments.  
 ☒ Not recommended.

And for various stages in case of degenerative diseases (e.g. Parkinson's disease)?  
  
 => Not mentioned here

Extract from:

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# Adapting processes and methods

ParkinsonCom  
project  
(communication  
system dedicated to  
users with  
Parkinson's disease)



Impossibility or  
difficulty to meet  
them in the lab  
or in specialized  
centers



Requirement analysis, co-design, evaluations: organization of **more than 100 sessions** in homes of Parkinson's patients (presence or not of **family caregivers**)

# Adapting processes and methods

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# Adapting processes and methods

If the end-users are not available in each stage...



Case of preliminary technical tests (before tests with blind people)

Illustration of user test with **low-cost simulation** of blind user (like in many studies)



# Adapting processes and methods

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# Adapting processes and methods

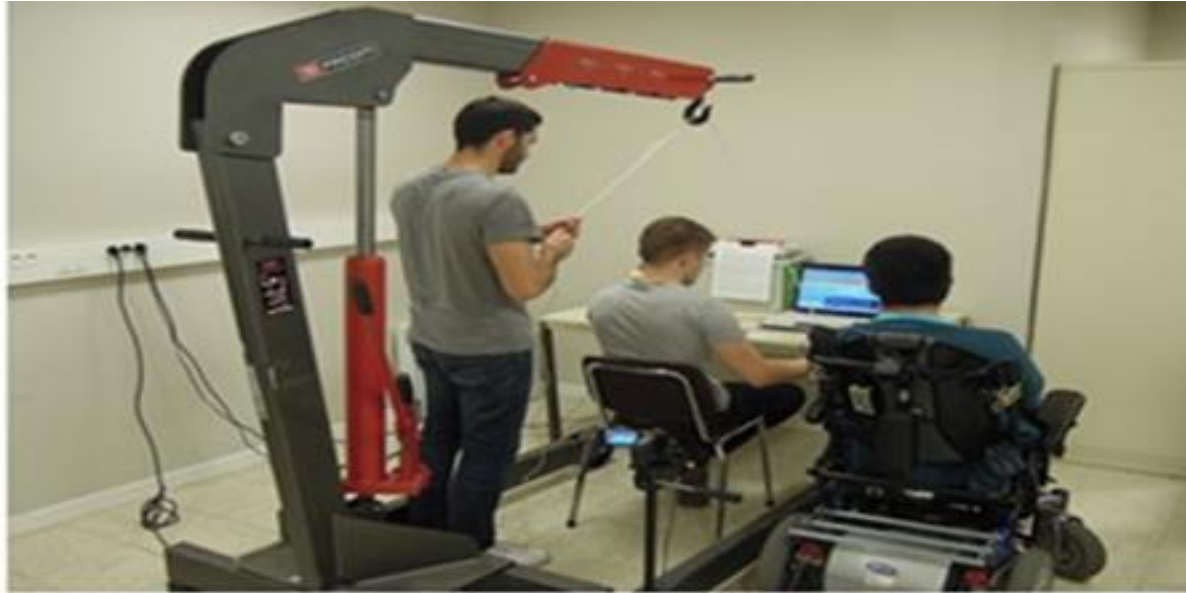
- Discount evaluation with **simulation of involuntary movements** (like users with **Cerebral Palsy**):

Recruitment of **non-disabled people**

To perform a set of **sequential tasks** according to a scenario (as in usual user tests)

Observations (video and direct), questionnaires

[Guerrier et al.,  
HCII 2021]



a) Back view of the experimental station:  
The **participant**: is in the center,  
the **experimenter** at the back operates a pulley system (to provoke involuntary movements, about 10 per minute, no fixed speed nor amplitude)

In this case: An **observer** with CP: on the right



Focus on the weighted bracelet

b) Position seen from above:  
A **participant** activates the joystick \* on the arm of the **observer's** armchair to her right

\* Joystick: controlled by a box using **infrared technology**, called Easy Rider (HMC company), fixed on the wheelchair

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6. Group discussions	✓	✓	■	☒	■	■
7. Empathic modeling	✓	✓	✓	☒ Not recommended?	☒	☒
8. User trials	■	■	■	■	■	■
9. Scenarios and personas	✓	✓	✓	✓	✓	✓
10. Prototyping	✓	✓	✓	✓	✓	✓
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# Adapting processes and methods



## Focus groups:



**SAMDI project (mobility assistance system dedicated to users with intellectual deficiencies)**

## Practical recommendations (extract):

- Before: various meetings to present the research project and to meet the participants (persons with ID, support staff, families)
- Use a familiar environment (place of residence, work, etc.)
- Calm environment, and the layout should encourage visual contact between the facilitators, researchers, and focus group participants for better communication
- Only people with ID around the table (+ near: member of the staff to reformulate if needed)
- Breaks and refreshments
- Limited number of questions, short, clear questions, formulated in a language register accessible to the interviewees

# Adapting processes and methods

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11. Cooperative and participatory design	✓	✓	✓	■	■	■
12. Art-based approaches					✓	✓

Not so direct with autistic people...

- ✓ Appropriate.
- Needs modifications and adjustments.
- ☒ Not recommended.

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# Adapting processes and methods

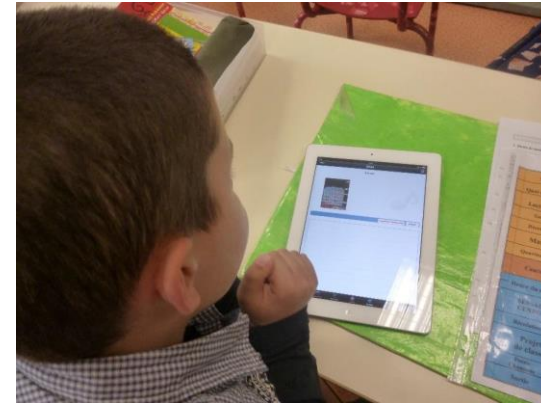
- Extract of a study [Marine Guffroy, PhD Thesis, 2017]:

**Preliminary period** (before the analysis and design of an assistive system for **autistic children in school**):

**Duration:** five weeks (time of confidence building)

**Recommendations (with a specific group of children):**

- Avoid eye contact
- be careful not to touch, or even brush against children
- do not turn off the computer equipment
- not singing
- come every week, and always the same day



**Activities:**

- « Marine participated in the usual course of activities and co-supervised some of them in order to that the children get used to her presence. Depending on the educational objectives, these activities took place in full class, in small groups or in pairs of an adult/a child. »

**After these five weeks:**

- All the children integrated the presence of the analyst (designer) in the class
- Everyone accepted eye contact
- The relationship of trust was established

# Adapting processes and methods

## Conclusion (recommandation):

**For each category of disability, all we need to do is think about how to use or adapt the existing methods, according to the characteristics and needs of disabled people... and their ecosystem**

# Outline

1. Methodological context
2. From Human-Centered Design to Disabled User & Ecosystem Centered Design
3. Adapting processes and methods
4. Disability awareness within companies \*
5. Conclusion & research ways

\*

From:

Mourali Y., Barathon B., Bourgois colin M., Chaabane S., Fassi R., Ferrai A., Guerrier Y., Guilain D., Kolski C., Lebrun Y., Lepreux S., Pudlo P., Sauvé J. (2023). Design and Prototyping of a Serious Game on Interactive Tabletop with Tangible Objects for Disability Awareness in Companies. In: D. Archambault and G. Kouroupetroglou (Eds.), Assistive Technology: Shaping a Sustainable and Inclusive World, IOS Press, pp. 318-325.

Mourali Y., Barathon B., Bourgois colin M., Chaabane S., Fassi R., Ferrai A., Guerrier Y., Guilain D., Kolski C., Lebrun Y., Lepreux S., Pudlo P., Sauvé J. (2023). Serious game for company governance: supporting inte-gration, prevention of professional disintegration and job retention of people with disabilities. DISAB Workshop, co-located with the 14th ACM SIGCHI Symposium on Engineering Interactive Computing Systems (EICS 2023), Swansea, UK.



# Disability awareness within companies

- From inclusive policies to inclusive companies:



➔ **Respect legislation and diversity**

➔ **Improve their reputation with consumers and investors**

# Disability awareness within companies

- Awareness to disability in the workplace: can be facilitated through **various activities**

[Thriiver, 2023]

## Activity 1

Organizing an inclusion day

## Activity 2

Offering employees the opportunity to share their experiences

## Activity 3

Providing key resources

## Activity 4

Creating an accessibility map

## Activity 5

Running workshops and training days

## Activity 6

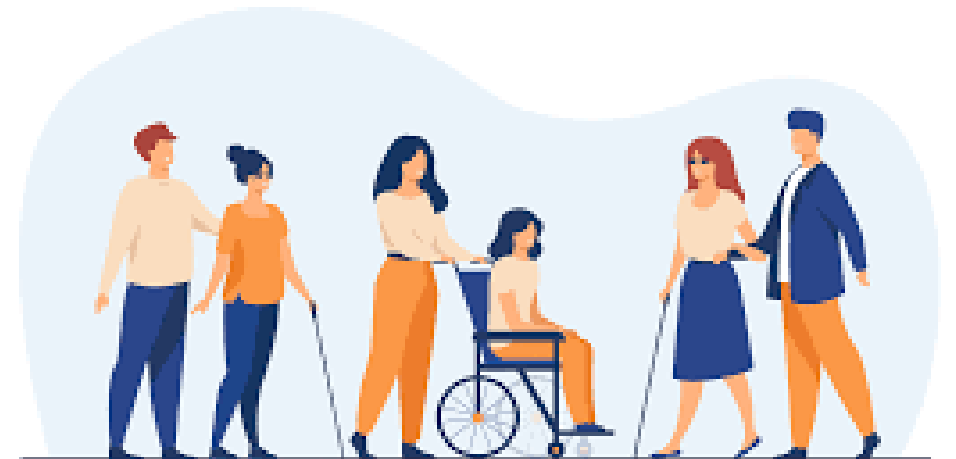
Organizing charity fundraising events

## Activity 7

Offering staff workplace needs assessments

## Activity 8

Providing mental health awareness training sessions



Thriiver: Your Guide To Disability Awareness in the Workplace. (2023).  
Accessible at: <https://thriiver.co.uk/disability-awareness-in-the-workplace/>

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**Running workshops and training days**

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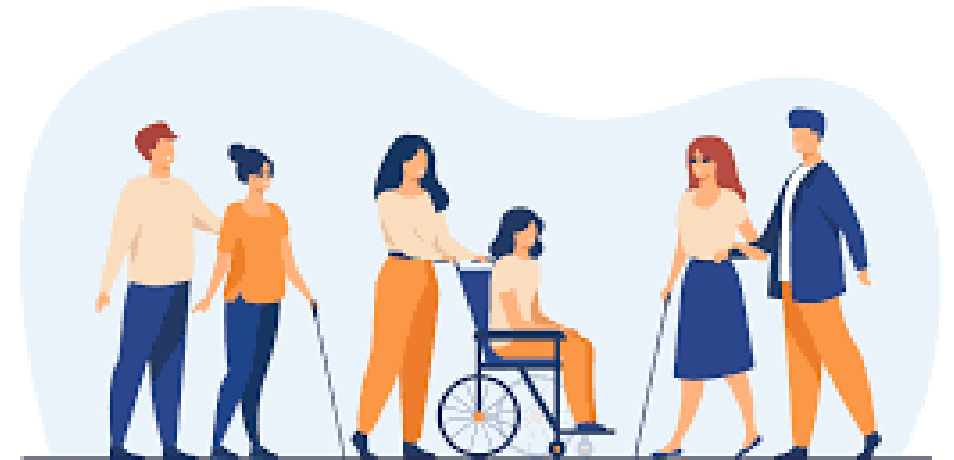
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# Disability awareness within companies

- **Organizing workshops and training days** for raising awareness of disability in the workplace

## Conferences



## Presentation of case studies



## Exercises



Classical  
pedagogical  
methods



# Disability awareness within companies



**Organizing workshops and training days** for raising awareness of disability in the workplace

**What about incorporating new interaction techniques to keep participants engaged and promote active learning?**

# Disability awareness within companies

- Innovative IT tool to raise awareness of **integration**, **prevention of professional disinsertion** and **retention** in employment of people with **disabilities**

## SG-HANDI Serious game



Financial support of  
the SG-HANDI project:



**TangiSense** interactive tabletop  
with **tangible objects** equipped  
with RFID tags

=> **Fun educational content:**  
Team challenges  
Video sketches

=> **Collective intelligence** in the  
service of **disability acculturation**



**Dynamic learning environment**

**Enhance the workshop effectiveness**

**Facilitate deeper understanding and engagement with the subject matter**

# Disability awareness within companies

## - SG-HANDI Serious Game - Users

1

Are company stakeholders such as executives, managers and employees

Are able-bodied, or with disabilities.

Play as a team to solve challenges proposed by the SG

Are the people to raise awareness

**The players**



2

Specialized in employment and disability

Is the master and manages the serious game

Gives instructions

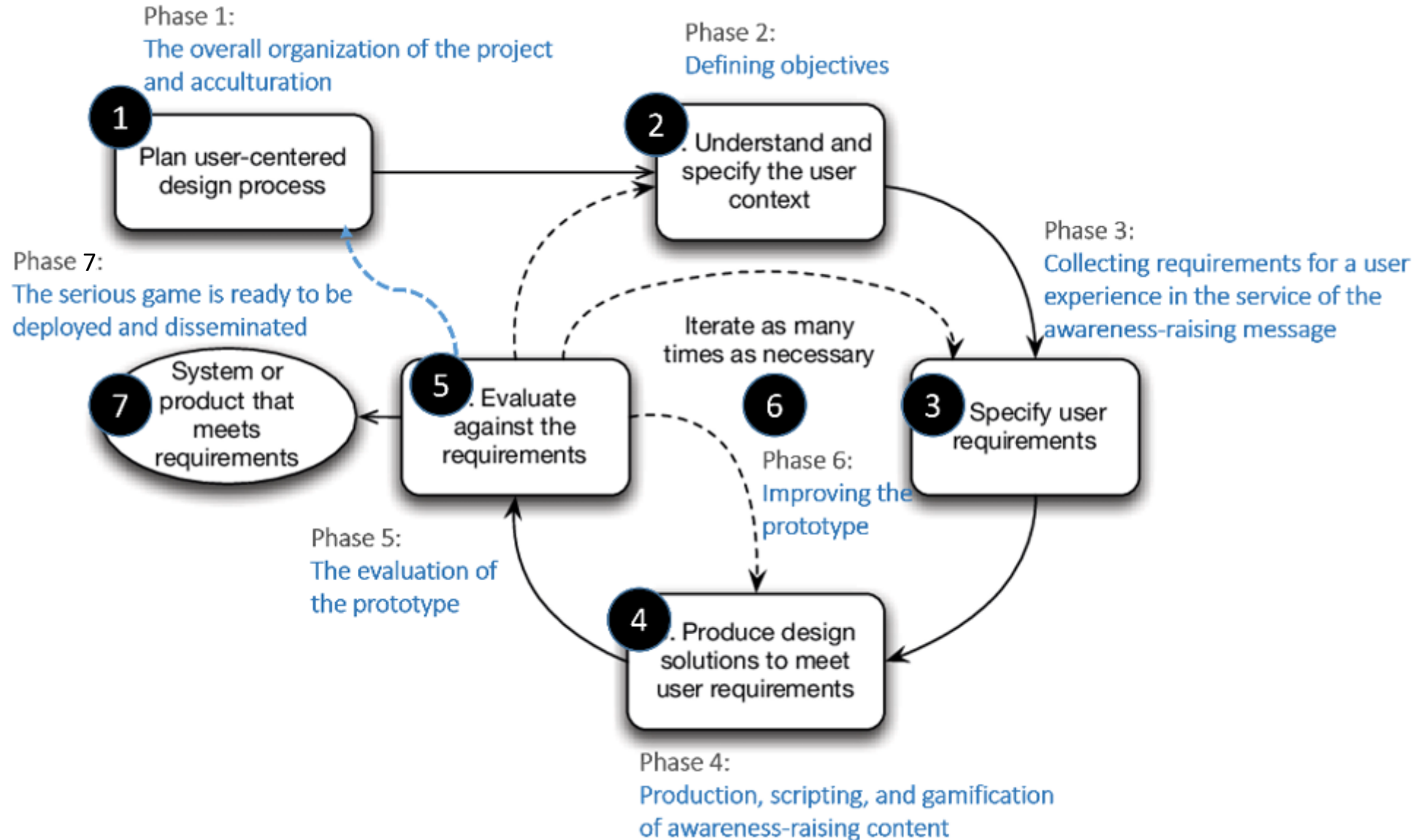
Orchestrates

Moderates discussions to make players aware in the target domain

**The facilitator**

# Disability awareness within companies

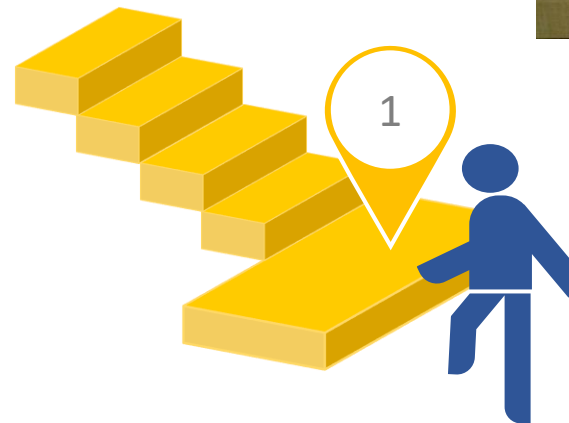
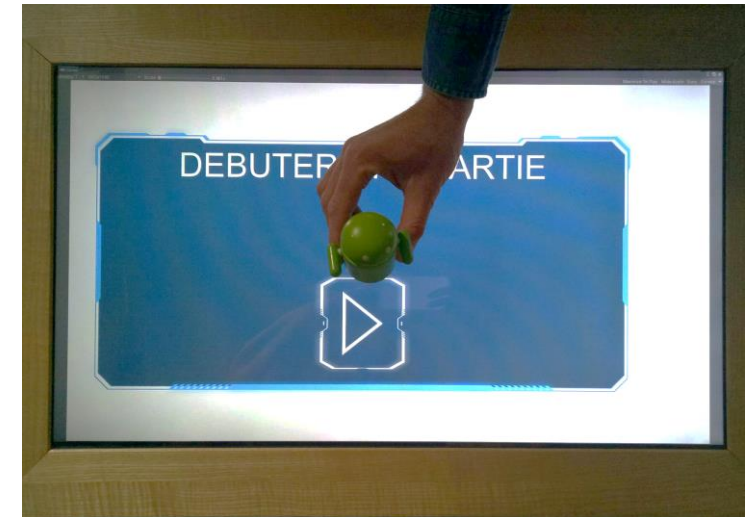
## - SG-HANDI Serious Game - HCD





# Disability awareness within companies

## - SG-HANDI Serious Game - Flow



### Introducing the game

- The facilitator presents the game
- Explains the technical aspects and shows how to use the interactive tabletop and the tangible objects.
- Launches the game.
- Once the players are ready, the facilitator decides to start the game by placing a personal pawn on the tabletop

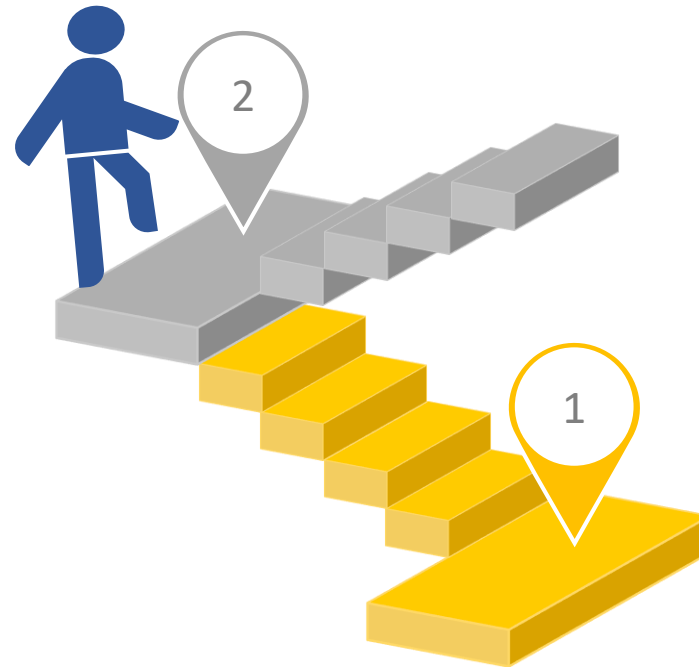
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## - SG-HANDI Serious Game - Flow



Starting the game and team building

- The facilitator asks the participants to get into 2 or 3 teams depending on their number.



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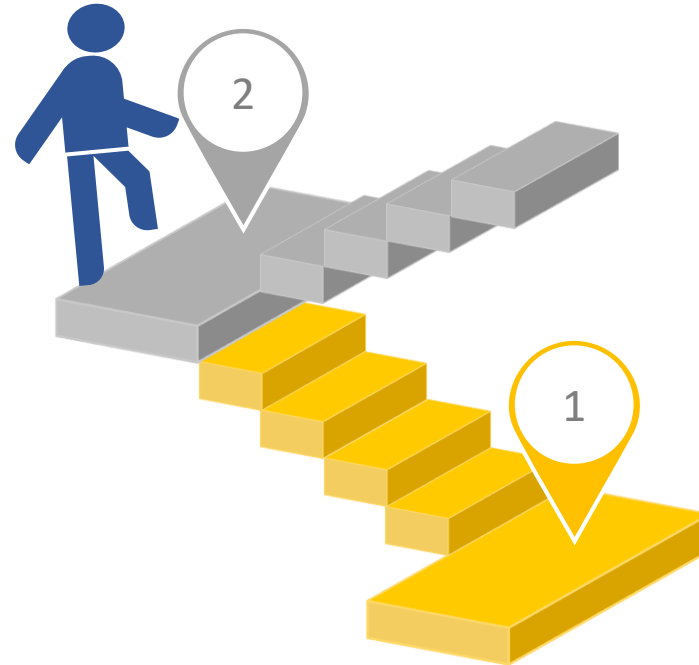
# Disability awareness within companies

## - SG-HANDI Serious Game - Flow



Starting the game and team building

- The facilitator asks the participants to get into 2 or 3 teams depending on their number.
- Each team chooses its (tangible) pawn and its (digital) logo.

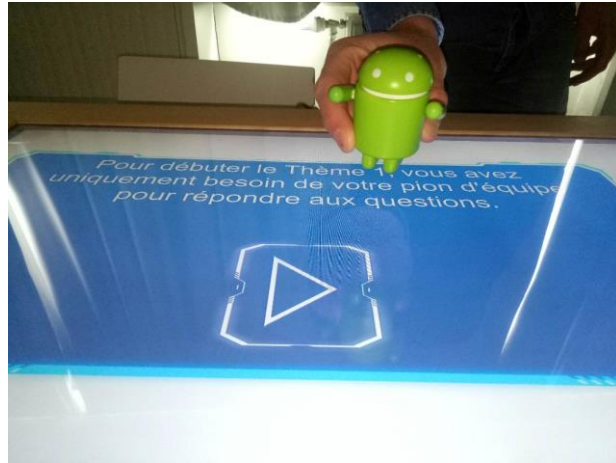


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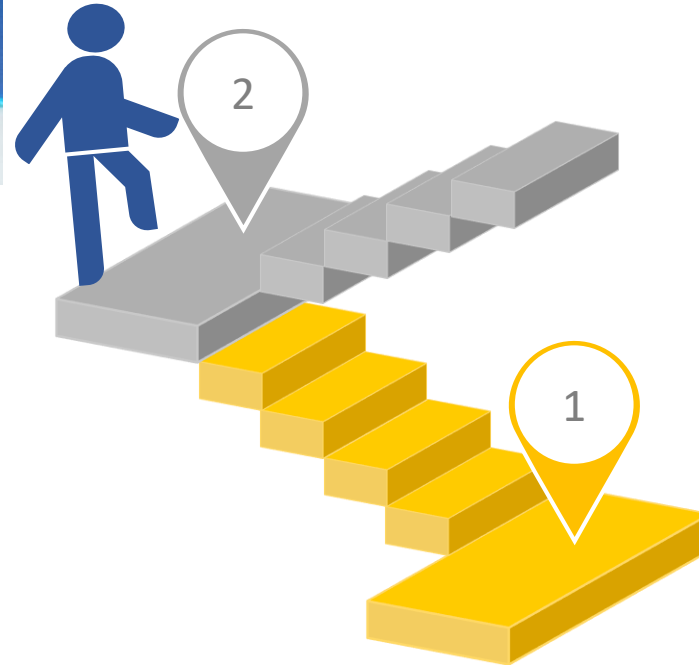
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- The facilitator asks the participants to get into 2 or 3 teams depending on their number.
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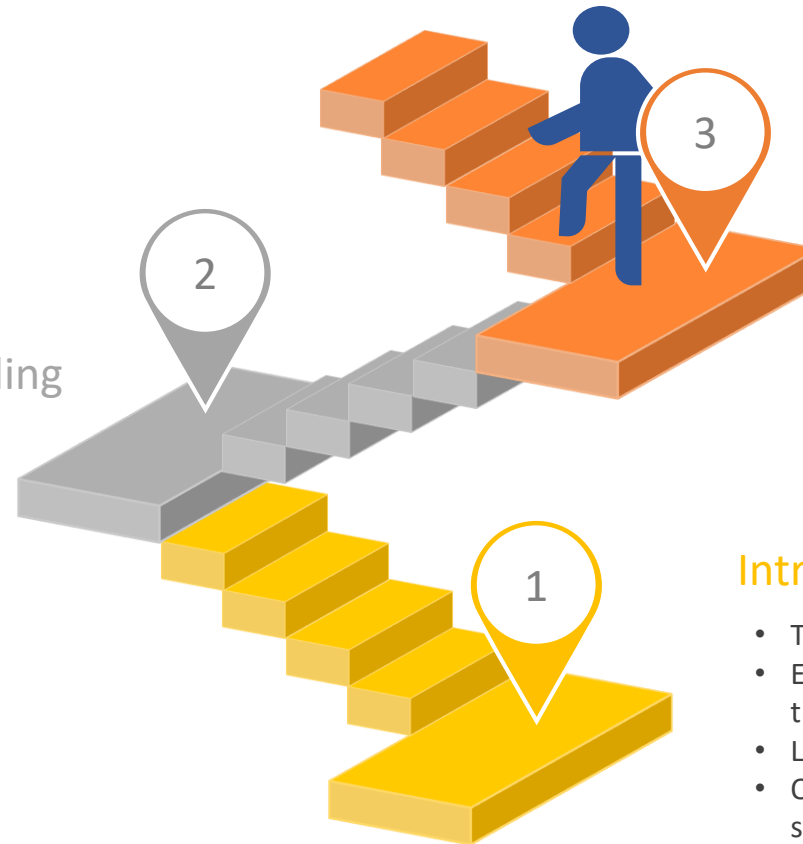
## - SG-HANDI Serious Game - Flow

### 1<sup>st</sup> part of the serious game

- Includes 5 themes
- In each theme, players are faced with one or more challenges to solve in time.
- Each challenge is most often followed by complementary explanations and/or a discussion.
- The facilitator can add or reduce the time for each challenge by using 2 different tangible objects.

### Starting the game and team building

- The facilitator asks the participants to get into 2 or 3 teams depending on their number.
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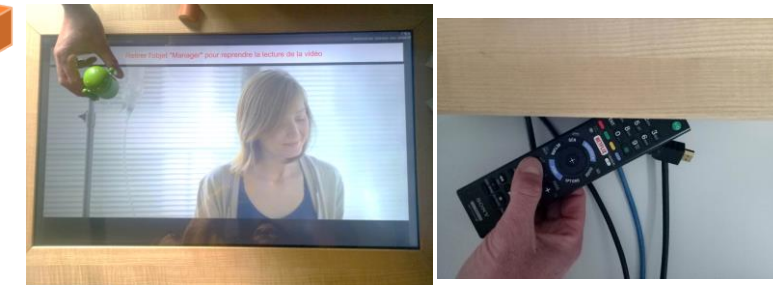
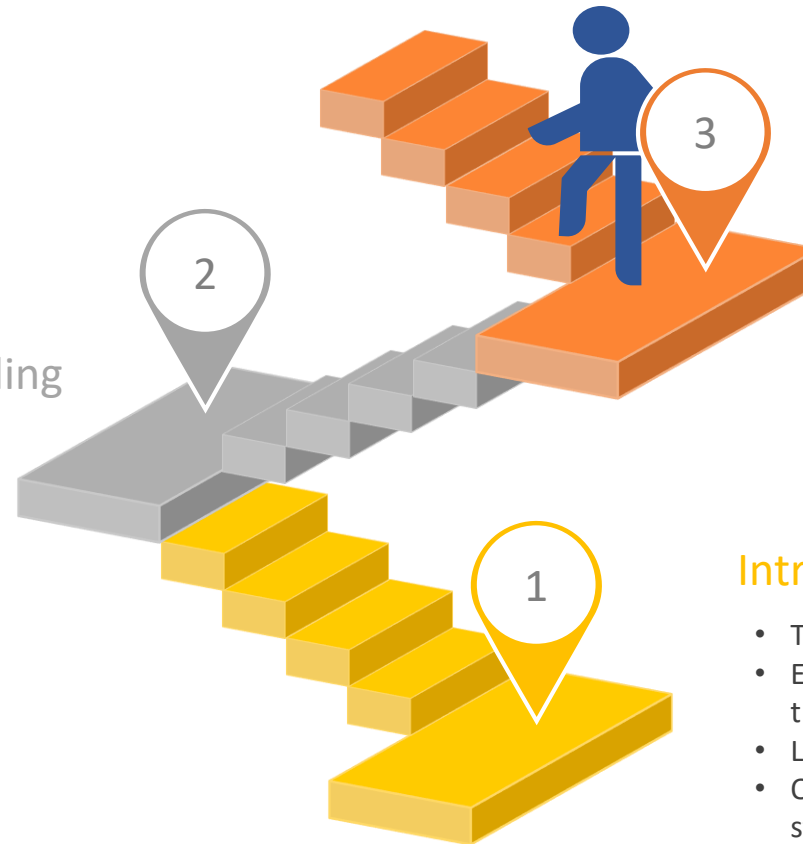
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- For some themes, video sketches are planned. The facilitator can take breaks and replay, increase or decrease the sound volume

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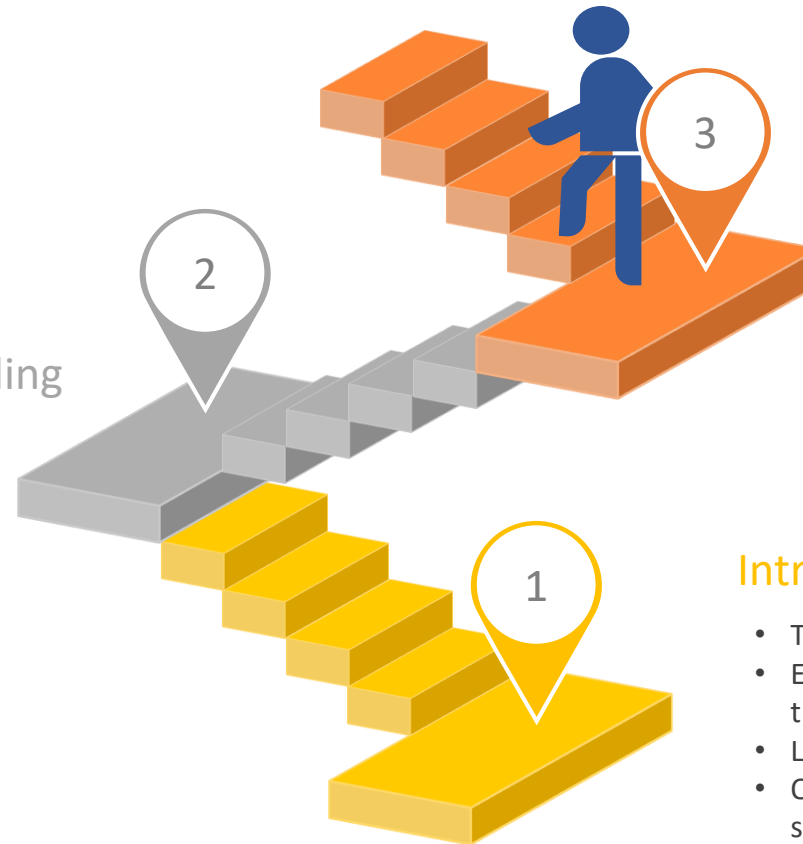
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- The facilitator can add or reduce the time for each challenge by using 2 different tangible objects.
- For some themes, video sketches are planned. The facilitator can take breaks and replay, increase or decrease the sound volume
- The facilitator decides to move from one challenge to another and from one theme to another using the pawn.
- Generally, a theme is closed by the podium and a discussion which recapitulates and enriches what has just been seen.

### Starting the game and team building

- The facilitator asks the participants to get into 2 or 3 teams depending on their number.
- Each team chooses its (tangible) pawn and its (digital) logo.
- The facilitator starts the first part of the game.



### Introducing the game

- The facilitator presents the game
- Explains the technical aspects and shows how to use the interactive tabletop and the tangible objects.
- Launches the game.
- Once the players are ready, the facilitator decides to start the game by placing a personal pawn on the tabletop

# Disability awareness within companies

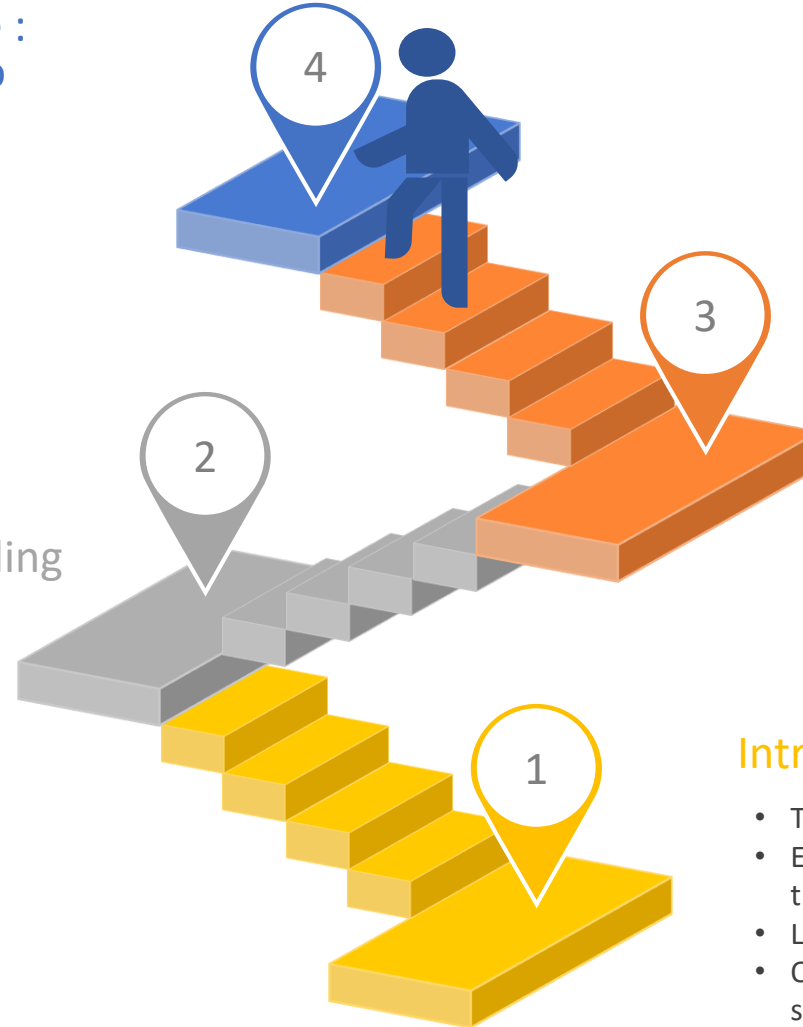
## - SG-HANDI Serious Game - Flow

### 2<sup>nd</sup> part of the serious game : Role play/Real-life scenario

- Players put themselves in the shoes of a company that aims to recruit a new employee
- To accomplish this mission, 5 challenges must be met
- The facilitator proposes a debriefing and concludes the awareness-raising session

### Starting the game and team building

- The facilitator asks the participants to get into 2 or 3 teams depending on their number.
- Each team chooses its (tangible) pawn and its (digital) logo.
- The facilitator starts the first part of the game.



### 1<sup>st</sup> part of the serious game

- Includes 5 themes
- In each theme, players are faced with one or more challenges to solve in time.
- Each challenge is most often followed by complementary explanations and/or a discussion.
- The facilitator can add or reduce the time for each challenge by using 2 different tangible objects.
- For some themes, video sketches are planned. The facilitator can take breaks and replay, increase or decrease the sound volume
- The facilitator decides to move from one challenge to another and from one theme to another using the pawn.
- Generally, a theme is closed by the podium and a discussion which recapitulates and enriches what has just been seen.

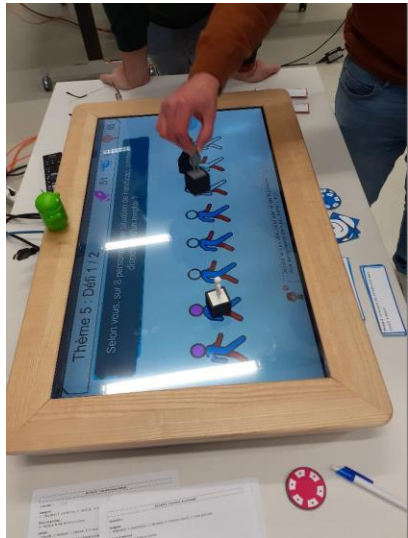
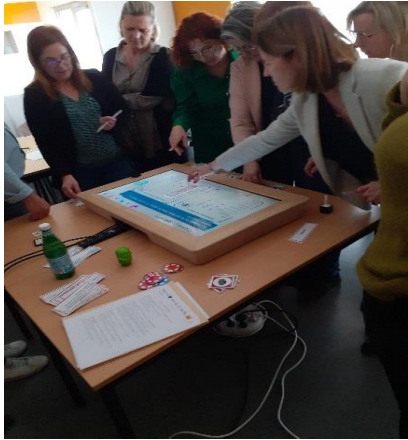
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# Disability awareness within companies

## - SG-HANDI Serious Game - Design



### Part 1

Teams confront each other with challenges

Challenges cover several facets of the disability field:

- basic concepts
- legislation
- company resources
- professional disinsertion
- compensation
- Etc.

Challenges are grouped into 5 themes and each theme is closed by a podium

- 1) Situational disability
- 2) Disability typologies
- 3) Disability recognition
- 4) Compensation
- 5) Job displacement

### Part 2

Role play/Real-life scenario

Participants try to succeed in the hiring mission of a new employee

Participants have to choose one of these sectors:

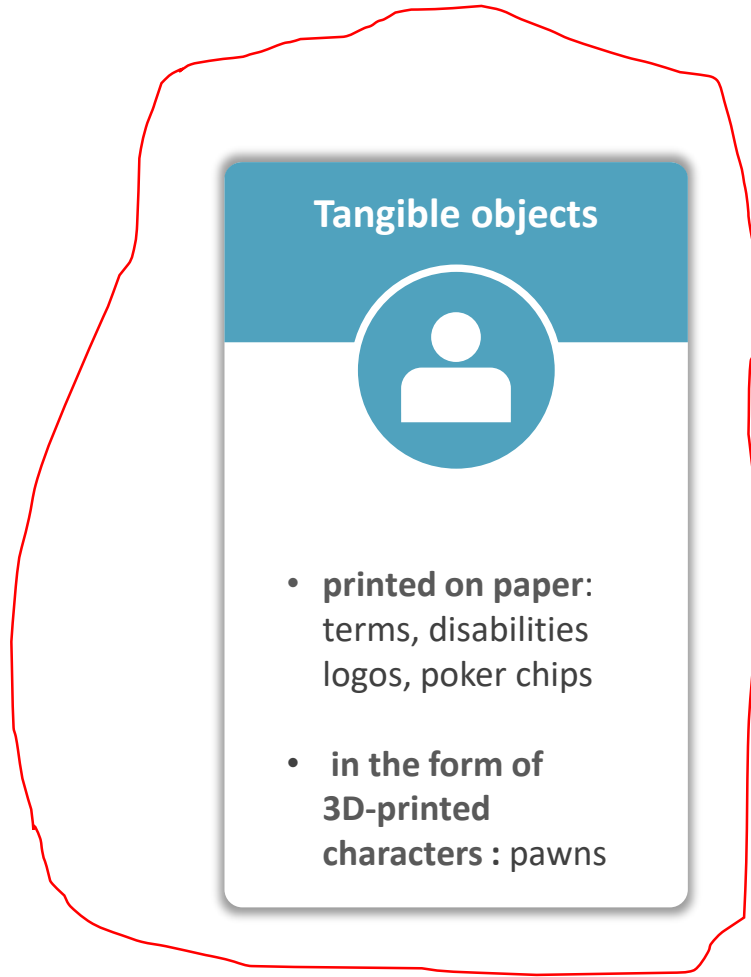
- logistics
- commerce
- industry

Participants have to accomplish 5 challenges:

- 1) job description
- 2) job offer
- 3) the interview
- 4) The communication
- 5) testimony

# Disability awareness within companies

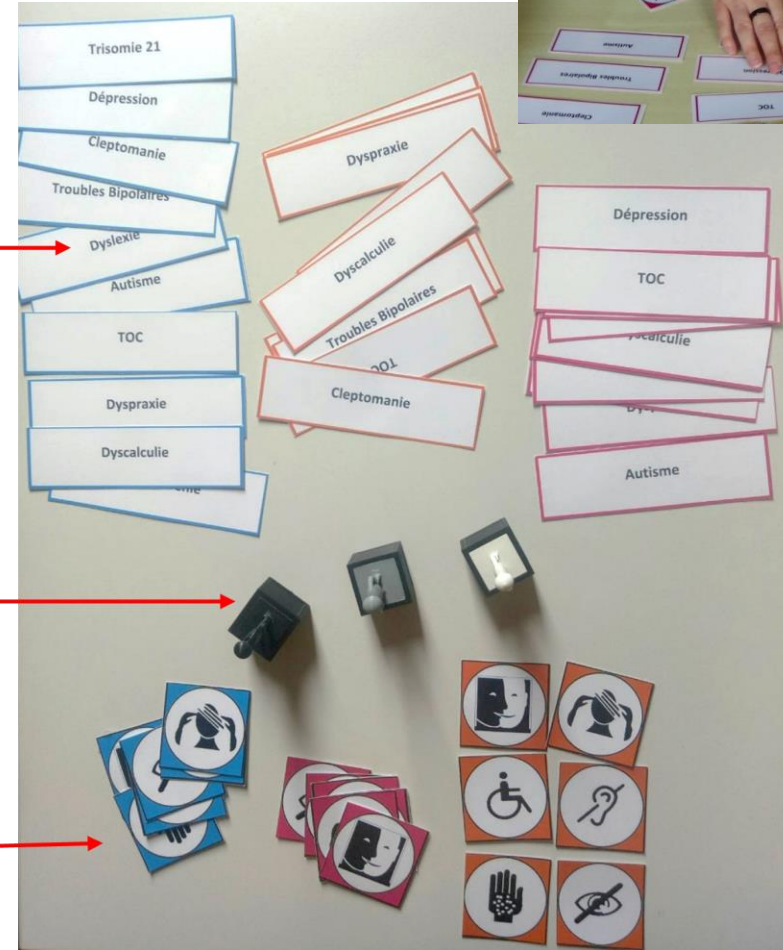
## - SG-HANDI Serious Game – Characteristics (1/3)



Terms

Pawns

Logos




➔ **Diversify to avoid monotony!**

# Disability awareness within companies


## - SG-HANDI Serious Game – Characteristics (2/3)

**Tangible objects**



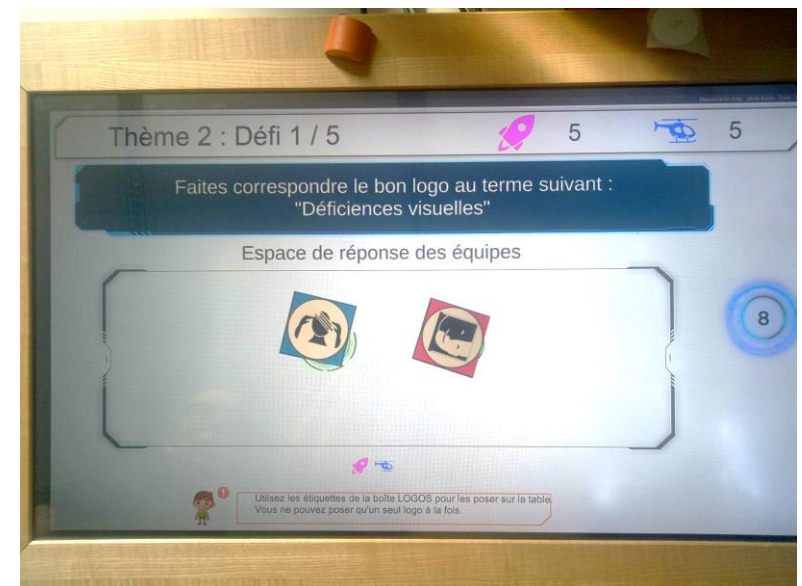
- **printed on paper:** terms, disabilities logos, poker chips
- **in the form of a 3D-printed characters :** pawns

**Types of questions**



- **quiz**
- **Drag-and-drop**
- ...


➔ **Diversify to avoid monotony!**



# Disability awareness within companies


## - SG-HANDI Serious Game – Characteristics (3/3)

**Tangible objects**




- **printed on paper:** terms, disabilities logos, poker chips
- **in the form of a 3D-printed characters :** pawns

**Types of questions**



- **quiz**
- **drag and drop**

**Temporality**



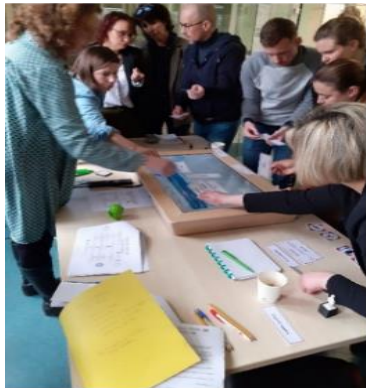
From challenge to challenge the temporality is varied to **avoid dullness** and **boredom**

➔ **Diversify to avoid monotony !**

# Disability awareness within companies

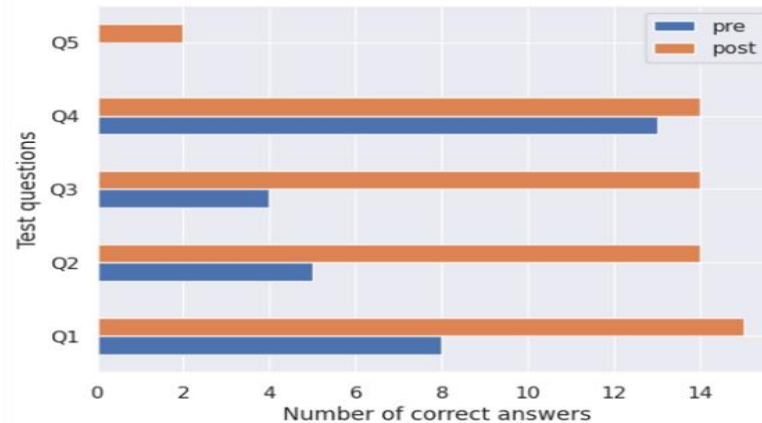
## - SG-HANDI Serious Game – First uses in companies (evaluation)

- During recent **disability awareness workshops** (11 groups – 8 to 10 participants per workshop)
- **Duration** of each workshop : **one and a half hours** (focus on the first part of the SG)
- Evaluation techniques: **observations** (cameras), **pre & post tests**, satisfaction **questionnaires**:
  - ✓ **SUS** (System Usability Scale [Brooke, 1996]) for **participants**
  - ✓ **CSUQ** (Computer Usability Satisfaction Questionnaire [Lewis, 2018]) for **facilitator**



**Promising engagement**  
of the participants

For the 3 first groups:



**Significant progression** in post-test  
showing the SG effectiveness

- **Possible improvements** proposed by the facilitators:
  - ✓ to shortcut one or several collective challenges, in case the available time is not sufficient
  - ✓ etc.
- Other part of collected data is being analyzed

# Disability awareness within companies

## - Conclusion:

- The **management of disability** in companies leads to new important **challenges** for corporate governance
- Importance to **raise the awareness** of various company stakeholders to **integration, prevention of professional disintegration and job retention** of people with disabilities
- One of the possible activities: to organize **workshops**
- Proposition of a **serious game** on RFID interactive tabletop with tangible objects
- Its first uses: started recently in several companies
- **Promising results**; data analysis in progress



# Outline

1. Methodological context
2. From Human-Centered Design to Disabled User & Ecosystem Centered Design
3. Adapting processes and methods
4. Disability awareness within companies
5. Conclusion & research ways

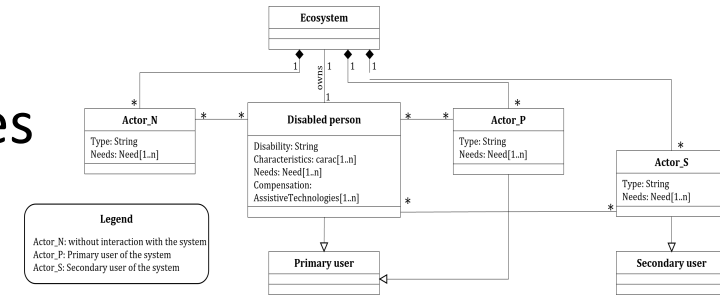
# Conclusion

- Massive use of **Human-Centred Design (HCD)** approaches
- **New methodological needs** emerging for projects involving **people with disabilities**
- Their characteristics may require the involvement of actors from their **ecosystem**
- Necessity to **adapt** certain methods to the characteristics of people with disabilities (e.g. people with intellectual disabilities)
- Another major challenge: **to raise awareness of disability issues** within companies

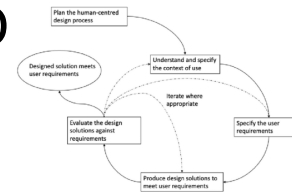


# Research ways

- To propose **Model-Driven Engineering** (MDE) approaches considering ecosystem meta-modelling and modelling



- To **study systematically and adapt** different categories of methods, usable in a HCD approach, according with **various** categories of disabilities



- To **study and combine** different approaches (using IT or not) **to raise awareness of disability issues** within companies (about employment)

and...



**- To raise (increasingly in-depth) awareness of disability considerations among designers**

# Human-centered design involving people with disabilities: a few research avenues based on methodological considerations

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**Obrigado for your attention! Any questions?**