ISO/IEC JTC 1/SC 24

Standardization: New Proposal

Mixed-methods User Experience Evaluation in AR/VR

A lean process for selecting appropriate UX evaluation methods and techniques in AR/VR.

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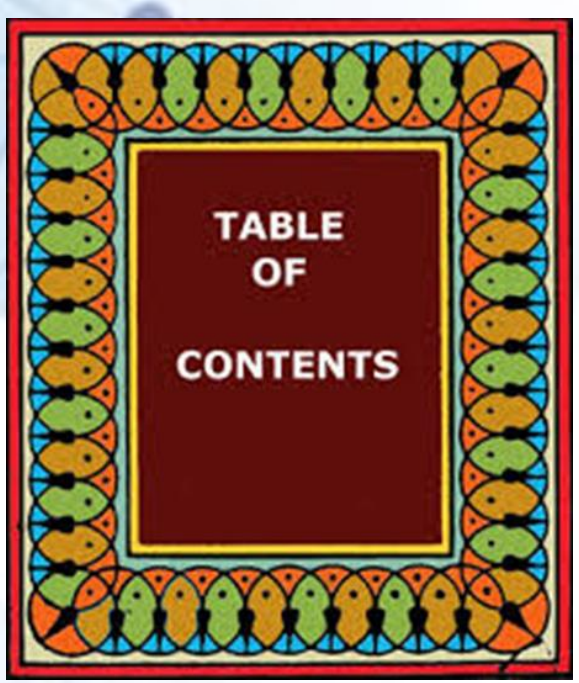
Table Of Content



- Terms and Definitions
- Introduction
- Scope of the proposed standard
- Rationale for adopting Mixed methods UX Evaluation in AR/VR
- Principles of Mixed methods UX evaluation
- Activities of Mixed methods UX evaluation
- Conclusion

1.

Terms and Definitions

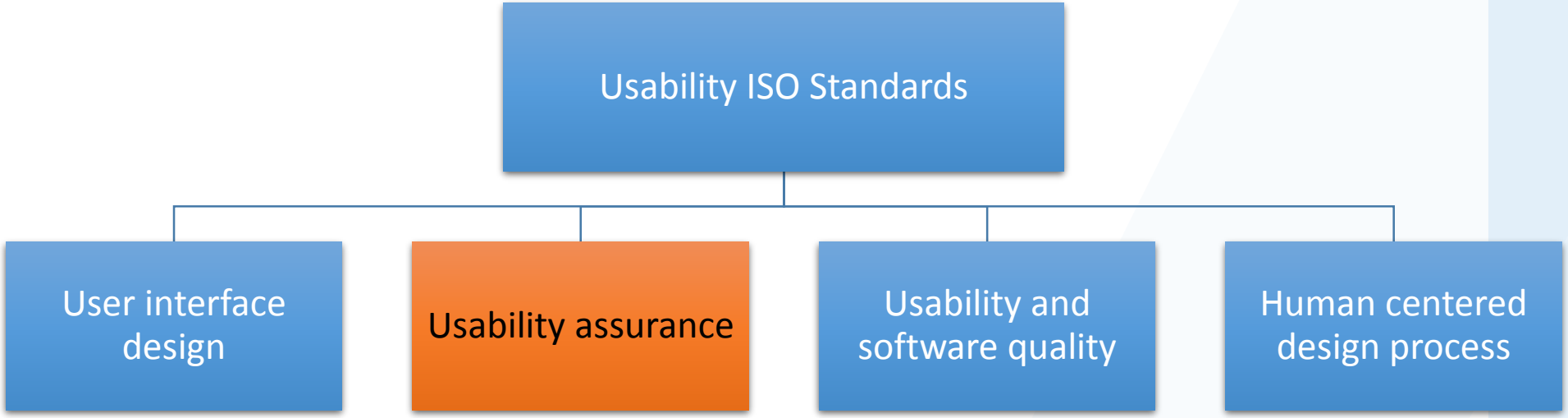
Terms and Definitions

- **context of use**
  - users, tasks, equipment (hardware, software and materials), and the physical and social environments in which a product is used
  - **[ISO 9241-11:2018]**
- **usability**
  - extent to which a system, product or service can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use
  - **NOTE Adapted from ISO 9241-11:2018.**
- **user experience**
  - person's perceptions and responses resulting from the use and/or anticipated use of a product, system or service
  - **[ISO 9241-210]**
- **user**
  - person who interacts with the product
  - ***[ISO 9241-11:2018]***
- **stake holder**
  - individual or organization having a right, share, claim or interest in a system or in its possession of characteristics that meet their needs and expectations
  - **[ISO/IEC 15288:2008]**
- **task**
  - activities required to achieve a goal
  - **[ISO 9241-11:2018]**
- **validation**
  - confirmation, through the provision of objective evidence, that the requirements for a specific intended use or application have been fulfilled
  - **[ISO 9000:2005]**
- **interactive system**
  - combination of hardware, software and/or services that receives input from, and communicates output to, users
  - **[ISO 9241-210]**

2. Introduction

International standards for usability

Over the last 20 years, industry and academic experts in human-computer interaction (HCI), ergonomics, and usability have met to put together a wide range of authoritative prerequisites and guidelines for designing, developing, and evaluating usable products



ISO 9241-11: Usability

- The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use

Measuring Usability

Effectiveness

The accuracy and completeness with which users achieve specified goals.

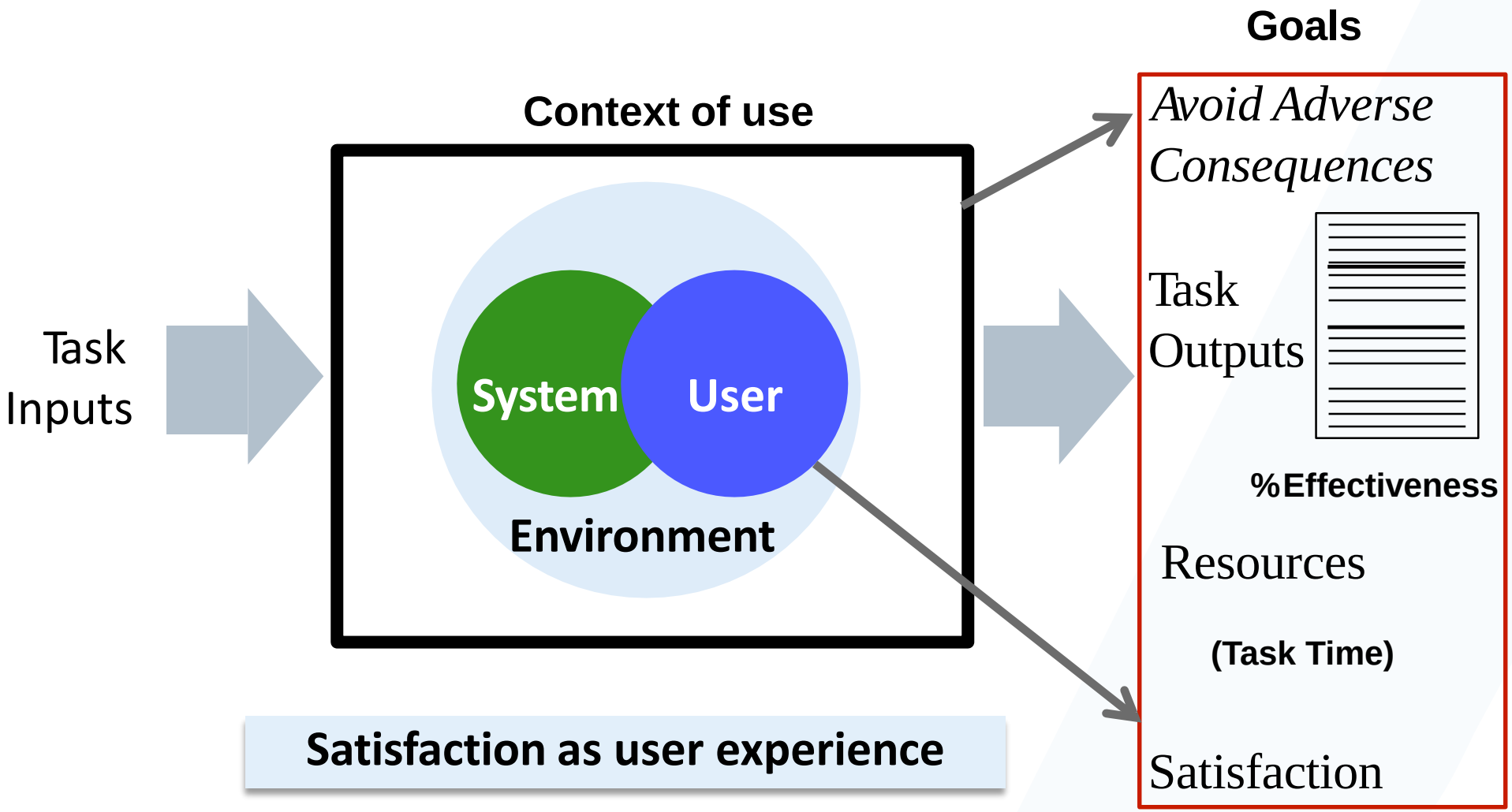
Efficiency

The resources expended in relation to the accuracy and completeness with which users achieve goals.

Satisfaction

The comfort and acceptability of use

System usability measures



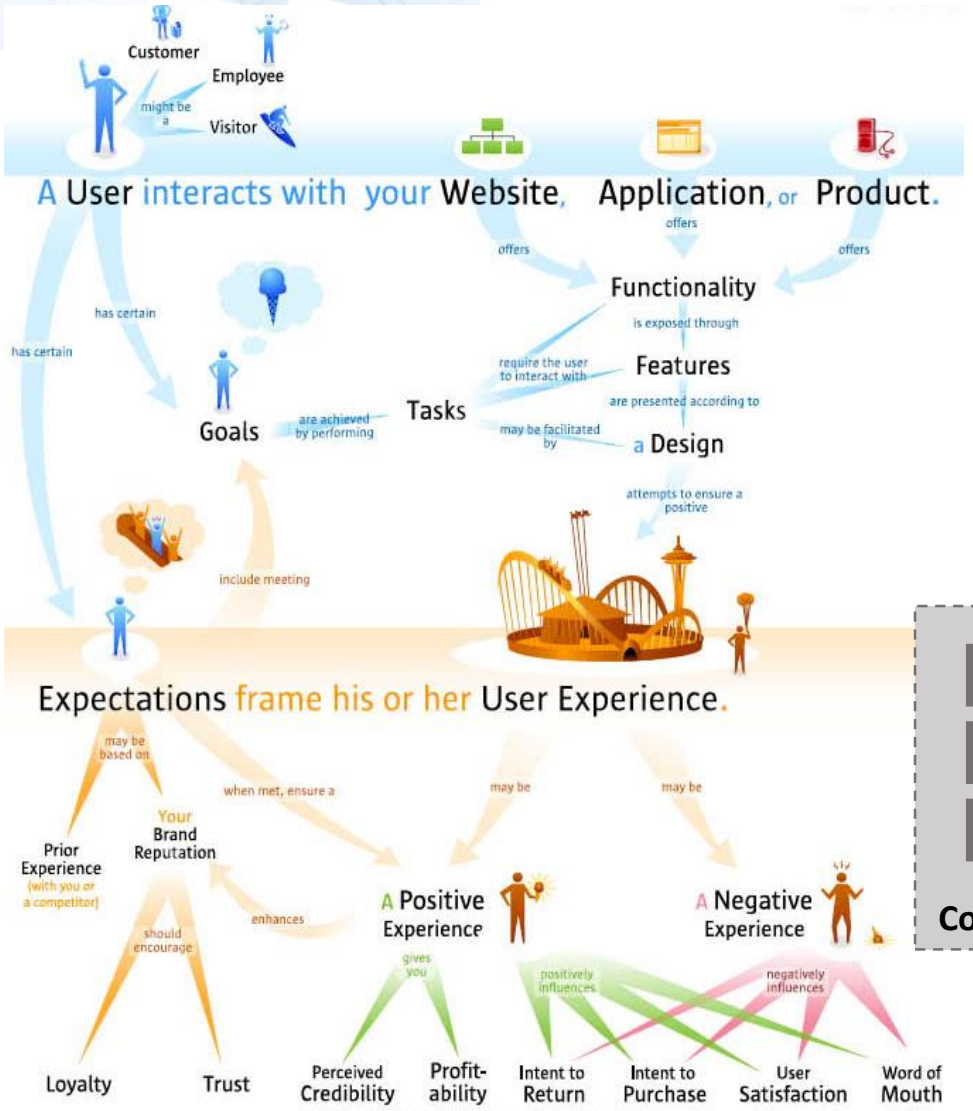
ISO 9241-210

Satisfaction as user experience

- "Likability" (cognitive), user's experience of:
  - Learnability
  - Usage
  - Consequences of use

- "Pleasure" (emotional):
  - Stimulation (personal growth, an increase of knowledge and skills)
  - Identification (self-expression, interaction with relevant others)
  - Evocation (self-maintenance, memories)
  - Pleasurable emotional reactions to the product (Norman's visceral category)

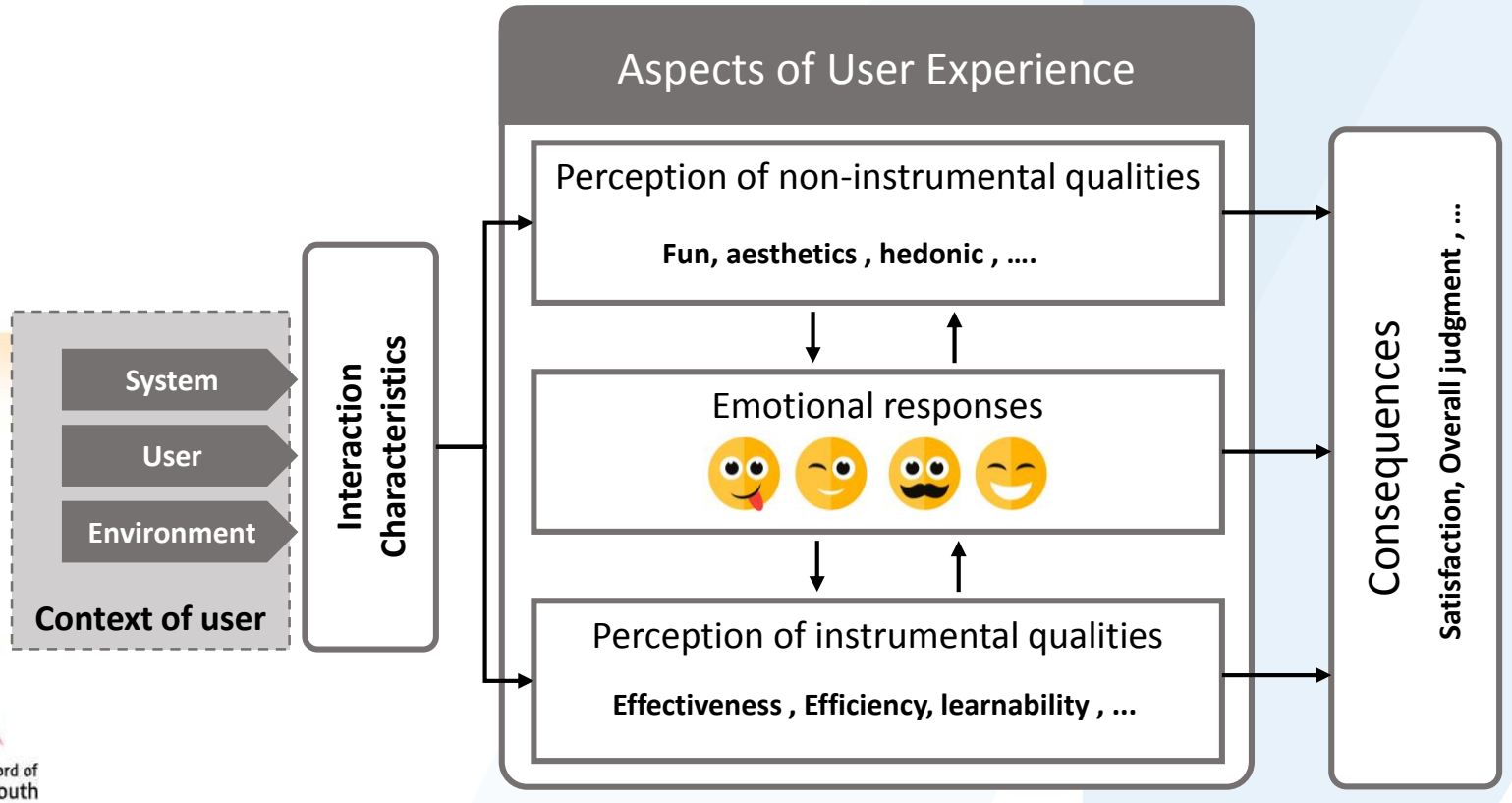
User Experience (UX)



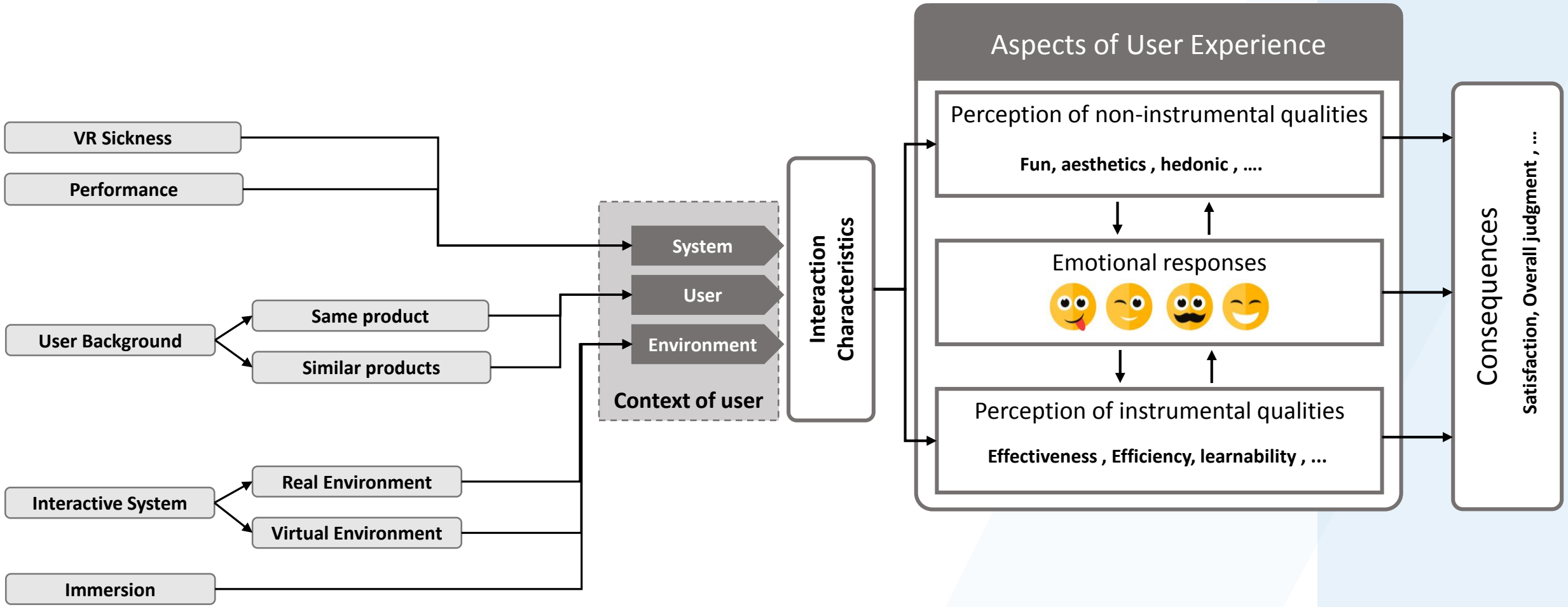
User Experience

person's perceptions and responses resulting from the use and/or anticipated use of a product, system or service

ISO 9241-210:2010

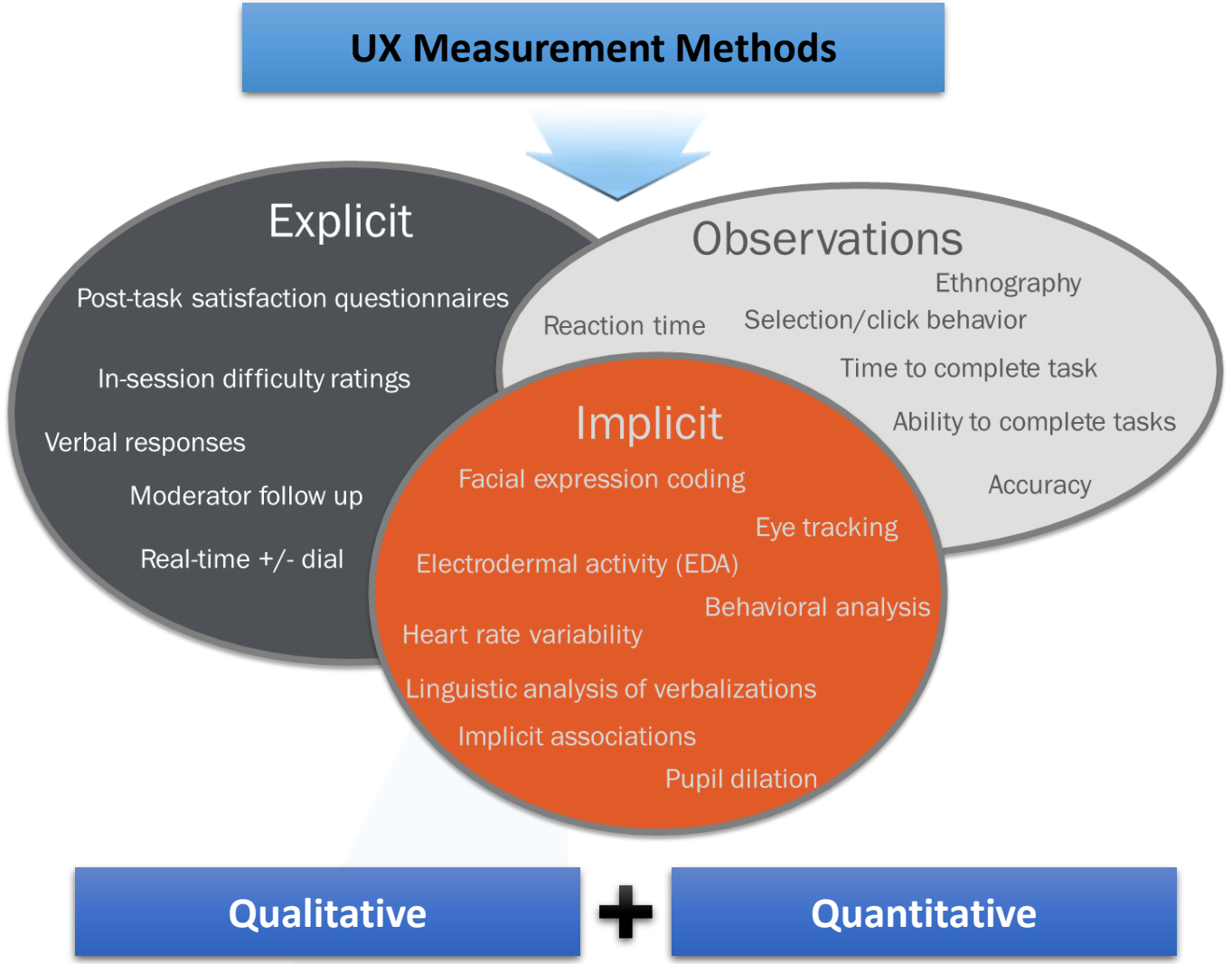


Factors to consider when evaluation UX in AR/VR



UX Methods and Techniques in AR/VR

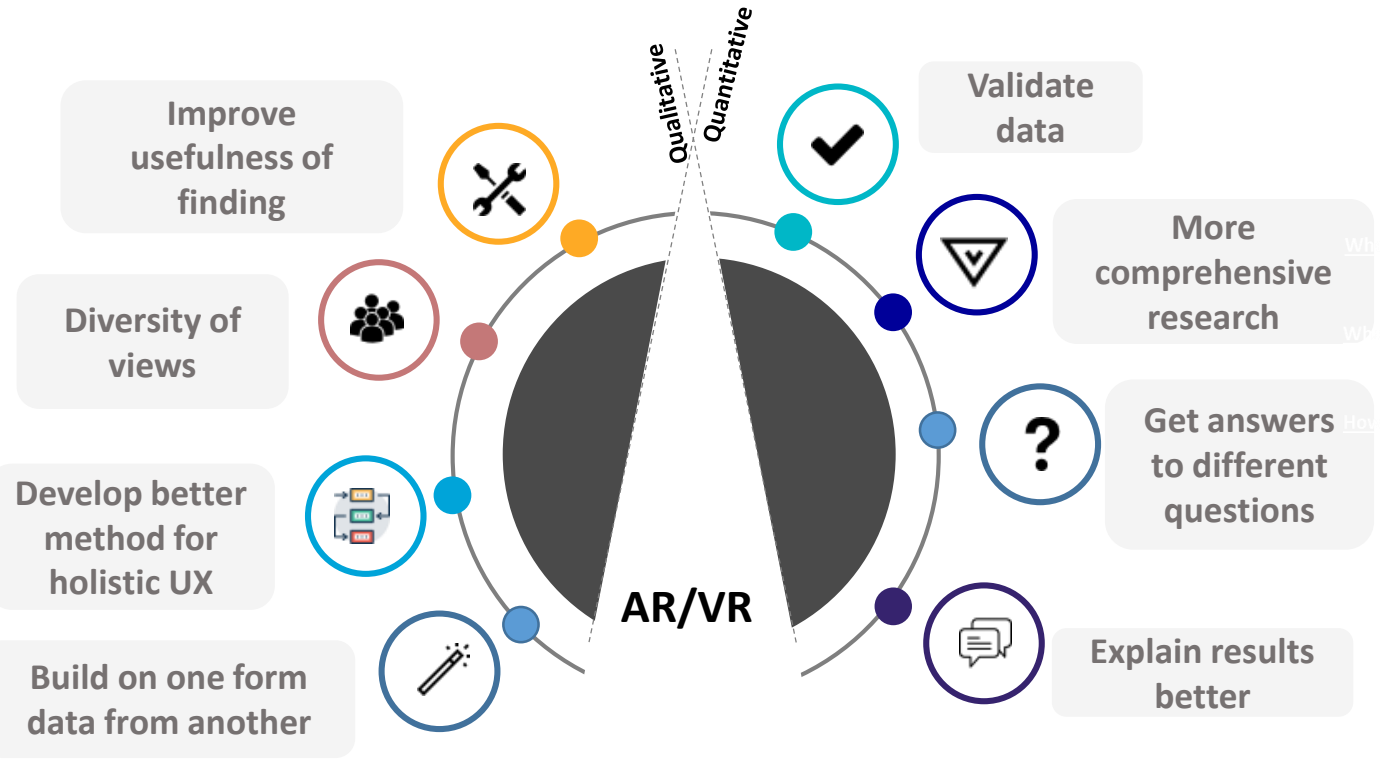
- Explicit
  - Questionnaire
    - NASA-TLX (Physical and Mental effort)
    - SSQ (VR Sickness)
    - SUDS (VR Sickness)
    - Attrikdiff (Pragmatic and hedonic quantities)
- Implicit
  - Physiological Sensors
    - GSR
    - ECG
    - EMG
    - Eye Tracking
- Observations
  - Performance Evaluation
    - Task Completion
    - Error Rate



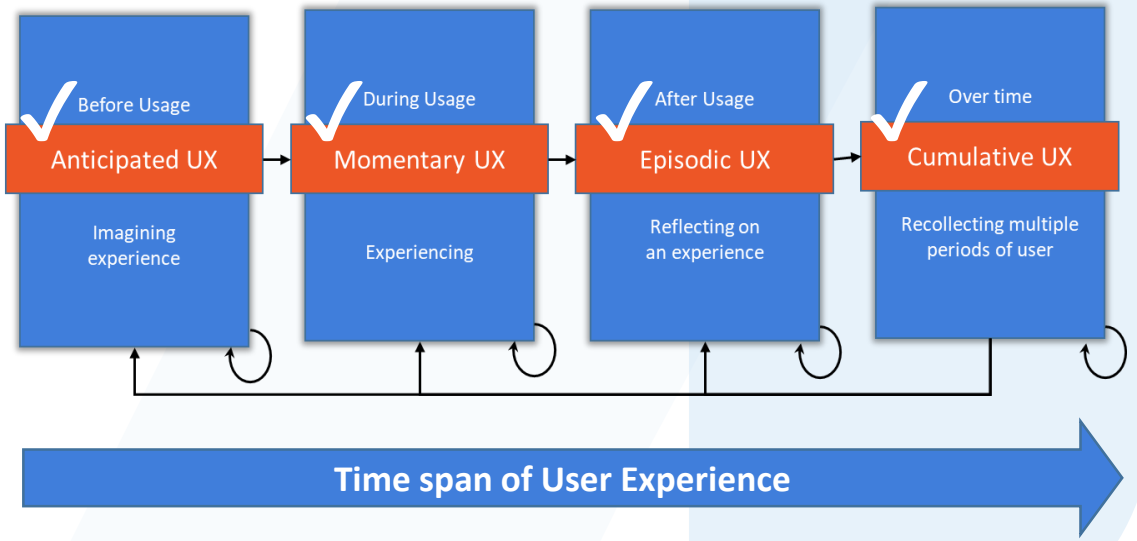
The Mixed Methods approach

What is missing in single method approach?

None of the measurements methods can, by themselves, completely capture the user's holistic experience



Qualitative and quantitative measurement to get a rich understanding of user experience



Time span of User Experiences: Example

User | Anticipated UX | Momentary UX | Episodic UX | Cumulative UX | Holistic

Perceptions

Excited

Experiencing

Reflecting

Recollecting

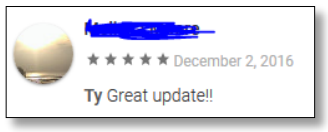
Pokémon GO
Niantic, Inc. Adventure

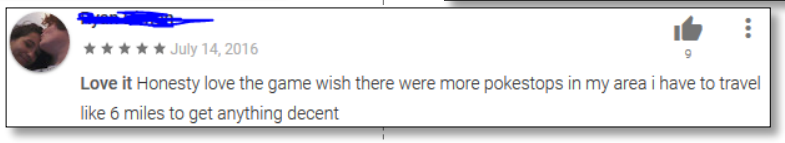
User

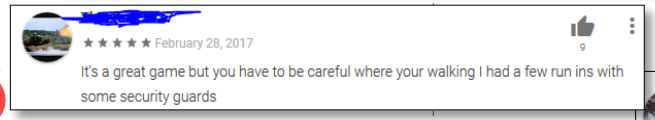
Product

Release: July 6, 2016

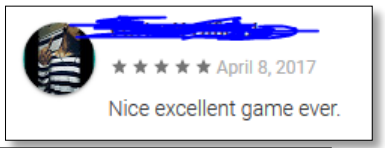
Before Usage

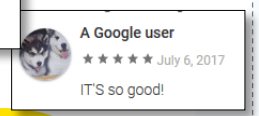




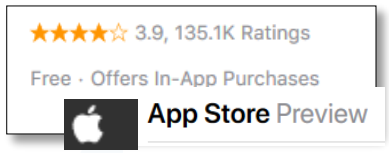


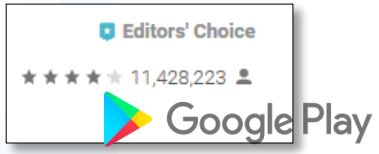
During Usage



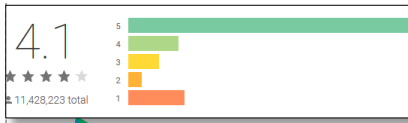


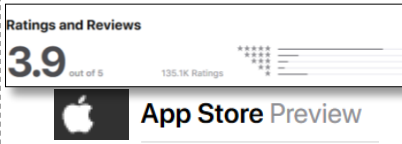
After Usage





Over time





Challenges of Mixed-Methods Approach

- **Context**
  - Environment
  - User
  - System
- **Method Curation**
  - Identification
  - Selection
  - Integration points
- **Change management**

3.

Scope of the proposed standard

Scope

Aim

Provides requirements and recommendations for selecting appropriate multimodal UX evaluation methods in AR/VR

Usage

evaluating user experiences during various stages of software development lifecycle (ISO/IEC 14764)

Constraint

Availability of UX evaluation methods, experienced evaluators, and context of use

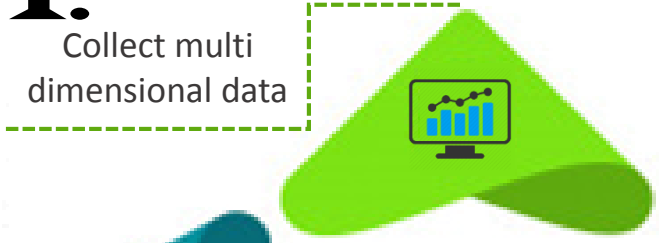
Benefit

can enhance the overall user experience of interactive system

4.

Rationale for adopting Mixed methods UX Evaluation in AR/VR

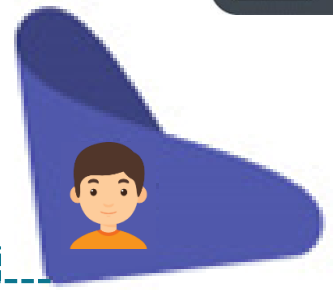
Rationale



1. Collect multi dimensional data

2. Reinforce confidence by multiple methods

3. Reduce subjectivity



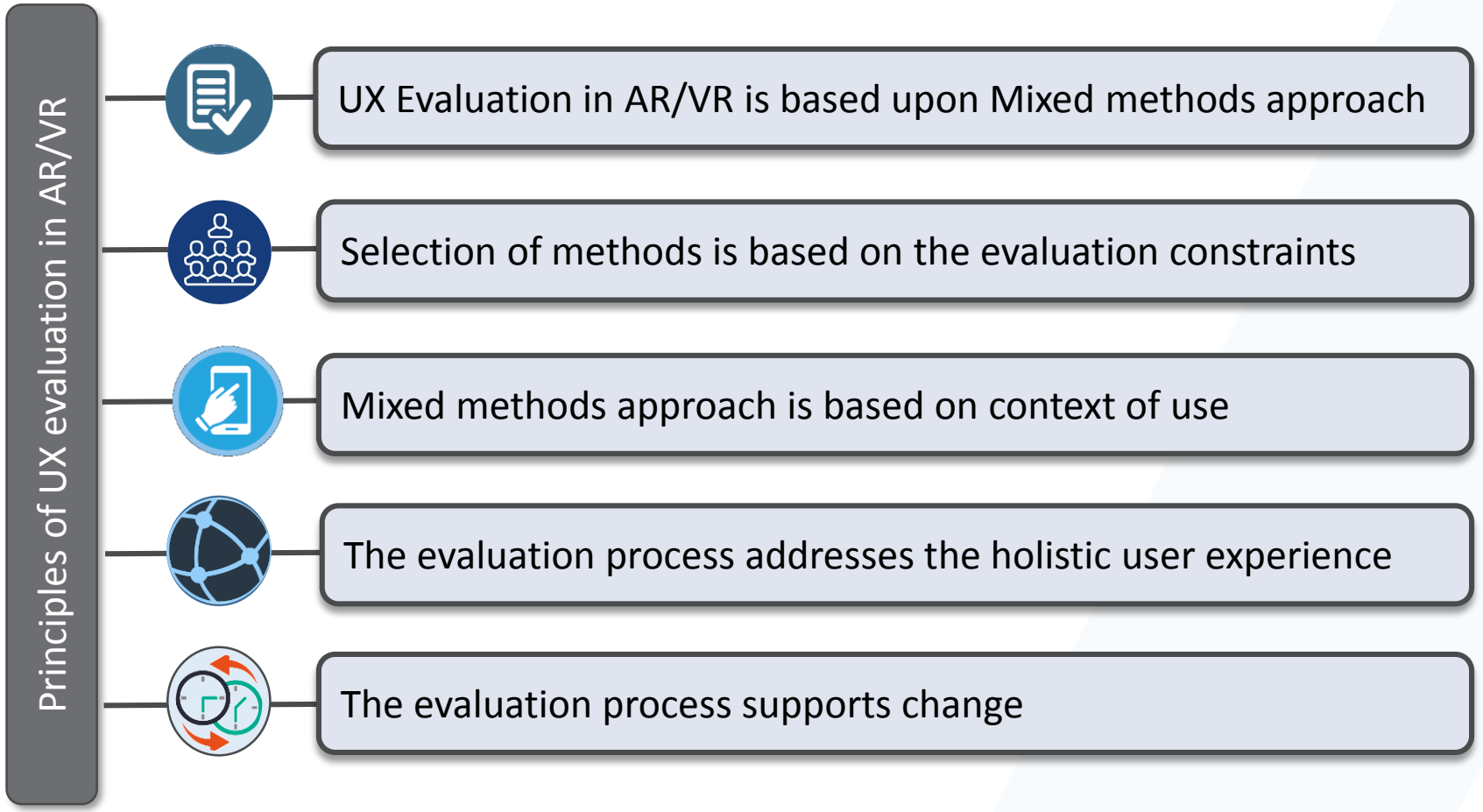
4. Improve overall UX

5. Retrieve users' information precisely

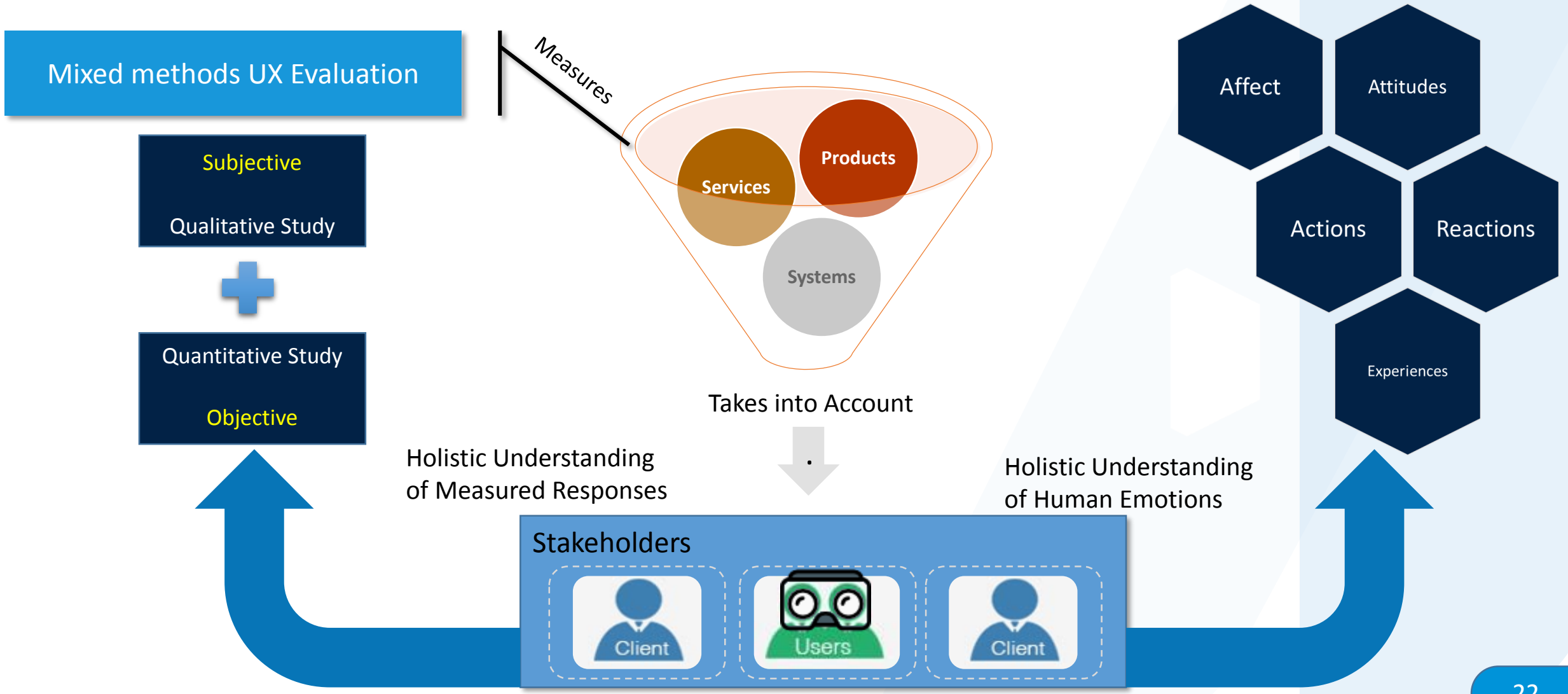
5.

Principles of Mixed methods UX evaluation

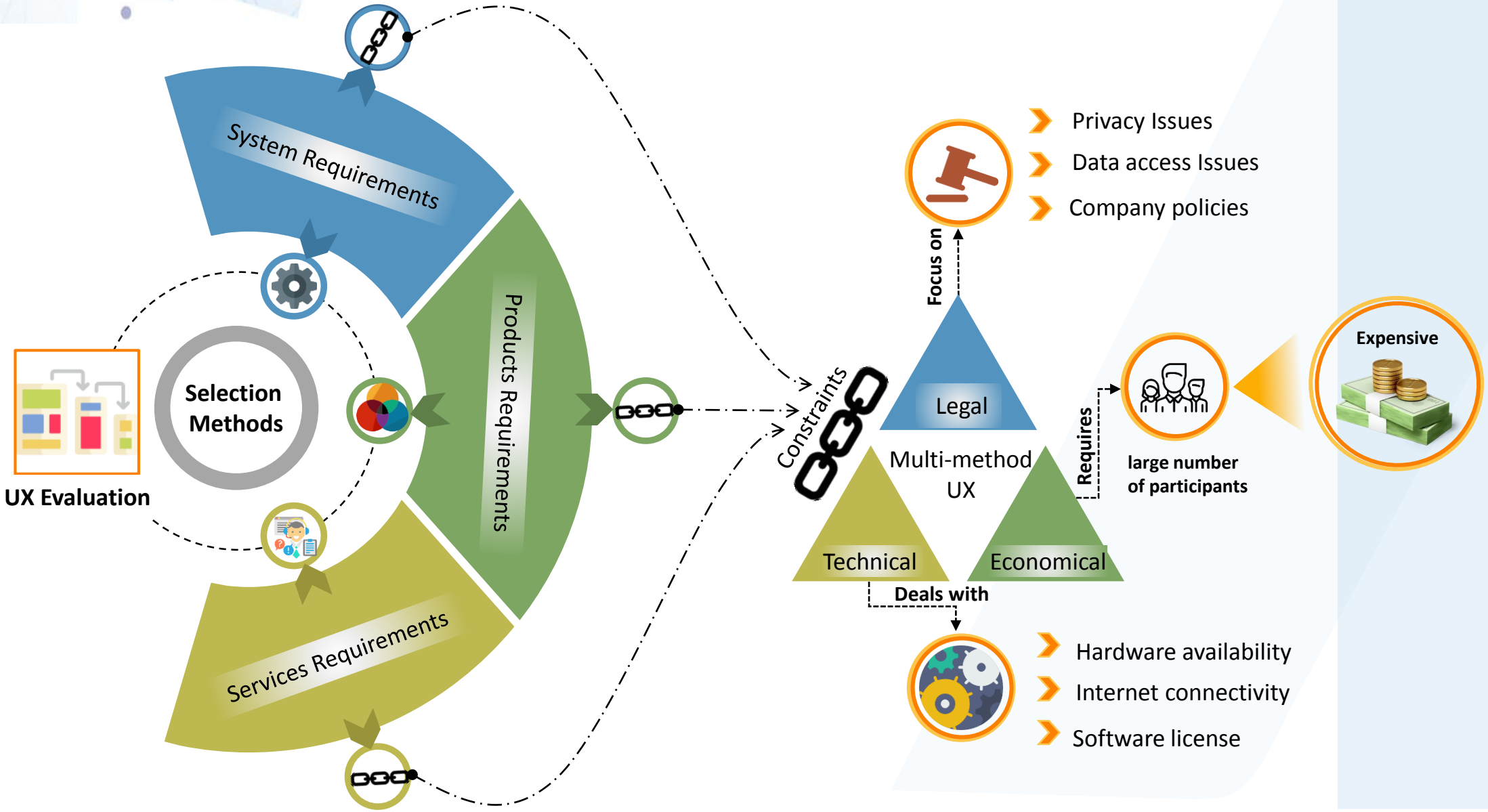
5. Principles of Mixed methods UX evaluation



5.1. UX Evaluation in AR/VR is based upon Mixed methods approach



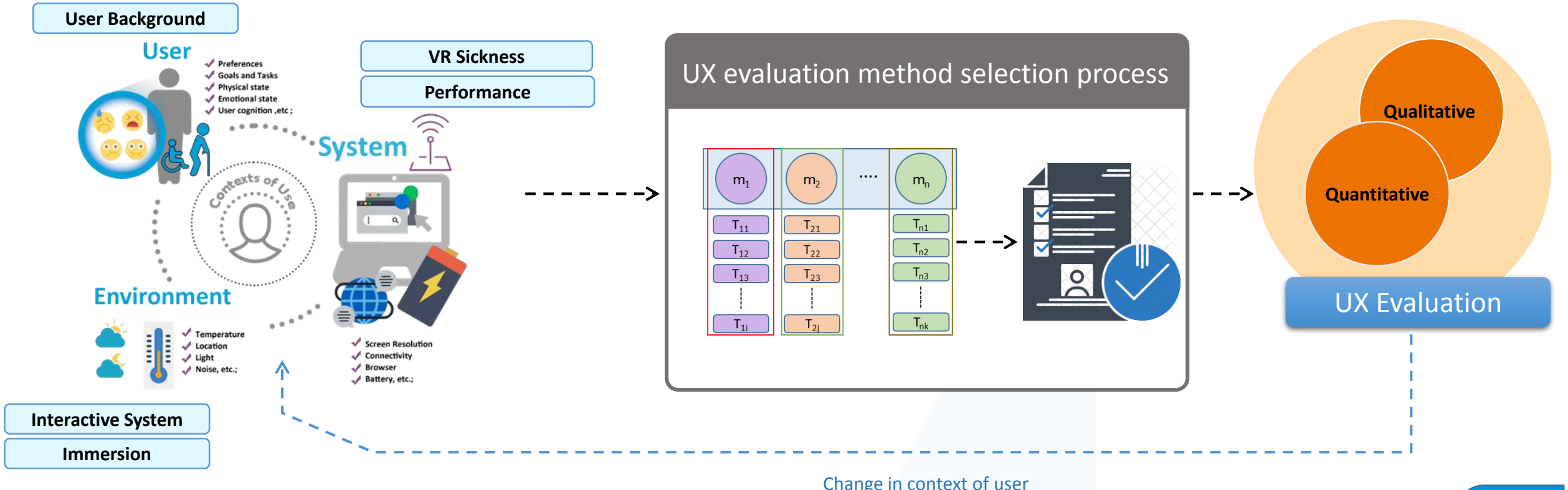
5.2. Selection of methods is based on the evaluation constraints



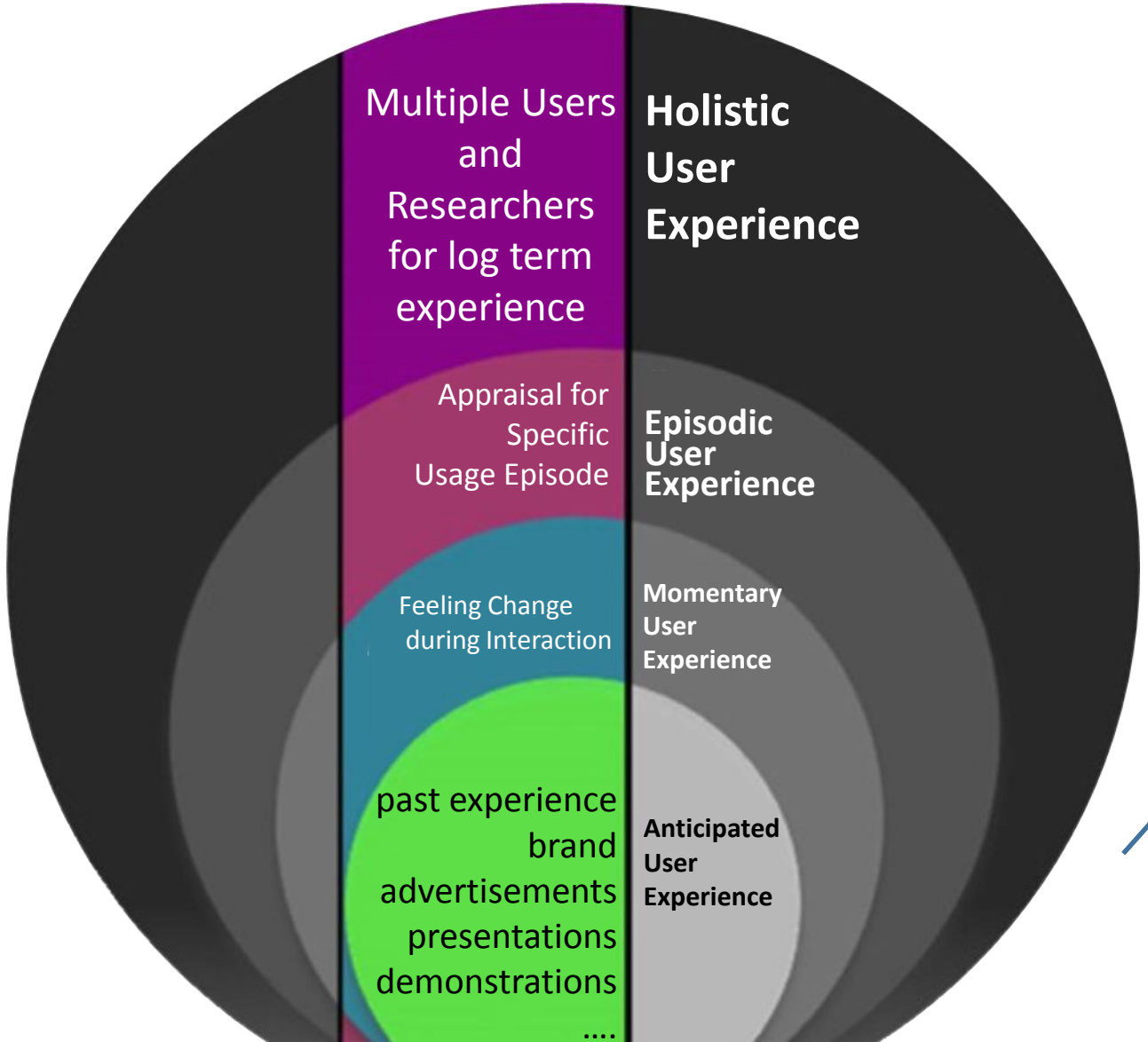
5.3. Mixed methods approach in UX is based on context of use

Context of use

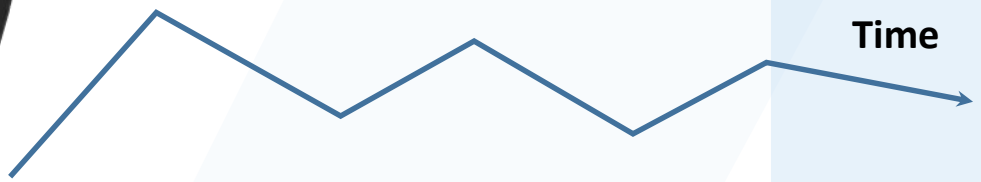
The context of use is a major concern for establishing the requirements for UX evaluation process



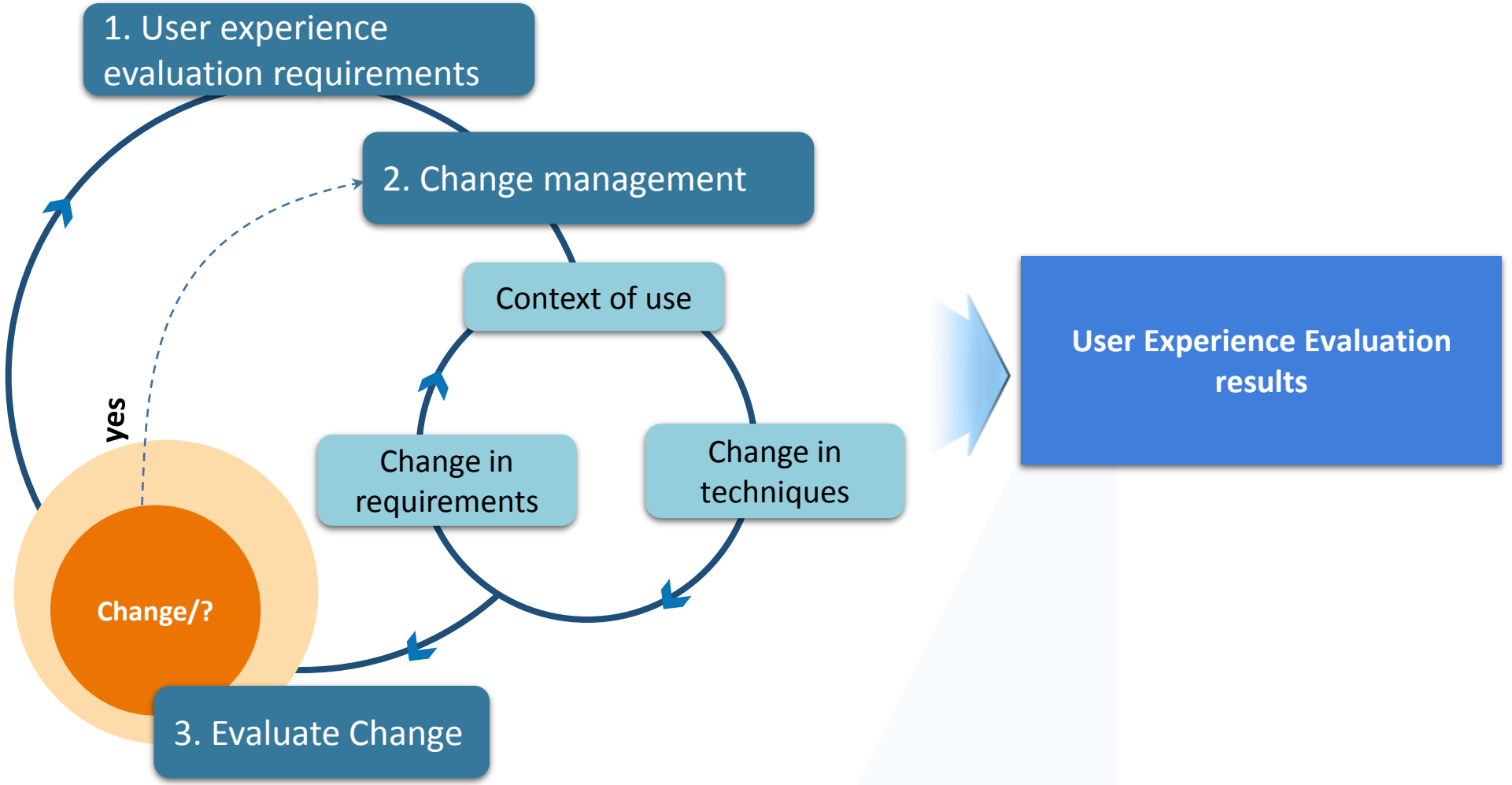
5.4. The evaluation process addresses the holistic user experience



Determine the quality of holistic user experience and the influences that improve user experience over time



5.5. The evaluation process supports change



6.

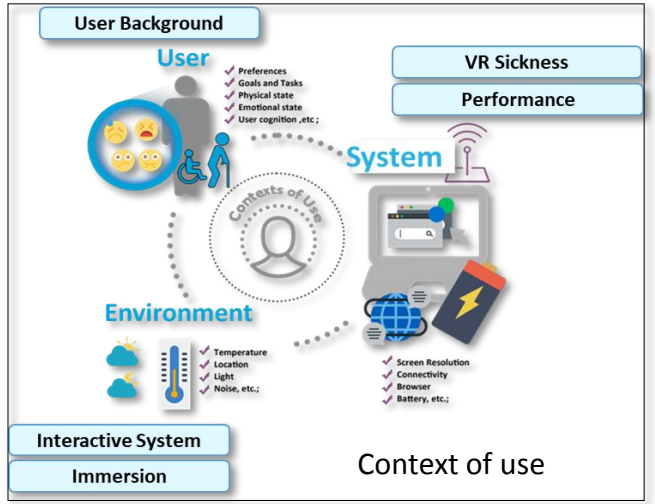
Activities of Mixed methods UX evaluation in AR/VR

Activities of Mixed-methods UX evaluation in AR/VR

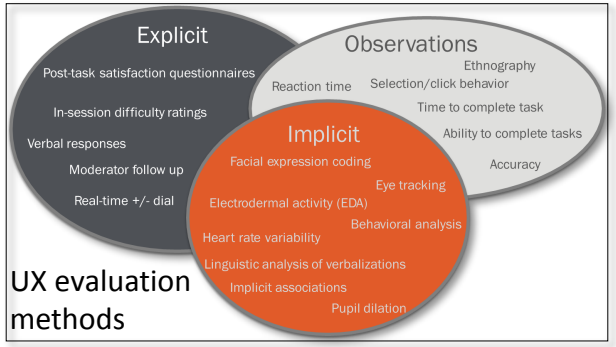
- The proposed process has the following 4 phases:
  - Preparation of the UX evaluation Methods and Techniques
  - Designing the evaluation environment
  - Applying of the user experience evaluation Techniques
  - Evaluating of the user experience evaluation solution
- The proposed process is Iterative
  - each evaluation cycle is one iteration

Activities of Mixed methods user experience evaluation

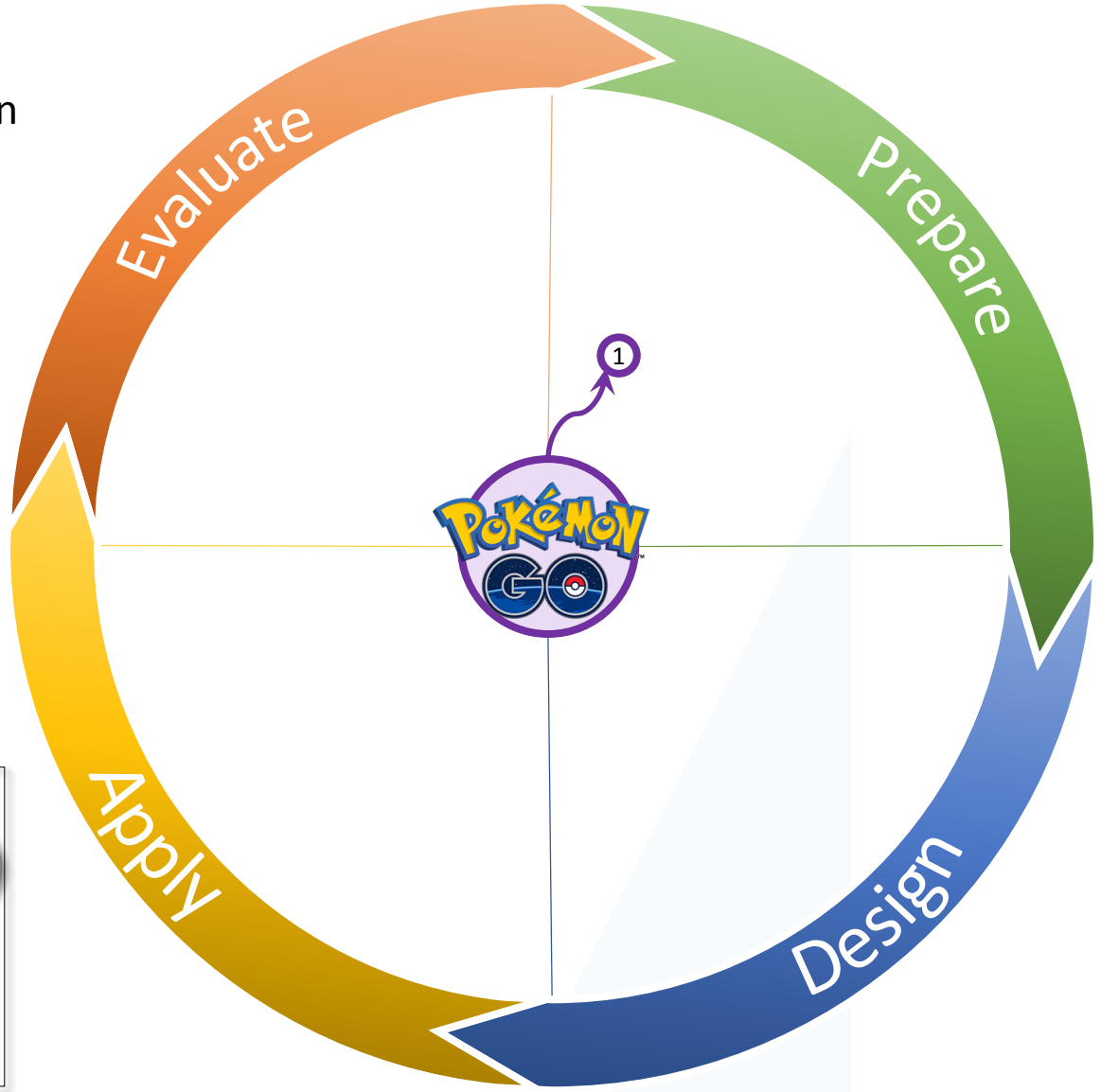
1. Identify the abstract set of UX evaluation methods, in an abstract context of use.



Context of use



UX evaluation methods



Activity

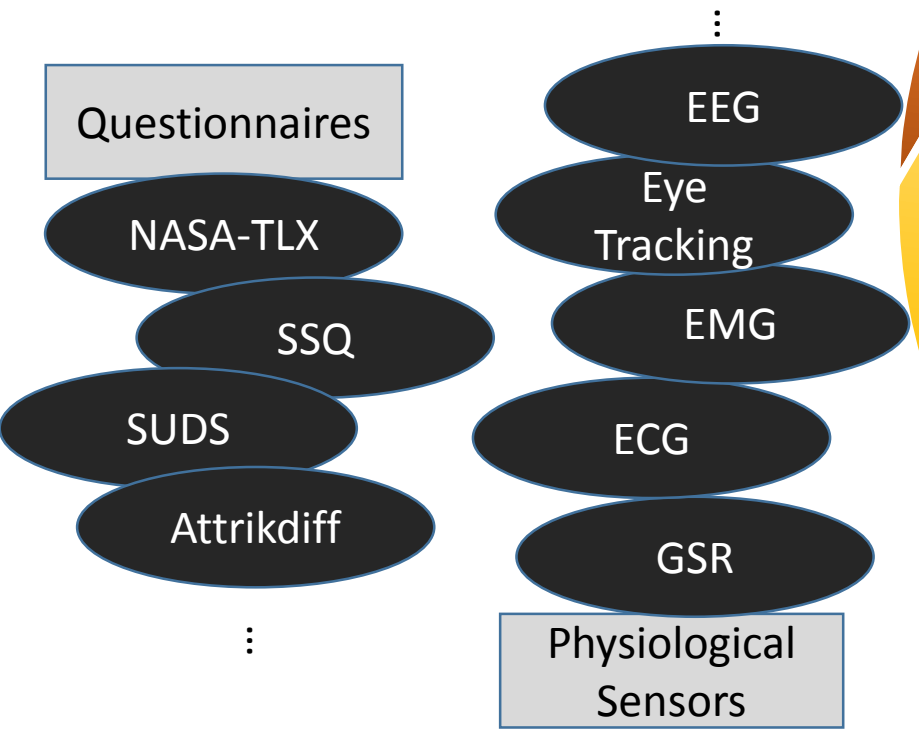
Normal Paths

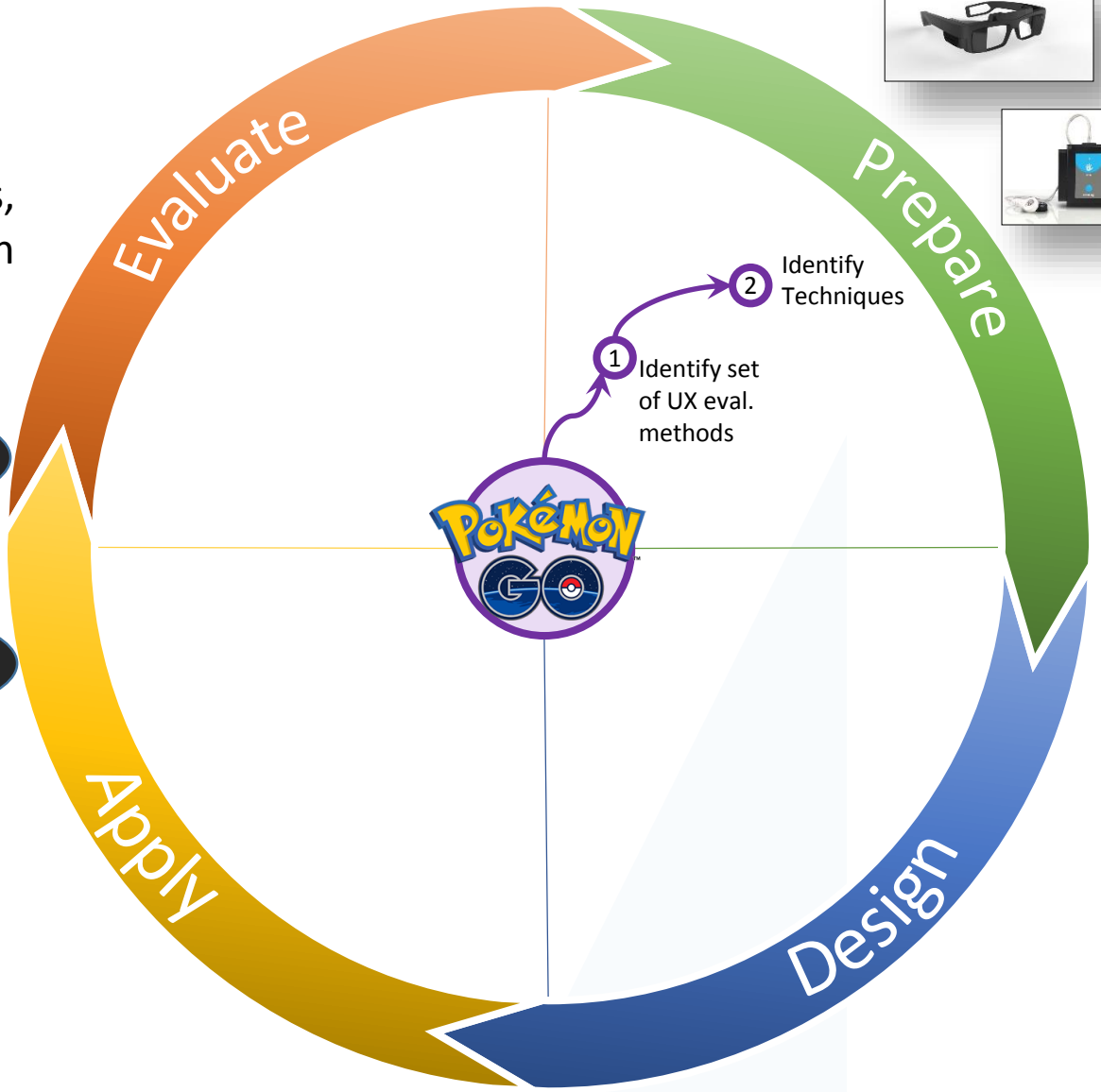
Failure Paths

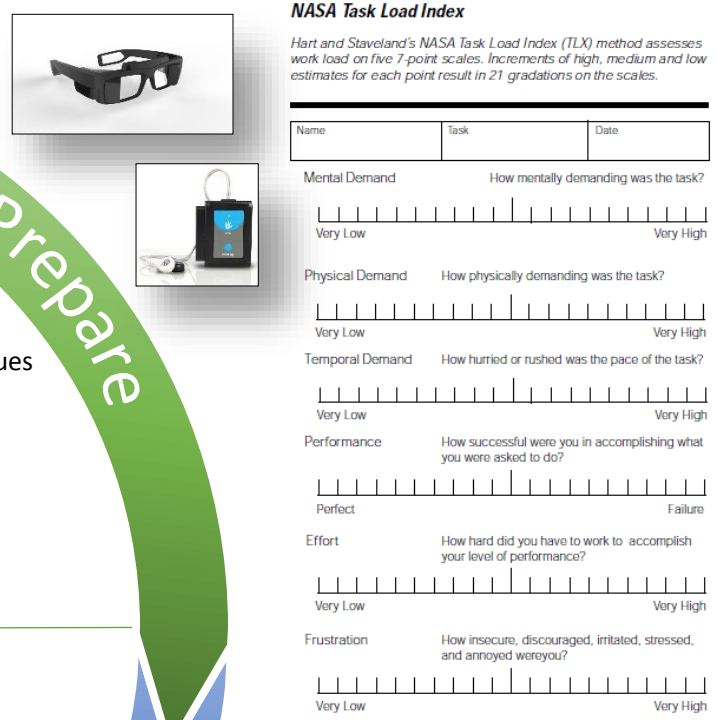
External Paths

Activities of Mixed methods user experience evaluation

2. Identify the UX evaluation techniques, for each method, which can be utilized in an abstract context of use.



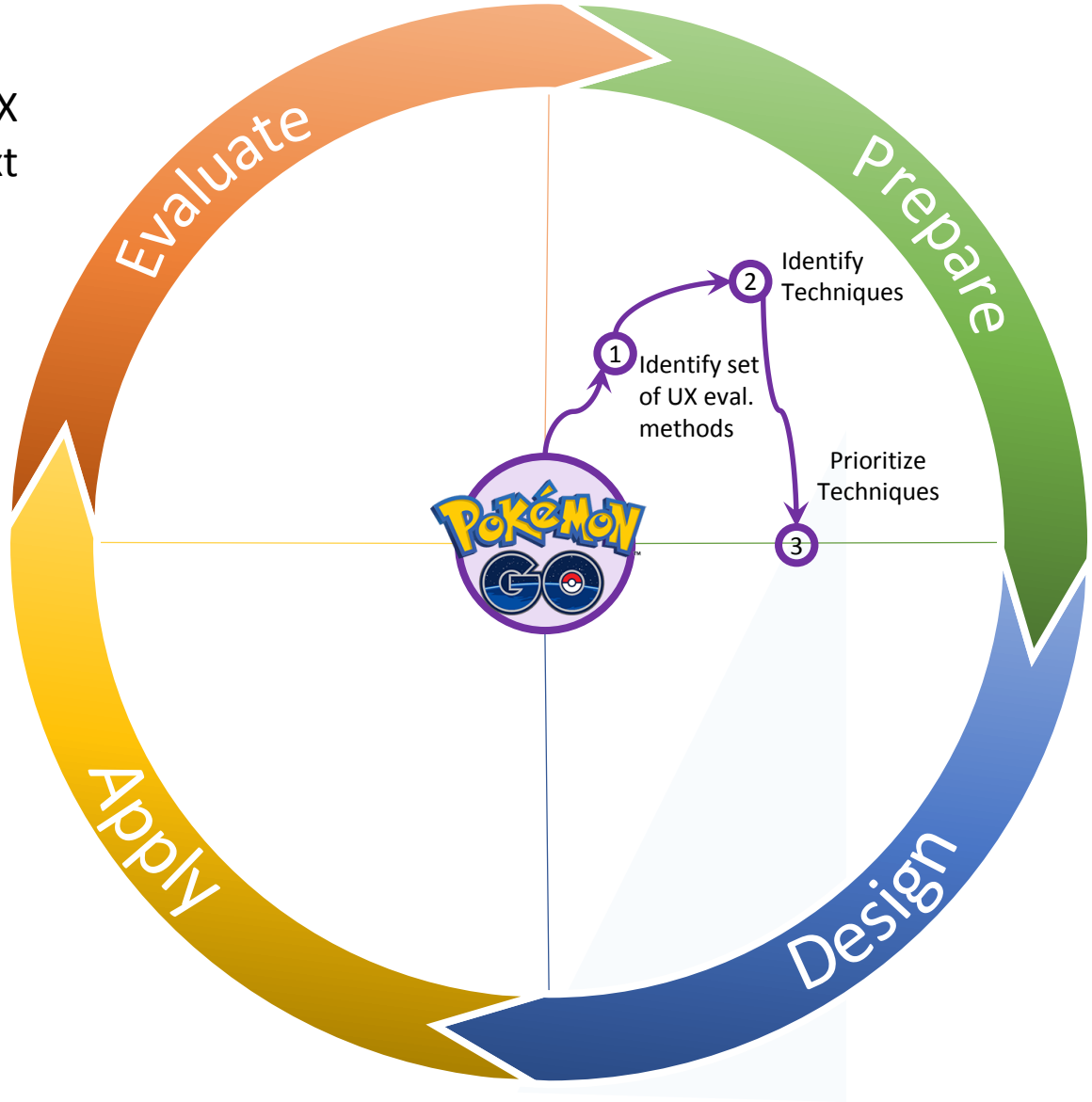




Activities of Mixed methods user experience evaluation

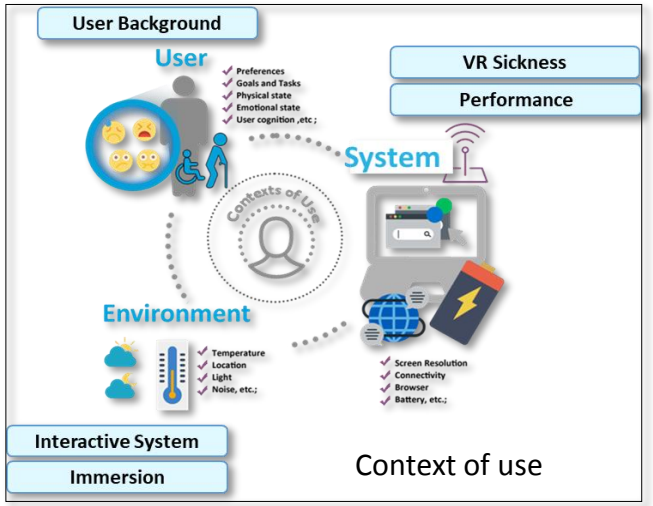
3. Prioritize Techniques, using UX evaluation templates from similar context of use

Questionnaires	Physiological Sensors
1. NASA-TLX	1. EEG
2. SSQ	2. EMG
3. Attrikdiff	3. ECG
⋮	4. GSR
	⋮

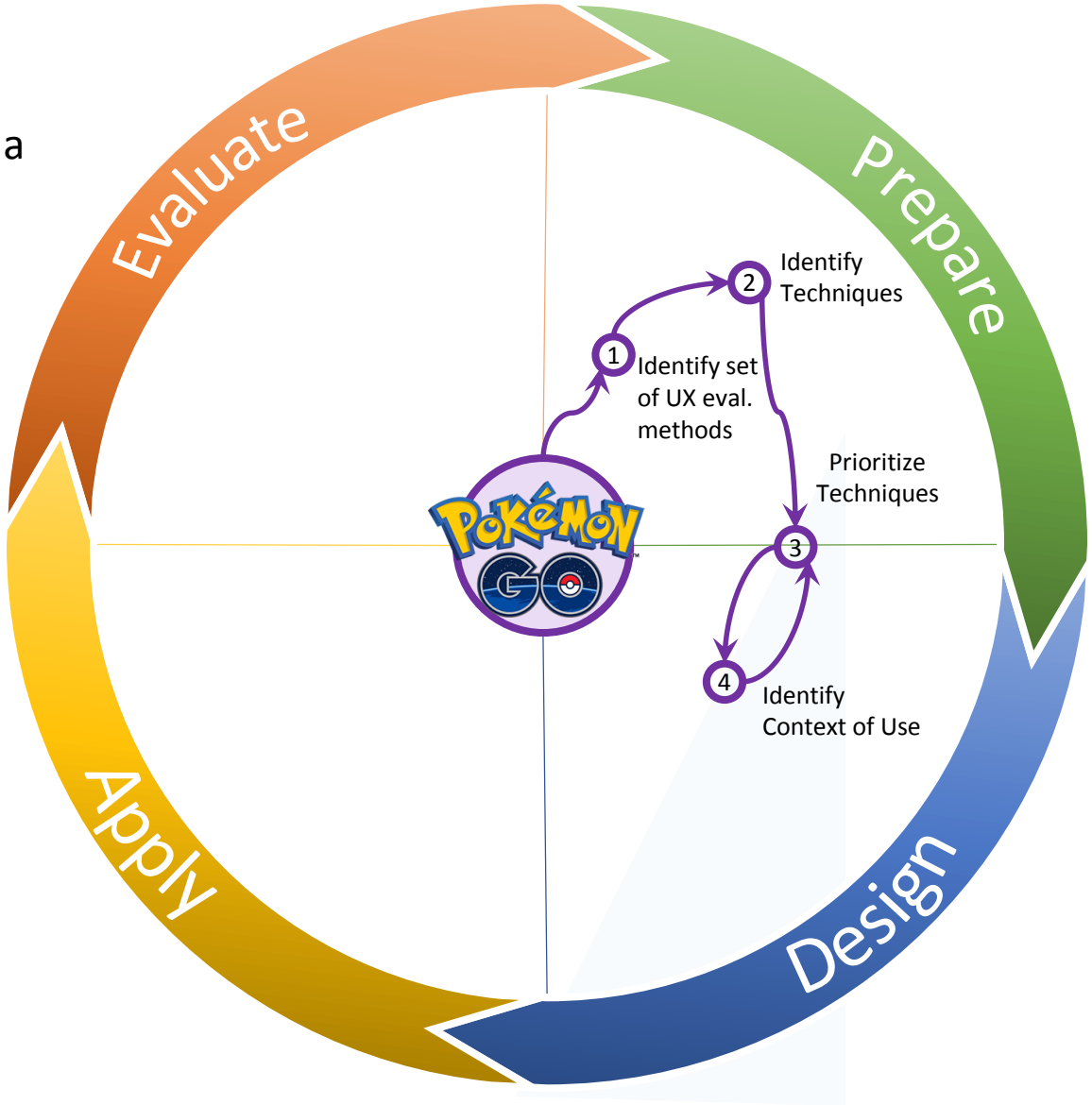


Activities of Mixed methods user experience evaluation

4. Identify the specific context of use
   - Go back to 3, until there is a change in the context of use



Context of use



Activity

Normal Paths

Failure Paths

External Paths

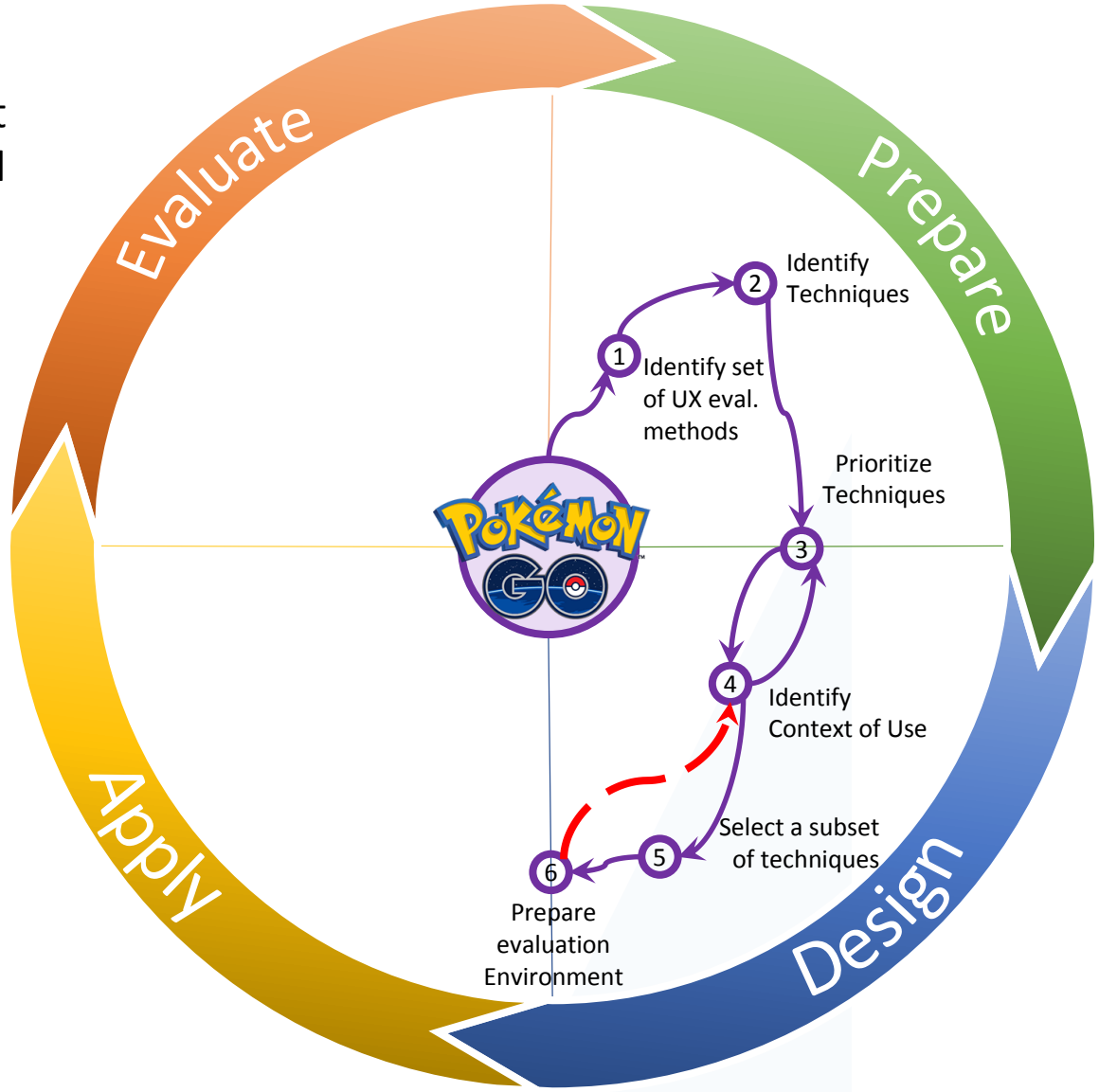
Activities of Mixed methods user experience evaluation

4. Identify the specific context of use
   - Go back to 3, until there is a change in the context of use
   - Move to 5, if the context of use, is not changing any more
5. Select a subset of techniques, based on the most recent technique prioritization and the evaluation planned evaluation environment

Questionnaires	Physiological Sensors
1. NASA-TLX	~~1. EEG~~
~~2. SSQ~~	1. EMG
2. SUDS	2. ECG
3. Attrikdiff	3. GSR
⋮	⋮

Activities of Mixed methods user experience evaluation

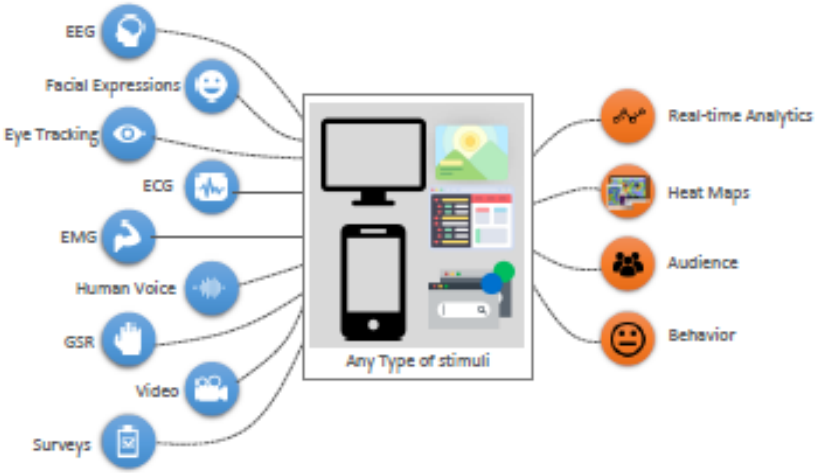
6. Prepare the evaluation environment
- Go to 4, if the environment, does not support the most recent specialized context of use
- Go to 4, if the environment changes

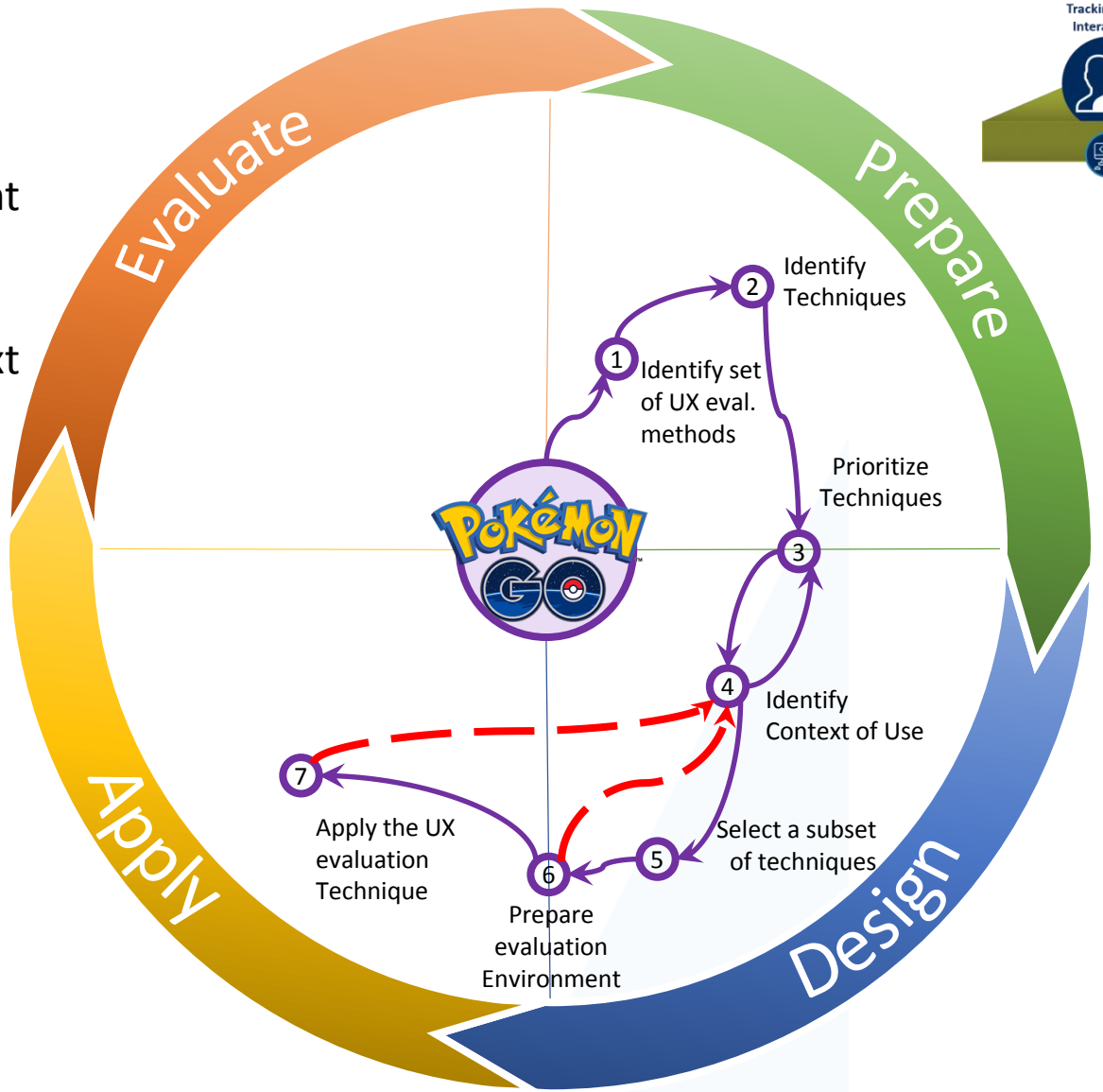


Activities of Mixed methods user experience evaluation

6. Prepare the evaluation environment
- Go to 4, if the environment changes
- Go to 7, if the evaluation environment does not change.

7. Apply the UX evaluation Technique
- Go to 4, if during application the context of use changes

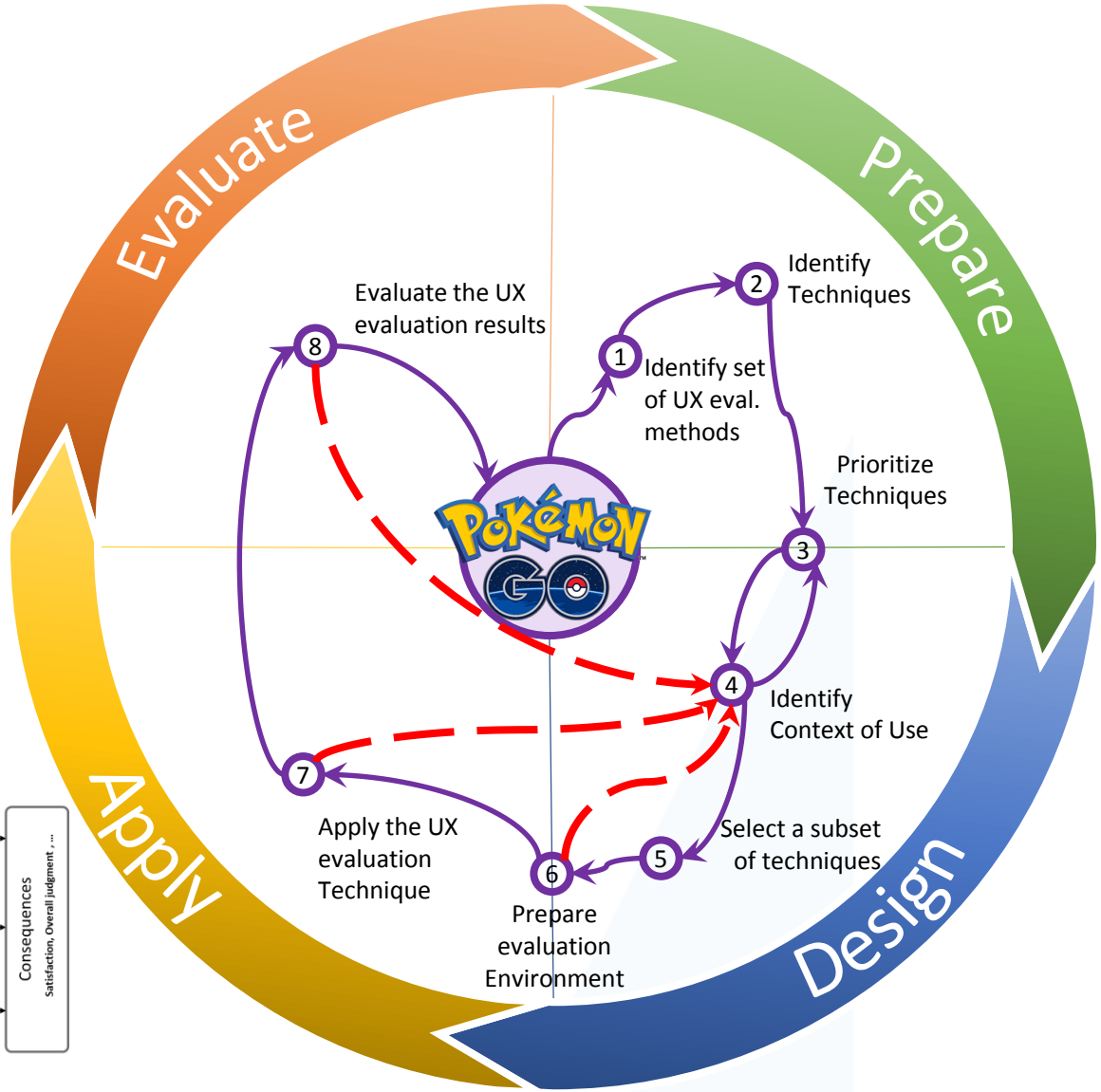


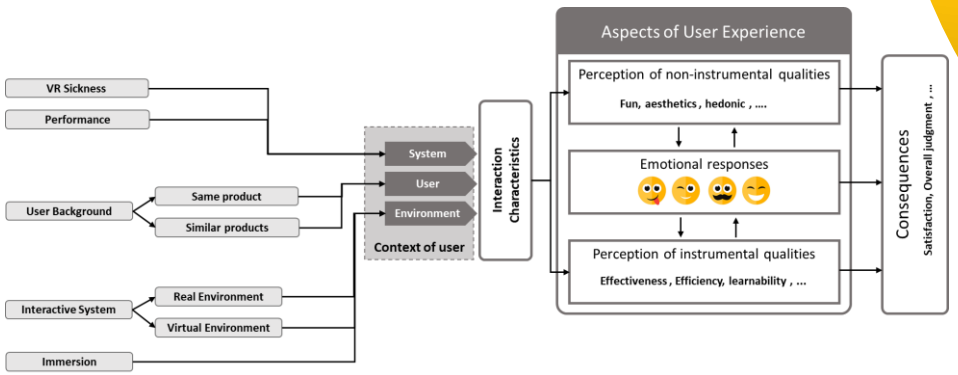


Activities of Mixed methods user experience evaluation

7. Apply the UX evaluation Technique
- Go to 4, if during application the context of use changes
- Go to 8, if there was no change

8. Evaluate the UX evaluation results
- Go to 4, if the evaluation results were not evaluate-able
- Use the UX evaluation feedback

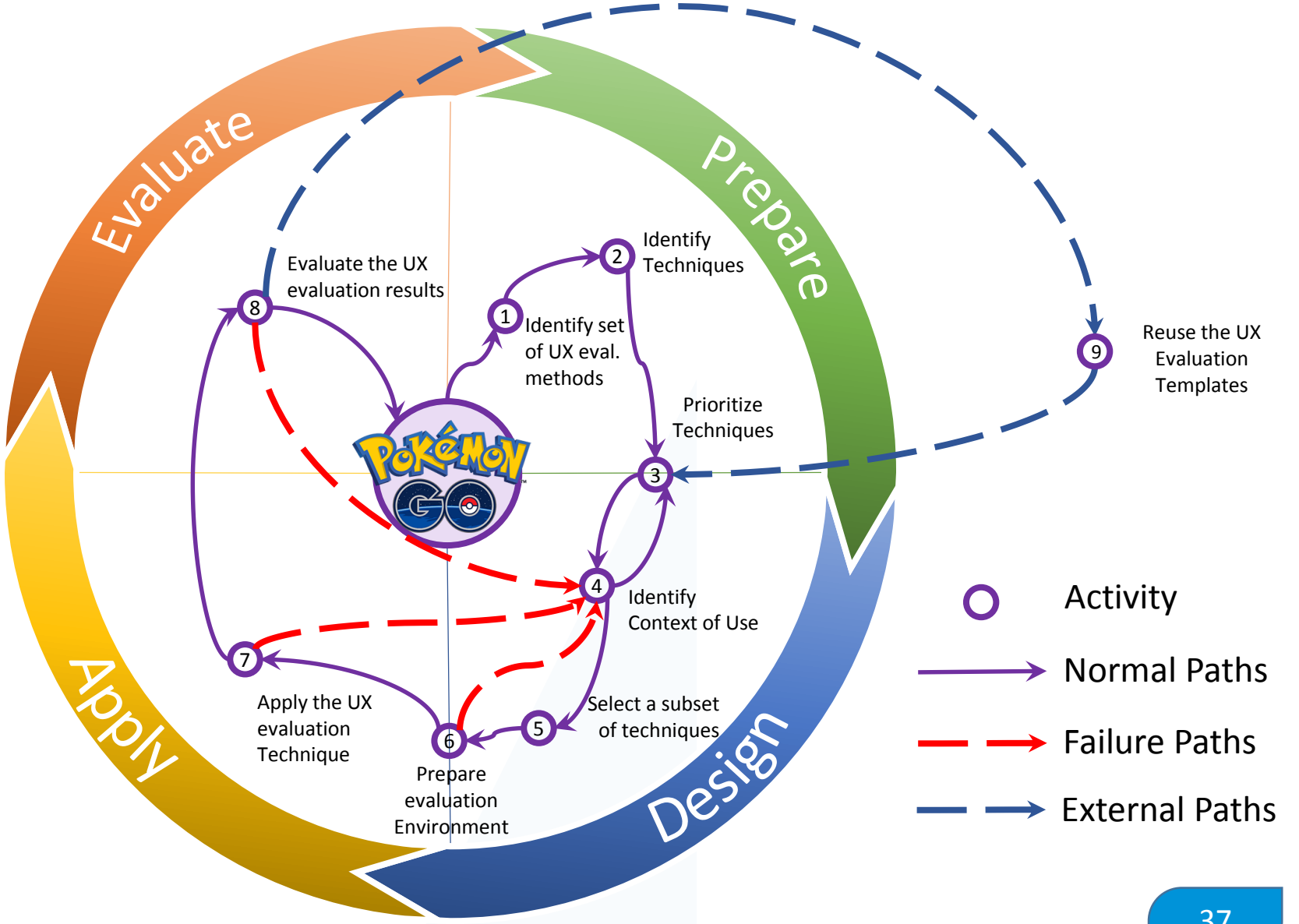




Activities of Mixed methods user experience evaluation

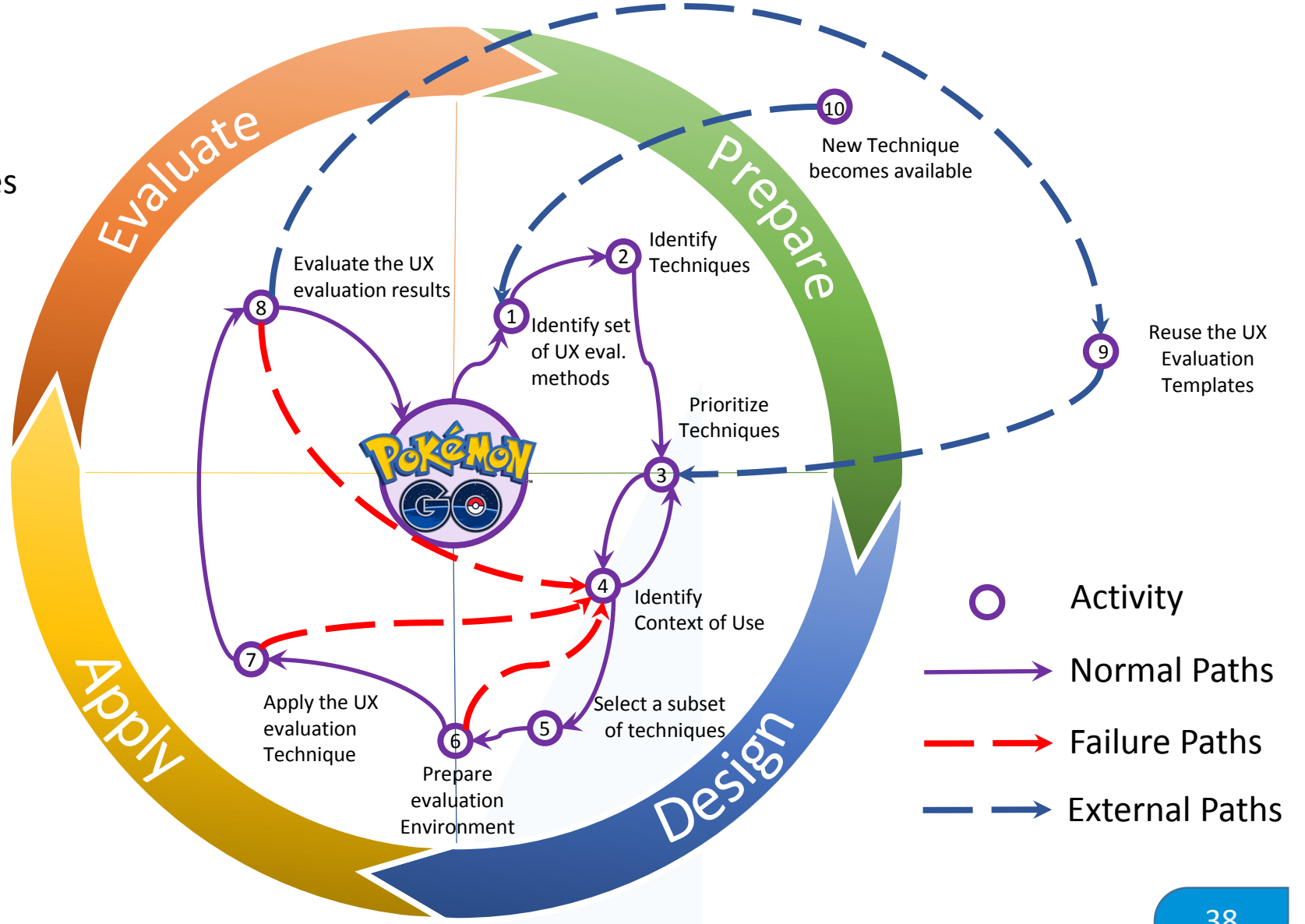
8. Evaluate the UX evaluation results
- Go to 4, if the evaluation results were not evaluate-able
- Use the UX evaluation feedback
- Go to 9, to make the UX evaluation template, reusable

9. Reuse the UX Evolution template at step 3.



Activities of Mixed methods user experience evaluation

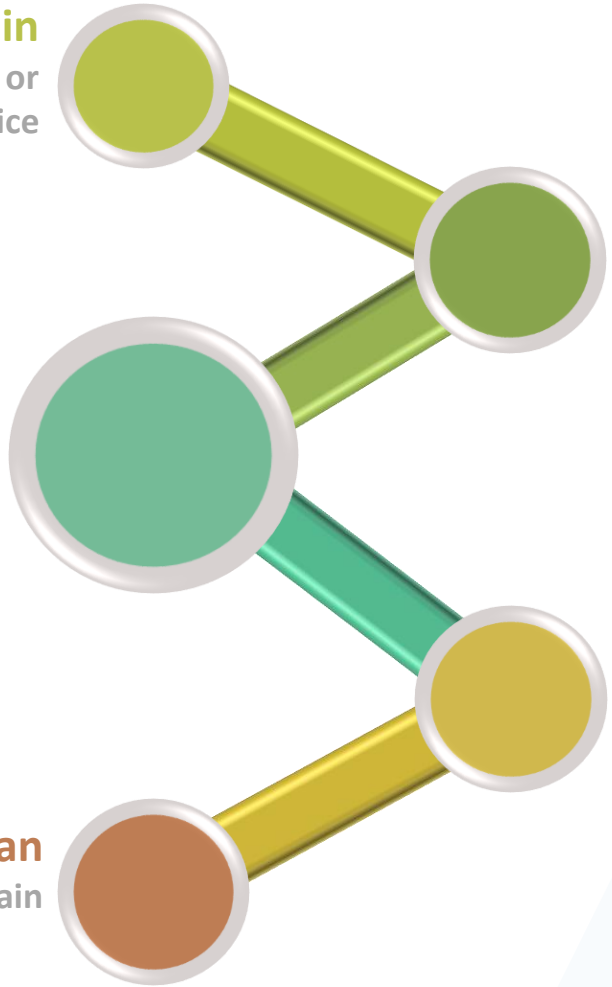
10. When a new technique becomes available, go to 1.



Conclusion

UX for any domain

UX is applicable in any domain for any product or service



Single Method UX Evaluation Approach

Biasness from user and environment may effect the consequences of the UX evaluation process

Mixed Method UX Evaluation Approach

Problems related to single method UX evaluation approach are resolved by this proposed standard

Proposed Standard Applicability

Proposed standard is applicable in any domain

Future Plan

Applying the proposed solution in AR/VR domain

Mixed methods UX Evaluation

Thank You

Activities of Mixed methods user experience evaluation

1.	Identify set of UX eval. methods
2.	Identify Techniques
3.	Prioritize Techniques
4.	Identify Context of Use
5.	Select a subset of techniques
6.	Prepare evaluation Environment
7.	Apply the UX evaluation Technique
8.	Evaluate the UX evaluation results
9.	Reuse the UX Evolution Templates
10.	New Technique becomes available