

Requirements Elicitation in the Design of Technologies for Collaborative Interaction



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Summary & Learning goals

Requirements elicitation is about exploring the problem space and defining what technology for collaborative interaction will be developed.

Requirements range from functional to contextual such as e.g. social, environment and user goals.

Methods for gathering and analyzing data to elicit requirements in the design of technologies for collaborative interaction will be presented.

Students should be able to:

- name methods for requirements elicitation and qualitative data analysis in the design of technology for collaborative interaction.
- formulate requirements in design of technology for collaborative interaction.
- apply requirement elicitation in design of technologies for collaborative interaction.
- evaluate requirements in the design of technologies for collaborative interaction.

Recommended readings

- Braun V. & Clarke V. (2006) Using thematic analysis in psychology, *Qualitative Research in Psychology*, 3:2, 77-101
- Schmidt K. & Rodden T. 1996. Chapter 11: Putting it all together: Requirements for a CSCW platform. Elsevier. [https://doi.org/10.1016/s0923-8433\(96\)80013-x](https://doi.org/10.1016/s0923-8433(96)80013-x)
- Didar Zowghi and Chad Coulin. 2005. Requirements elicitation: A survey of techniques, approaches, and tools. In *Engineering and managing software requirements*. Springer, 19-46. <https://link.springer.com/content/pdf/10.1007/3-540-28244-0.pdf>

Content / Outline

- What is a design requirement?
- What is design requirements elicitation?
- Why requirements?
- Data analysis
- Types of requirements
- How to formulate requirements?
- Summary
- References

What is a design requirement?

- A statement about an intended product that specifies what it is expected to do or how it will perform.

Bad example:

- The collaborative system must be user friendly.
 - How do we measure user friendly?

Good example:

- The collaborative user interface shall be menu driven. It shall provide dialog boxes, help screens, radio buttons, and dropdown menu for user inputs.

What is a design requirement? Examples

The **teapot** shall:

- Be able to contain liquid.
- Be able to contain more than 5dl.
- Have a handle that never exceeds 37 degrees.
- Be aesthetically attractive for people 25 years.
- Be affordable for students.

The **online wiki** shall:

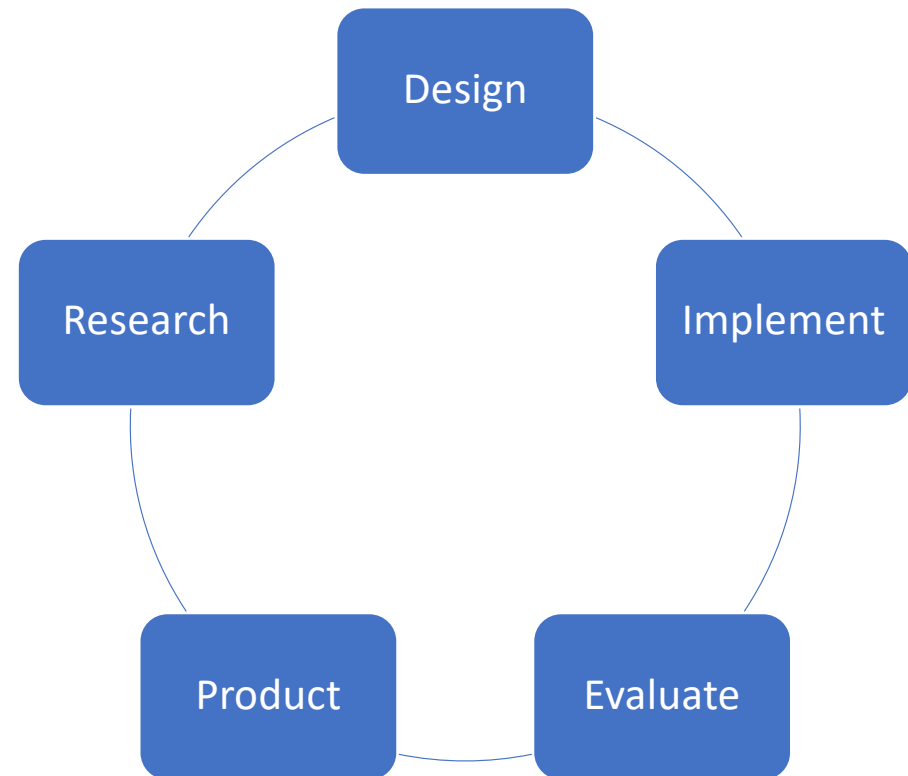
- Provide a login for users
- Allow users to edit and upload content
- Highlight changes in content
- Inform who the author is
- Notify editor about edited content
- Allow editor to approve or reject edited content and publish online
- Be accessible on any platform
- Provide the ability to adjust font size (e.g., small, medium, large) to help users with impaired vision

What is design requirements elicitation?

- Requirements elicitation is concerned with understanding the needs of users and stakeholders
 - ultimate aim of communicating needs to developers
- Requirements are **elicited** rather than just captured or collected.
 - Implies elements of seeking, uncovering, discovery, acquiring, emergence, and development in the elicitation process.
- Requirements are spread across many sources
 - the problem owners, the stakeholders, documentation, field notes, transcripts, other existing products, etc.
- Getting the right requirements is considered a vital but difficult part of design projects

What is design requirements elicitation?

- Requirements elicitation
 - In all parts of the design process.
 - Ensure that the lessons learned feed into each other.
 - Repeatedly revisited.
 - Iterate! Iterate!
- Make requirements explicit
 - Avoid losing key requirements in iterations
 - Both technical and social!



What is design requirements elicitation?

- You are likely to get more requirements than expected.
 - More is better than less, initially.
- Elicitation process include:
 - Communication
 - Prioritization
 - Negotiation
 - Collaboration
 - Validation

What is design requirements elicitation?

- Understanding the Application Domain by real world investigations
- Identifying the Sources of Requirements
 - Stakeholders, users, organization, documentation, context
- Analyzing the Stakeholders
- Selecting and combining the Techniques, Approaches, and Tools to Use
- Eliciting the Requirements from Stakeholders and Other Sources
 - establish the scope for the system, investigate the needs and wants of the stakeholders in order to satisfy the major objectives and address the key problems.

Why design requirements?

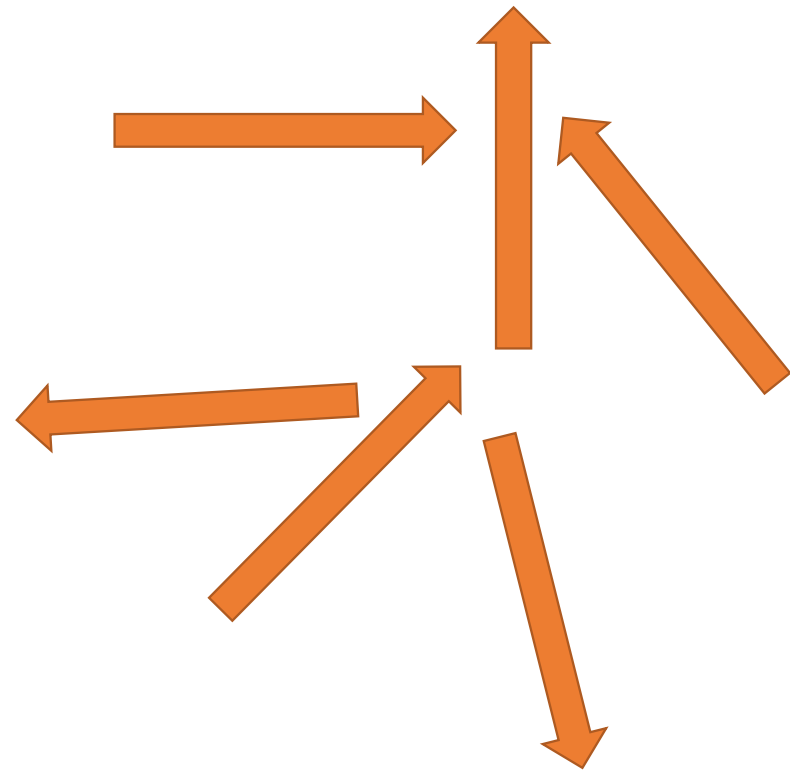
- Human activity is highly flexible, nuanced, and contextualized
 - Systems need to be similarly flexible, nuanced, and contextualized in e.g.
 - information sharing,
 - roles,
 - social norms
- There is a gap between the social requirements of systems and its technical mechanisms.
- The **social-technical gap** is the divide between what we know we must support socially and what we can support technically.

Why design requirements? Challenges for collaborative technologies

- Systems do not adequately support:
 - fluent transitions between formal and informal interaction
 - interweaving of individual and cooperative interactions that characterizes everyday practice
- Social requirements:
 - The membership of cooperative groups is not stable and often even nondeterminable.
 - Interaction changes dynamically with constraints of a situation.
- We need to formulate better social requirements

Why design requirements?

- Exploring the problem space and defining what will be developed.
- Requirements clarify direction for building a product
- Without requirements, the product team can head in different directions!



Stakeholder Requirements Definition Process of ISO/IEC 15288

“The purpose of the Stakeholder Requirements Definition Process is to define the requirements for a system that can provide the services needed by users and other stakeholders in a defined environment.

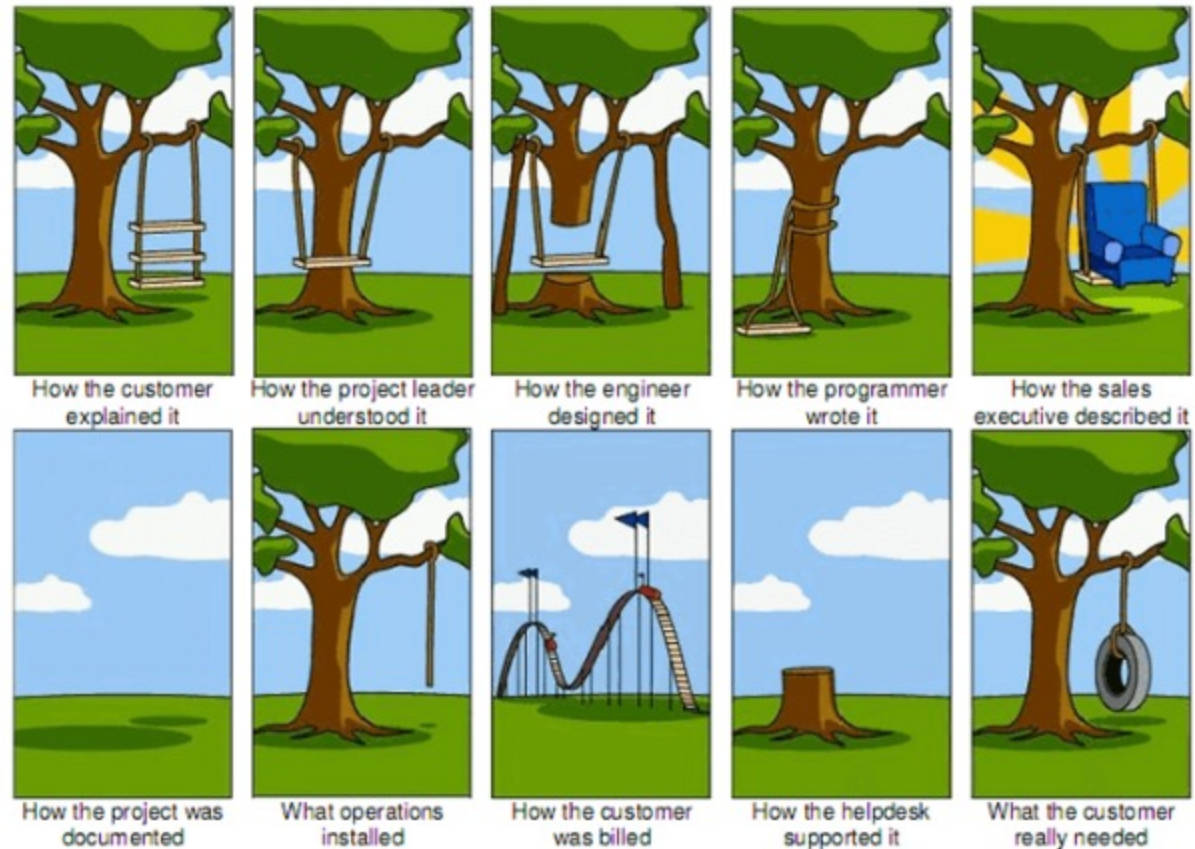
It identifies stakeholders, or stakeholder classes, involved with the system throughout its life cycle, and their needs and desires.

It analyzes and transforms these into a common set of stakeholder requirements that express the intended interaction the system will have with its operational environment and that are the reference against which each resulting operational service is validated in order to confirm that the system fulfils needs.”

Ref: <https://www.iso.org/standard/63711.html>

Why design requirements?

- Requirements
 - supports technical developers
 - allows users to contribute
 - keeps design process on track
- Miscommunication is more likely if requirements are not clearly articulated.



Tree swing cartoon – original source unknown:
https://en.wikipedia.org/wiki/Tree_swing_cartoon

Why design requirements? Consequences of unclear requirements



Shopping system – bad consequence means less profit



Air traffic control system – bad consequence means death

Data analysis: Examples of approaches and tools

- Data analysis depends on the data
 - Is transcription necessary?
- Quantitative:
 - Percentages and averages, mean, median, R (statistics)
- Qualitative
 - inductive (extracted from the data)
 - deductive (pre-existing concepts)

Tools for data analysis:

- Quantitative data
 - Spreadsheet — basic graphs
 - Statistical packages: SAS and SPSS
- Qualitative data
 - Categorization and theme-based analysis
 - Quantitative analysis of text-based data
 - Nvivo and Dedoose

Data analysis: Qualitative method examples

- Conversation analysis
 - How conversations are conducted
- Discourse analysis
 - How words are used to convey meaning
- Content analysis
 - How often something is featured or is spoken about
- Interaction analysis
 - Verbal and non-verbal interactions between people and artifacts
- Grounded theory
 - Constructing a theory around the phenomenon of interest
- Systems-based frameworks
 - Large-scale involving people and technology, such as a hospital or airport
- User research generates masses of qualitative data in the form of transcripts and observations that can be summarized and made actionable through analysis to identify the main findings.

Data analysis: Thematic analysis

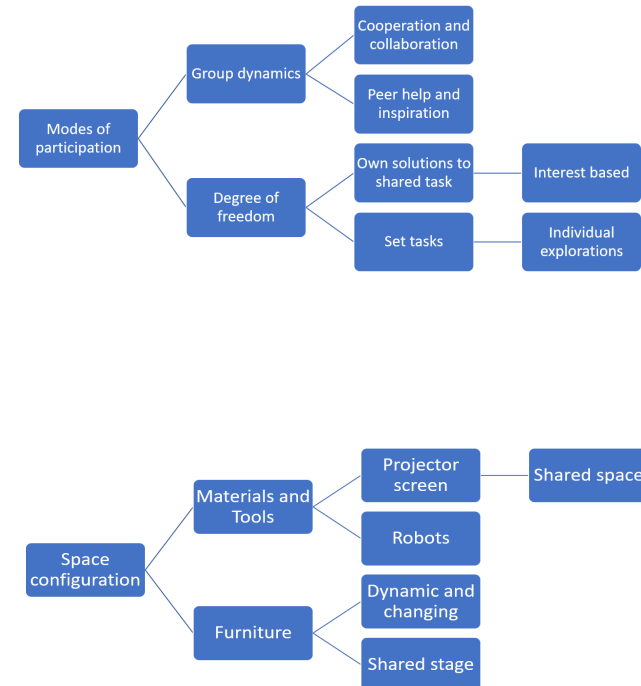
Commonly used method in interaction design, and suitable for collaborative technologies

Procedure:

1. Familiarization with the data
2. Generate initial codes
3. Combine codes in overarching themes
4. Review themes
5. Define and name each theme
6. Write up conclusion

Ref: Braun & Clark (2006)

Example of thematic map:
Parts of a thematic analysis of programming workshops

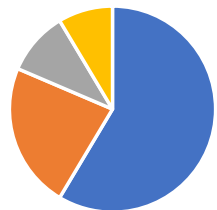


Tip! Video on how to do thematic analysis:
<https://www.youtube.com/watch/KUZ6iGvJIGI>
By NN/g Nielsen Norman Group

Data analysis - What to do with the results?

Present findings as visualizations, diagrams, reports, etc,or...Elicit requirements from data!

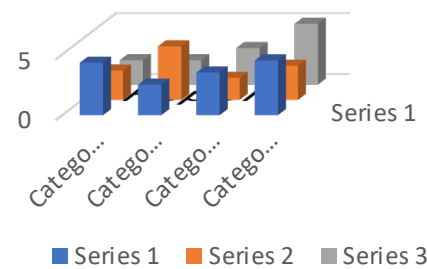
Results



■ 1st Qtr ■ 2nd Qtr
■ 3rd Qtr ■ 4th Qtr

Report

Chart



How to formulate requirements

- Need - The requirement is Necessary
 - What would happen if you didn't include this requirement?
- Verifiable – The requirement is Verifiable
 - Evaluation – criteria of acceptance - How will you know you have met the requirement?
- Clear and concise
 - 30-50 words, unambiguos, easy language.
 - Requirements use **shall**.
 - (Statements of fact use *will*, Goals use *should*).
 - Avoid *are, is, was, etc, and/or*.
- Complete - Contain all information and measures.
- Consistent - same terminology.
- Viable and attainable - Budget, schedule, skills.

Bad requirement:

- The product shall last over time.
 - How long is time? 1 day or 100 years? How much use?

Good requirement:

- The product shall last for ten years of daily domestic use.
 - Example: IKEA kitchen & bed guarantee

Basic rule: avoid HOW (to implement) and WHY (it is needed)

How to formulate requirements: MoSCoW

prioritization technique to reach a common understanding on the importance of requirements

- **M** - Must have this requirement to meet the business needs
- **S** - Should have this requirement if possible, but project success does not rely on it
- **C** - Could have this requirement if it does not affect anything else on the project
- **W** - Won't be this time, but would like to have this requirement later

MUST HAVE Things you can't live without
SHOULD HAVE Things considered important, not vital
COULD HAVE Good to have
WON'T HAVE Little to no value

About MoSCoW, e.g.:

<https://www.projectsmart.co.uk/moscow-method.php>

Types of requirements

Functional requirements

- what the product will do

- Example:
 - System: Verification email shall be sent to user whenever he/she registers for the first time on some software system.
 - Webform: shall provide a way to recover or reset a lost password
 - Milk carton: Shall have the ability to contain fluid without leaking.
 - Cup: Shall have the ability to contain tea or coffee without leaking.
- It is mandatory to meet these requirements.

Nonfunctional requirements

- the characteristics of the product, how it works.

- Example:
 - System: Emails shall be sent with a latency of no greater than 2 hours.
 - Webform: form fields and error messages shall support assistive devices such as text-to-speech readers
 - Milk carton: Shall not break under pressure of its own weight.
 - Cup: Shall contain hot liquid without heating up to more than 45°C.
- It is not mandatory to meet these requirements.
 - Failing to meet non-functional requirements can result in systems that fail to satisfy user needs.

Interaction design involves understanding both functional and nonfunctional requirements.

Types of requirements

User requirements

- **User characteristics**
 - Key attributes of users
 - abilities and skills, educational background, preferences, personal circumstances, physical or mental disabilities, etc.
 - User as novice, expert, casual user, frequent user:
 - novice - step-by-step guidance.
 - expert - flexible interaction with more wide-ranging powers of control.
 - Accessibility
 - Available to anyone, restricted access
- **Usability goals**
 - agreed upon early in the development process
 - used to track progress
 - Easy to use, intuitive, easy to learn, require training
- **User experience goals**
 - harder to identify quantifiable measures
 - Appealing, fun to use

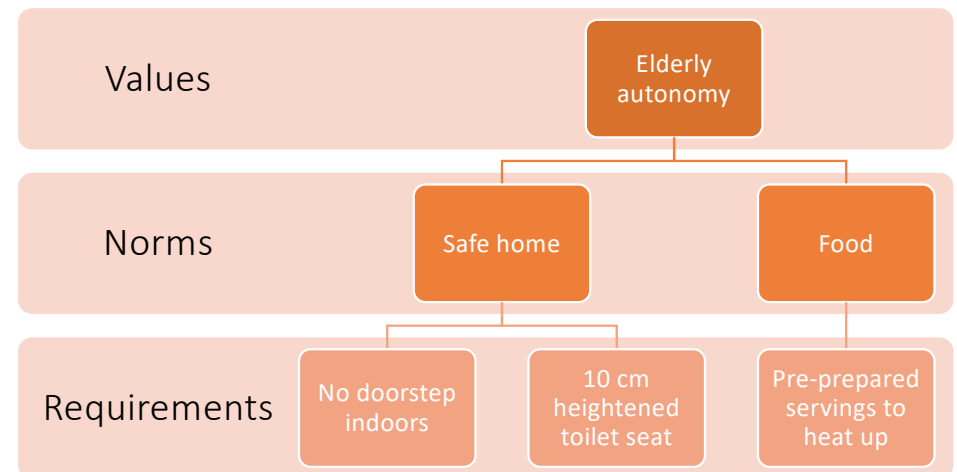
Environmental requirements, or context of use

- **Physical environment,**
 - Amount of lighting, noise, movement, and dust, etc.
 - Will users need to wear protective clothing, such as gloves?
 - Example: ATM
 - public context - speech interface is problematic.
- **Social environment,**
 - Collaboration and coordination .
 - Will data need to be shared?
 - Synchronous or asynchronous?
 - Co-located or distributed?
- **Organizational environment,**
 - user support
 - resources for training
 - communications infrastructure
- **Technical environment**
 - what technologies will the product run on or need to be compatible with?
 - Technological limitations?

Types of requirements: Values-based

Requirements can be elicited from values
(of project, stakeholders, etc)

Values-based requirements for elderly autonomy at home:



Types of requirements: Values-based

Requirements can be elicited from values (of project, stakeholders, etc)

How to:

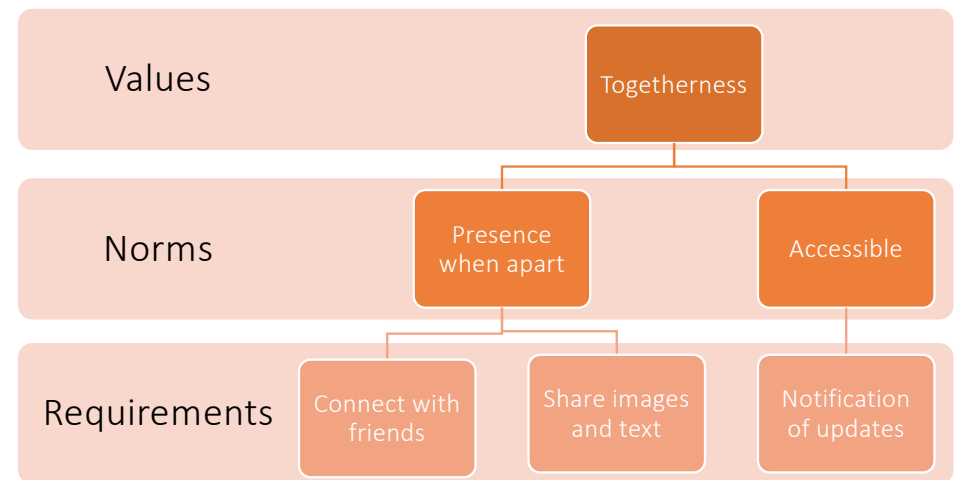
STEP 1: Analyse a project value and construct one or more design norms

- Norms refer to properties, attributes or capabilities that the product, system or service should possess. Such norms may include striving to e.g. “maximize safety” or “minimize costs” without a specific target.
 - Example: When designing a social media service the value “togetherness” can become the norm “presence when apart”.

STEP 2: Construct specific design requirements.

- The second step is to turn the norms into more specific targets, here referred to as specific design requirements. The requirement should be more specific with respect to A) the scope of applicability of the objective, B) the goals or aims strived for, and C) the actions or means to achieve these aims.
 - Example: When designing a social media service, the norm “presence when apart” can be translated into the requirements “connect with friends”, “share images and text”, etc.

Values-based requirements for a social media service:



Summary

- Data analysis is essential
- Method of data analysis depends on the data gathering method
- Requirements is the link between stakeholder data and the design
- Requirements can be values-based, functional or non-functional
- Requirements can be prioritized by MoSCoW
- Well-stated requirements has the following attributes:
 - The requirement is Necessary
 - The requirement is Verifiable
 - The requirement is Attainable
- Requirements are concise and unambiguous
- Good requirements are solution-neutral
- What...not how
- Requirements use 'shall'
- **Requirements outcome:**
 - Specified characteristics and context of use
 - Defined constraints on a solution
 - Traceability of stakeholder requirements to stakeholders and their needs
 - Defined basis for validation

References

- Braun V. & Clarke V. (2006) Using thematic analysis in psychology, *Qualitative Research in Psychology*, 3:2, 77-101
- Sharp, Preece, & Rogers. 2019. *Interaction Design: Beyond Human-Computer Interaction*. John Wiley & Sons. ISBN: 111954730X, 9781119547303
- van de Poel I. (2013) Translating Values into Design Requirements. In: Michelfelder D., McCarthy N., Goldberg D. (eds) *Philosophy and Engineering: Reflections on Practice, Principles and Process*. *Philosophy of Engineering and Technology*, vol 15. Springer, Dordrecht. https://doi.org/10.1007/978-94-007-7762-0_20
- Schmidt K. & Rodden T. 1996. Chapter 11: Putting it all together: Requirements for a CSCW platform. Elsevier. [https://doi.org/10.1016/s0923-8433\(96\)80013-x](https://doi.org/10.1016/s0923-8433(96)80013-x)
- Ackerman, M. S. (2000). The Intellectual Challenge of CSCW: The Gap Between Social Requirements and Technical Feasibility. In *Human-Computer Interaction* (Vol. 15, Issues 2–3, pp. 179–203). Informa UK Limited. https://doi.org/10.1207/s15327051hci1523_5
- About MoSCoW
 - <https://www.projectsmart.co.uk/moscow-method.php>
- About user requirements:
 - <http://www.projectsmart.com/project-management/getting-realistic-user-requirements.php>



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