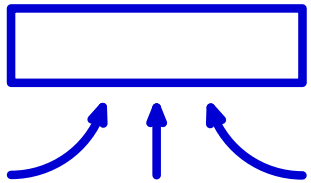
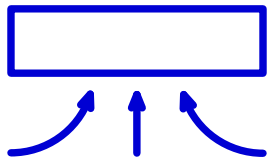
Requirements Engineering I

Chapter 11

# RE Support and Guidance



# Chapter roadmap



**11.1** RE tools

The little helpers

**11.2** RE Standards

Are they known, used and useful?

**11.3** RE syllabi and body of knowledge

Standardizing RE knowledge and skills

**11.4** AI for RE

Harnessing AI for RE

**11.5** Requirements Engineering Ethics

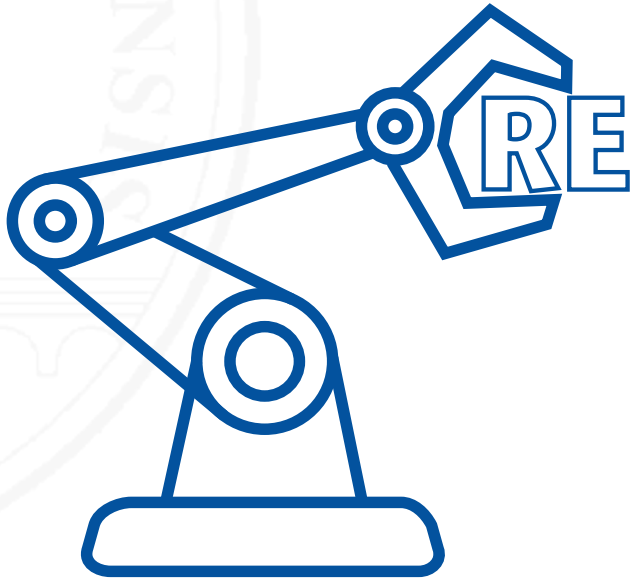
Ethic principles and dimensions mapped to RE

# 11.1 Requirements engineering tools

[Carrillo de Gea et al. 2011]

What can be supported by a RE tool?

- Elicitation (e.g., analysis of textual artifacts)
- Documentation (generating and editing requirements work products)
- Modeling (primarily model editors)
- Management (Store and retrieve, prioritize, trace,...)
- Validation (finding quality problems, simulators, model checkers,...)



# Support levels for RE tools

- General purpose
  - Word processors
  - Spreadsheet tools
  - General purpose graphic drawing tools
- Database-level
  - Requirements management tools for organizing, storing, retrieving and tracing requirements
- Language & method-based
  - Tools supporting specific requirements languages, e.g., drawing state machine diagrams
  - Tools for supporting specific methods, e.g., validation with model-checking, or checking a document for compliance

# Which RE tool should I use / buy?

[Bruckhaus, Madhavji, Janssen, Henshaw 1996]

- No general recommendation possible
- Depends on what the tool(s) shall support
- An RE tool does not automatically improve productivity
- An up-to-date list of requirements tools is maintained at the VOLERE website:

  https://www.volere.org/requirements-tools/

# 11.2 RE Standards

IEEE 830-1984 IEEE Guide to Software Requirements Specifications

- The first RE standard – very good by its time
- Revised 1993 and 1998
- IEEE 830-1998 is officially retired, but still in use, in particular for documenting requirements

ISO/IEC/IEEE 29148, originally from 2011, revised 2018

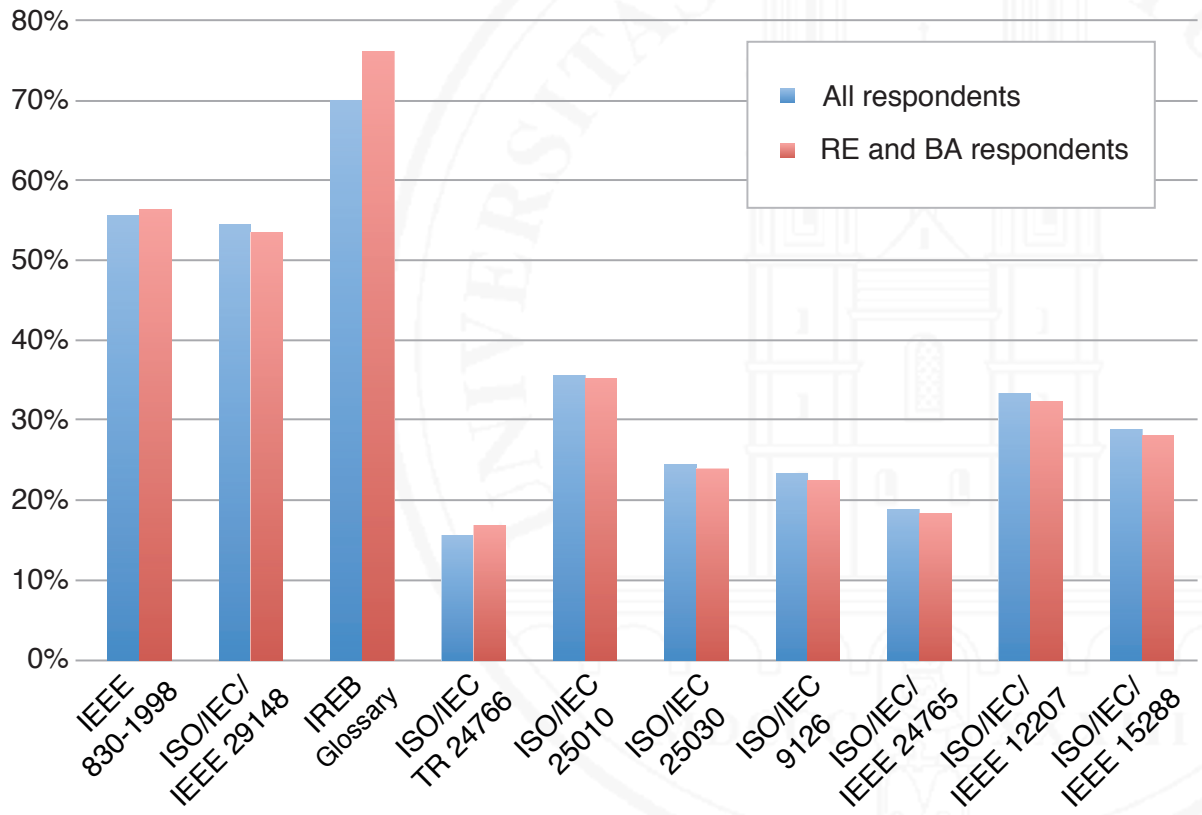
- A very heavyweight, document- and process-centric standard
- Does not work well for participative and lightweight RE processes

[IEEE 1998]
[ISO/IEC/IEEE 2018]

# Knowledge and use of RE-related standards

[Franch, Glinz, Méndez and Seyff 2022]

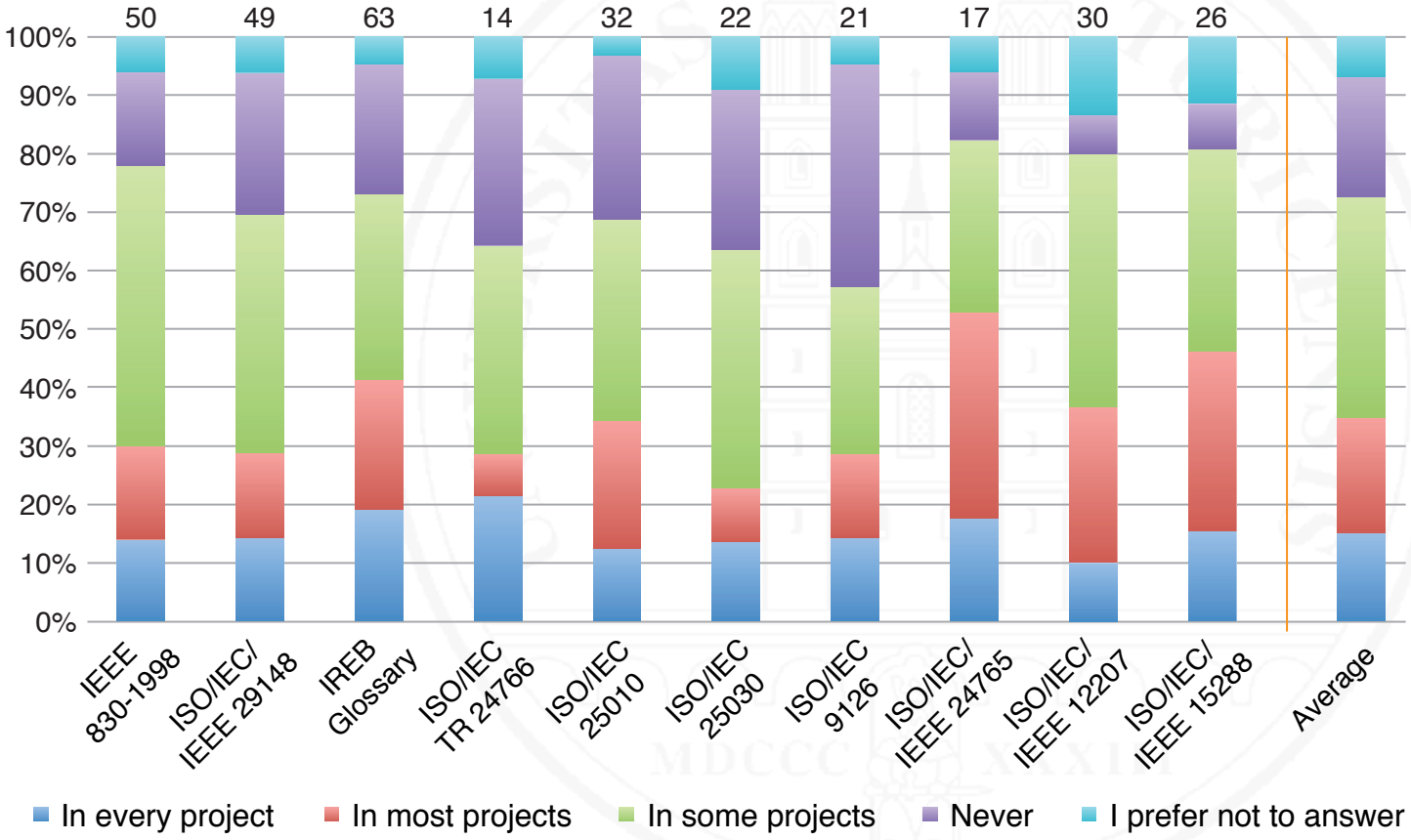
Results from an empirical study:




→ The knowledge of RE-related standards is rather low

# Knowledge and use of RE-related standards – 2

## Frequency of usage




→ The known standards are barely used

# Related standards

Quality standards, particularly in conjunction with quality requirements

- ISO/IEC 25010 System and Software Quality Requirements and Evaluation: Quality Models
- ISO/IEC 25030 Software Product Quality Requirements and Evaluation: Quality Requirements
- ISO/IEC 9126 Software Engineering – Product Quality: Quality Model (superseded, predecessor of ISO/IEC 25010)

System and software engineering standards, e.g.,

- ISO/IEC/IEEE 12207 on software life cycle processes
- ISO/IEC/IEEE 15288 on system life cycle processes
- ISO/IEC/IEEE 24765 on systems & software engineering vocabulary

# Domain-specific standards

Domain-specific standards may impact Requirements Engineering

Example:

ISO 26262 Road Vehicles — Functional Safety

If a customer or regulator demands compliance of a system with ISO 26262, then traceability between requirements and test cases is mandatory.

# 11.3 RE syllabi and body of knowledge

There is no Requirements Engineering Body of Knowledge (RE BoK) document

The IREB CPRE – Certified Professional for Requirements Engineering – foundation level

is a de facto basic RE BoK, consisting of a syllabus, a handbook and a glossary

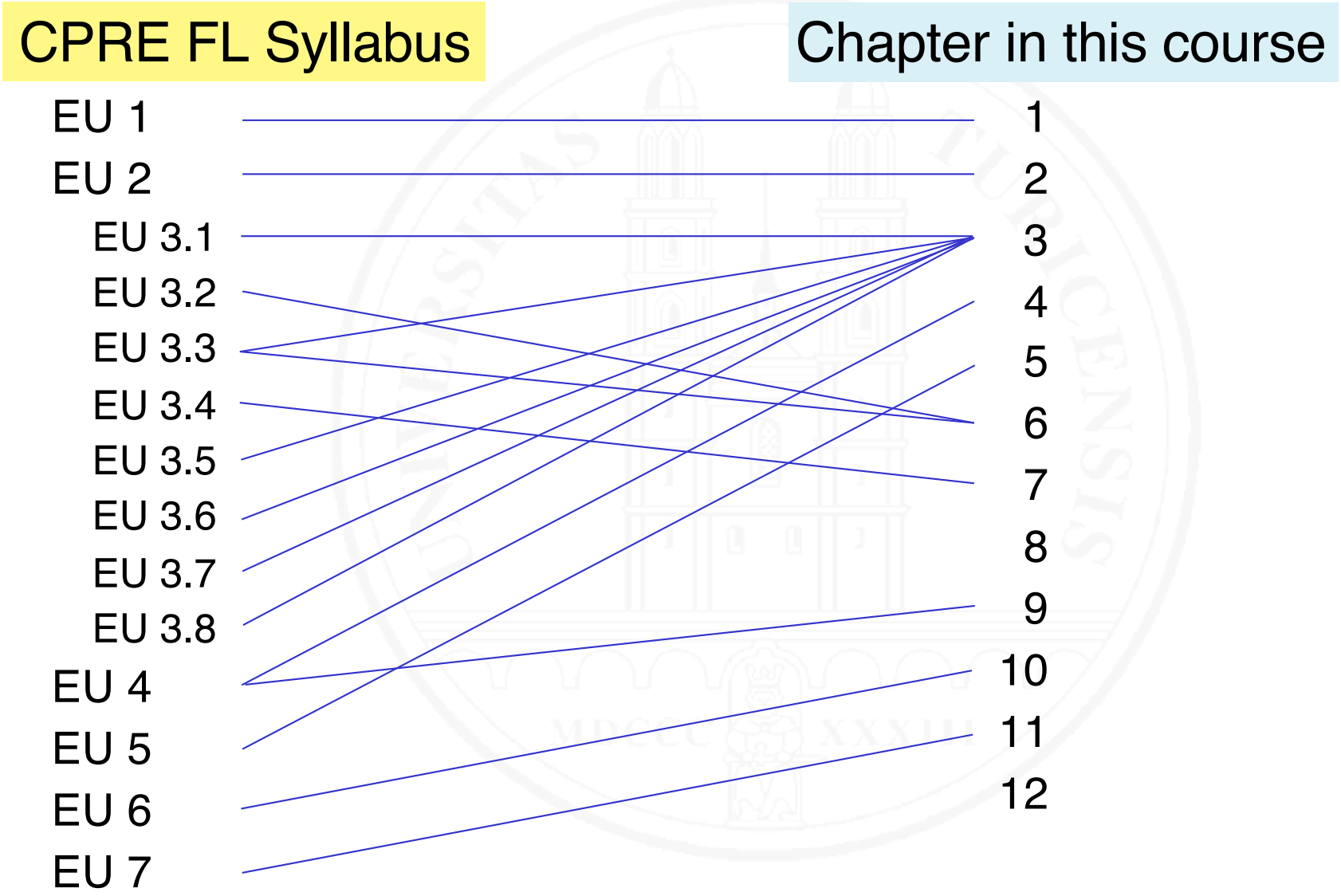
https://ireb.org/en

[IREB 2024]
[Glinz, van Loenhoud, Staal and Bühne 2024]
[Glinz 2024]

# IREB CPRE vs. this course

- This course covers all topics of the IREB CPRE foundation level syllabus
- The terminology is the same
- Some topics of this course go beyond the CPRE FL, for example:
  - COTS-aware processes (Chapter 5)
  - Formal specification (Chapter 8)
  - Standards, AI for RE, RE Ethics (Chapter 11)

# Synopsis of topics



# 11.4 AI for RE

[Dalpiaz and Niu 2020]
[Vogelsang 2024]

What can AI do for RE?

Primary means: processing natural language text with machine learning

- Find and classify, for example
  - Identify potential requirements in user feedback (app reviews, tweets)
  - Classify sentences in a document into requirements and informational statements
  - Extract glossary candidates from textual requirements
  - Find smells in requirements
  - Find trace links between RE documents

# What can AI do for RE – 2

- Recommend, for example
  - Recommend further stakeholders / stakeholder roles during stakeholder analysis
  - Provide advice for configuring requirements in a product line
- Analyze, for example
  - Automated impact analysis when requirements change
- Generate, for example
  - Propose requirements for a given problem or for vaguely stated needs
  - Propose acceptance criteria for a given user story
  - In the long run: generate a solution for a given problem

# What can AI do for RE – 3

- Support, for example
  - Support human interaction between stakeholders and requirements engineers
  - Chatbots for autonomous interaction with a big number of stakeholders

# Example: The ALERT.me approach

[Guzmán, Ibrahim, Glinz 2017]

Context: Large product or service providers continuously receive thousands of tweets about their product.

Problem: Some of these tweets contain user needs that are a source of requirements for evolving the product or service. Manually finding these tweets is tedious and expensive.

Illustration: Two tweets to Slack:

@SlackHQ At my company we share code snippets around a lot. There should be a quick way to copy a raw code snippet to your clipboard. User need

I always uwanted t-shirts, but I didn't know socks were an option. I've got the start with my @SlackHQ faves - gotta catch 'em all! Other stuff

# Example: The ALERT.me approach – 2

Solution: Create a tool that extracts user needs and presents them in a convenient form to the requirements engineers

Three steps:

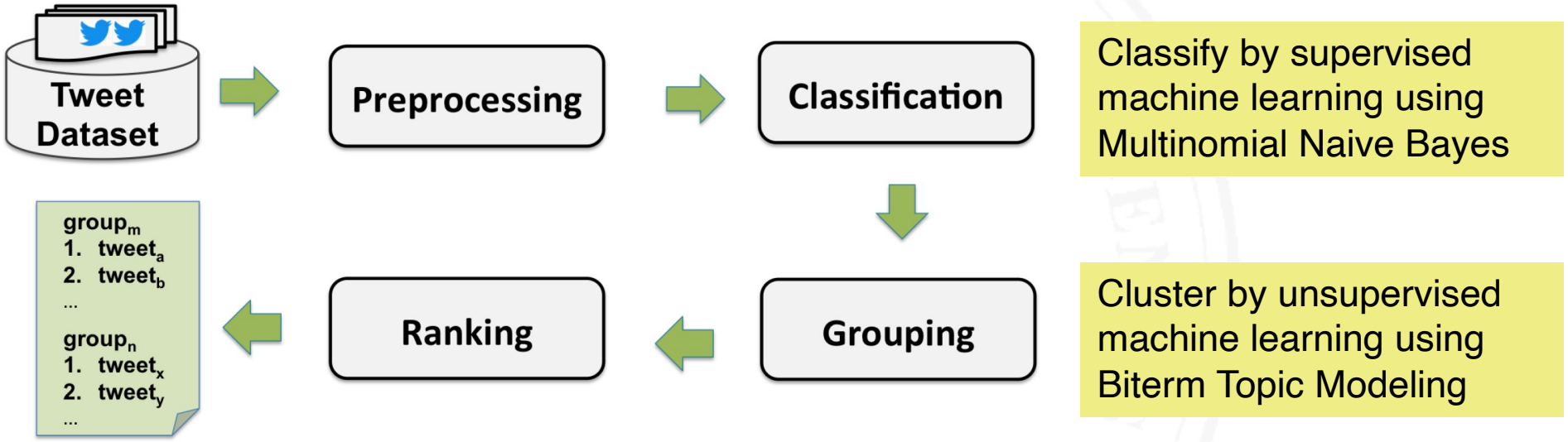
1 Classify tweets into improvement requests and other

2 Cluster improvement requests by grouping them into topics

3 Rank the grouped requests by their relevance

# Example: The ALERT.me approach – 3

## Architecture of ALERT.me



# The recall problem of AI-based RE tools

[Berry 2021]

- Automated classifiers make mistakes:
  - Not including relevant items in the result set (false negatives; recall < 100 %)
  - Including irrelevant items (false positives; precision < 100 %)
- A tool such as ALERT.me is still useful when recall is only about 80 %.
- In other contexts, a tool with 80% recall can be useless because the missed items have to be found manually

# Mini-Exercise

Explain why an AI-based tool with a recall of 80% can be very useful in certain RE contexts and useless in other RE contexts.

# Analytic vs. generative AI tools

[Vogelsang 2024]

Analytic AI tools (such as ALERT.me)

- Configured for specific tasks
- Need to be trained
- Rather easy to handle and interpret once training is done

Generative AI tools (such as ChatGPT)

- General-purpose large language models
- Specific prompts required for RE problems: context, task, expected result(s), qualities, constraints,...
- Interpretation of results requires humans in the loop
- May need additional training on context and RE problems
- Proper prompting can become an RE task in itself

# 11.5 Requirements Engineering Ethics

Three relevant ethical dimensions

- Ethics of profession
- Ethics of use
- Ethics of design


**in RE**

[Simon 2022]
[Barker&Ferguson 2022]
[Norman 2013]

# Ethic principles

- No harm 
- For the good 
- Fairness 
- Autonomy 
- Transparency 

# Ethics of profession in RE

- Consider how to act ethically as a requirements engineer
- Comply with the code of ethics
  - of your organization
  - of professional societies where you are a member

Some advice

- Refuse working on maleficent requirements (no harm)
- Assess benefits and risks of systems built according to the requirements (for the good)
- Treat equal stakeholders equal (fairness)
- Guide stakeholders, but do not force them (autonomy)
- Be able to explain what you are doing and why (transparency)

# Ethics of use in RE

- Consider the impact of your requirements on the users of the system to be built
  - Can the system in use do harm (to people, the environment, the society,...)?
  - Does the system help its users doing things better than before?
  - Does or can the system discriminate certain users or or favor them over others without a valid reason?
  - Does the system help empower its users?
  - Does the system help users understand what the system does when they use it?

# Ethics of design in RE

- Consider the impact of your requirements on the design of the system to be built
  - Are there requirements that prevent the system from doing harm (safety, security, reliability,...)
  - Do the requirements enable designing a system that provides benefit for, for example, its users, the environment or the society – and do this with controllable risks?
  - Do the requirements enable designing a system that is user-friendly and empowers its users?
  - Are there requirements asking for explainability of what the system does when in operation?