EVOLVING PATTERN LIBRARIES IN DISTRIBUTED EXPLORATIVE PROJECTS

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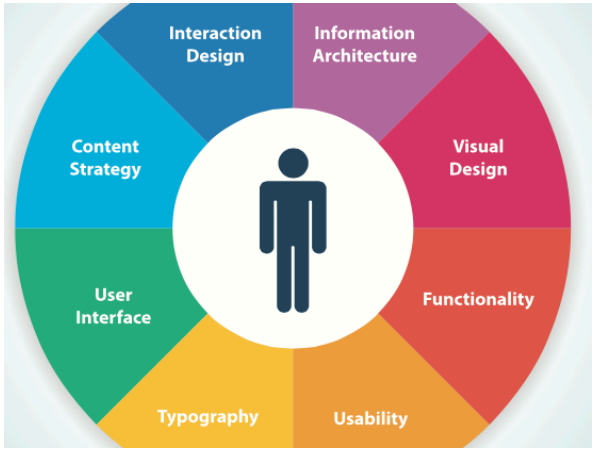
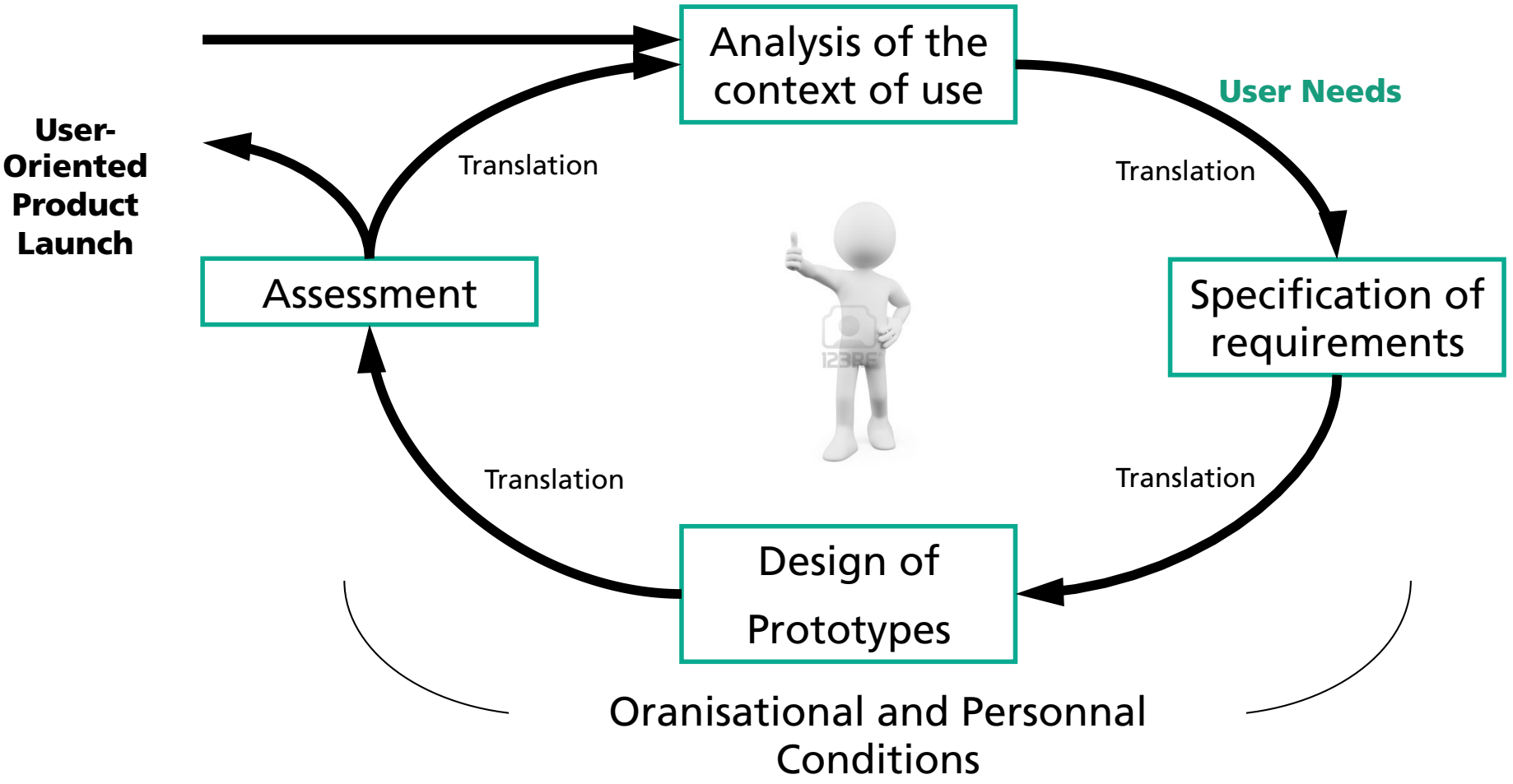


User-Centered Computing

Goal:
Optimizing usability and usefulness of IT in the interplay with organizational work practice, structures and processes.

How to? - Usability Engineering Process

ISO 9241-210



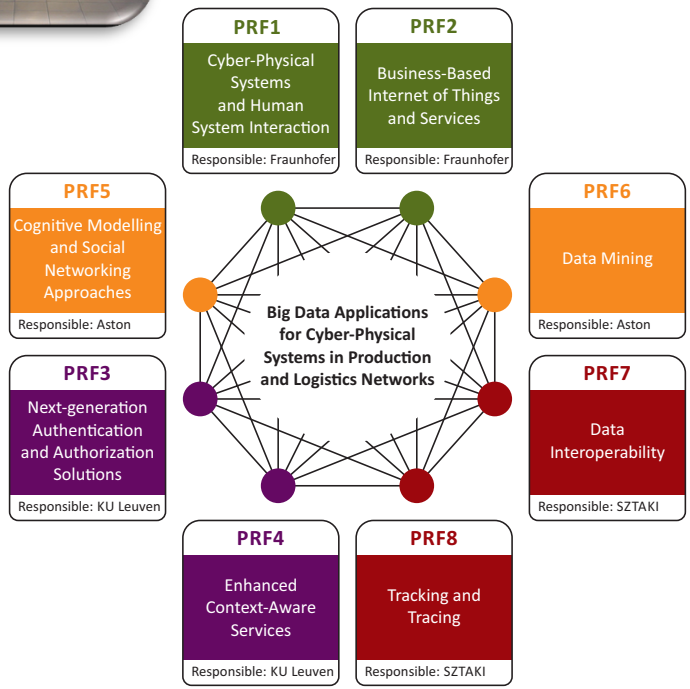
User Centred Ubiquitous Computing – Project Portfolio

- **Internet of Things and Services / Smart Cities**
  - Ebbits, BEMO-COFRA, **E3 Production**, **MAESTRI**, **ALMANAC**, **LinkSmart®**, **Industrial Data Space**

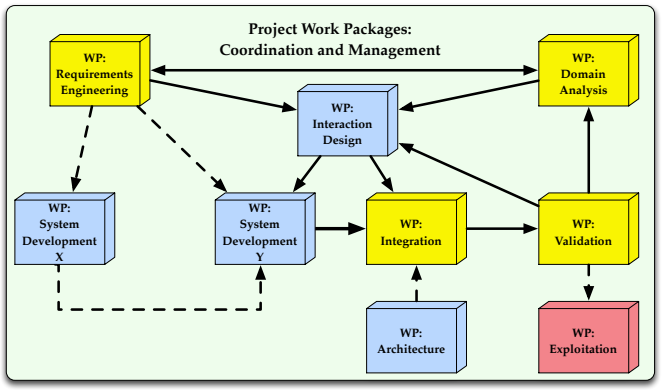
- **Energy Efficiency and Smart Environments:**
  - Adapt4EE,SEAM4US, SEEMPubS, **DIMMER**, **IMPReSS**, **GreenCom, Flex4Grid**

- **Emergency Response / Healthcare, HCI and multimodal assistance**
  - BRIDGE, MICA, **AILB**, **PARADISE, SatisFactory**

User-Oriented Projects



Research Projects – Challenging Structures



- Various disciplines
- Different professional backgrounds
- Individual experience, methods and processes
- Complex communication
  - Different documentation formats and notations
  - Volatile knowledge
- Parallel activities need synchronization
- Staff changes
- Details about decisions are forgotten

Central Question and Aim

"How can we achieve that all project members benefit from gathered knowledge and made experience?"

- Creation of a common growing knowledge structure
  - Based on small chunks of knowledge
  - Created by ***all*** stakeholders
  - Iterative refinement
  - Understandable for every project member
- Approach: **Adapt the concept of design patterns**

Towards an Evolving Pattern Library

- Patterns are formulated ***after*** gathering experience
- ***However:***
  Knowledge needs to ***evolve*** in parallel to the project's achievements
- Research Questions:
  - What qualities are missing in currently existing pattern approaches?
  - How should a collaborative pattern formulation and maturation process be structured in order to reflect a pattern's development?
  - How can a pattern's formulation quality be ensured and validity be measured?
  - Which activities are performed by which roles?
  - How does the process remain easy to apply and to understand by the users?
  - What are accepted ways of showing progress and activity?

Pattern Formulation Approaches

- Exchange of Experience within Communities *[Borchers 2001, Graham 2003, van Duyne et al. 2007, Scott and Neil 2009, Tidwell 2011]*
- Online discussions within public and private libraries *[PatternTap LLC 2013, van Welie 2013, Yahoo! Inc. 2013]*
- Pattern formulation during engineering *[Grill and Blauhut 2008, de Rore 2009]*
- Active pattern mining workshops *[Iba and Isaku 2014]*
- Hypotheses supported by usability evaluations *[Kunert 2009]*
- From observations to best practices *[Leacock 2005, Averbakh et al. 2011]*

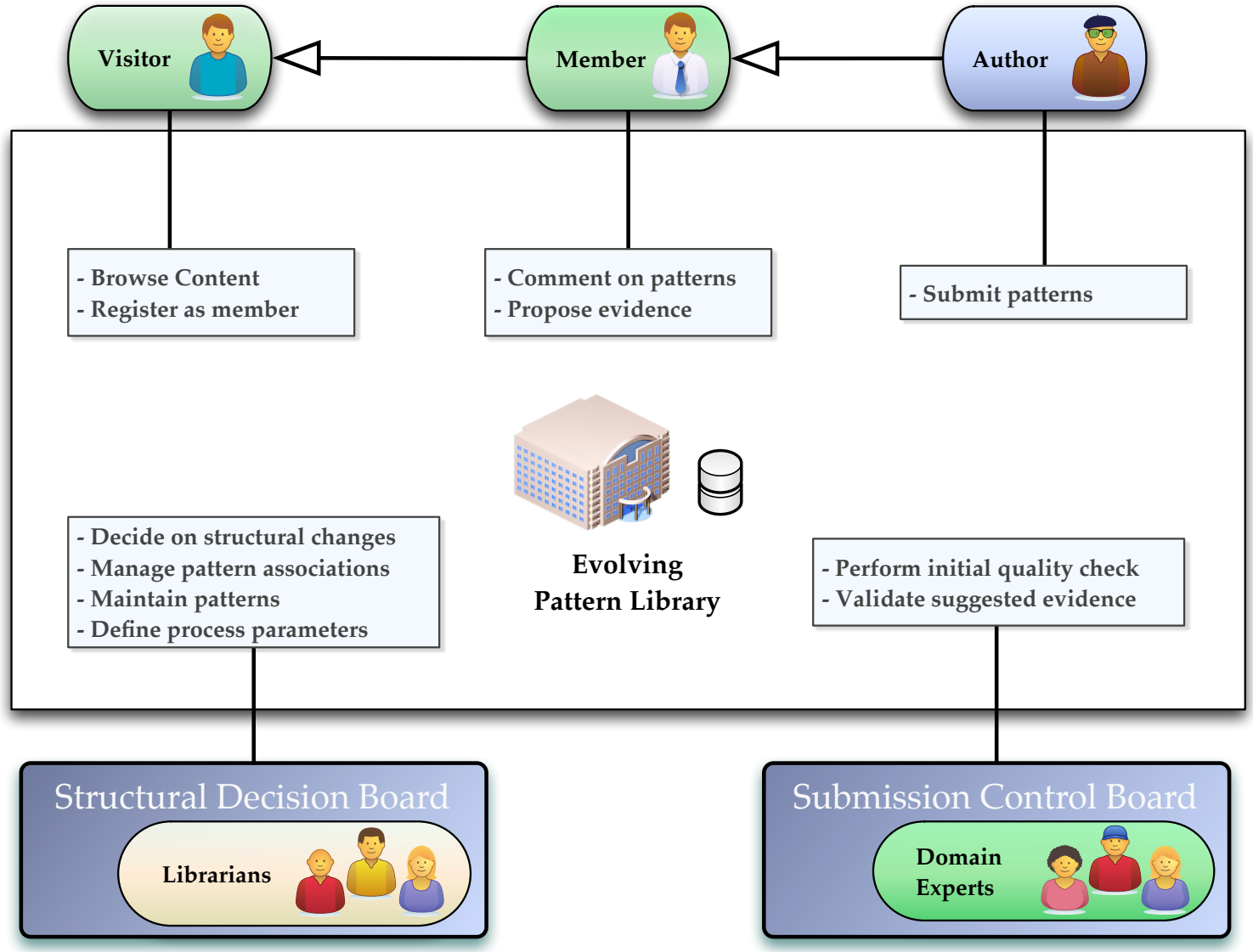
Summary of Discovered Problems

- Tedious pattern generation
- Closed author groups
- Lacking influence on pattern formulation
- Extensibility and actuality of patterns
- Lacking reuse of existing knowledge
- Non-transparent pattern derivation
- Long-term motivation and inclusion of stakeholders
- Lacking recommendation and guidance
- Missing knowledge about bad practices

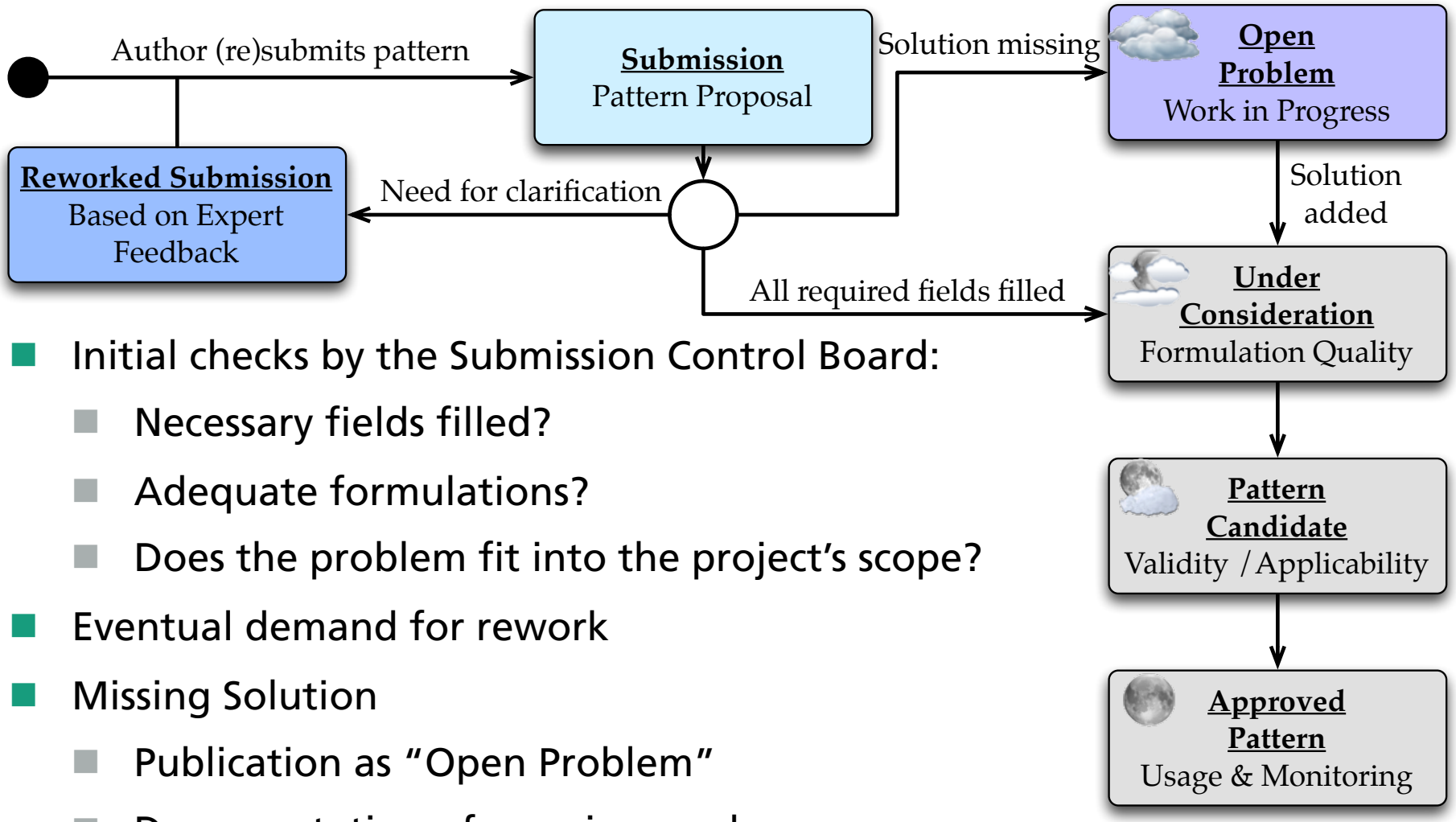
Requirements for a Collaborative Pattern Formulation and Maturation Process

- Pattern discussion
- Maturity states
  - Formulation quality
  - Reliability
- Evolving pattern library structure
  - LoA: Standards, processes, guidelines, applied practices, realizations
  - Number, maturity and position of patterns
- Role model for contribution and library management
- Process and rules for formulation, maturation and validation
- Means for showing activity → Motivation

Collaborative Pattern Formulation – Roles and Use Cases

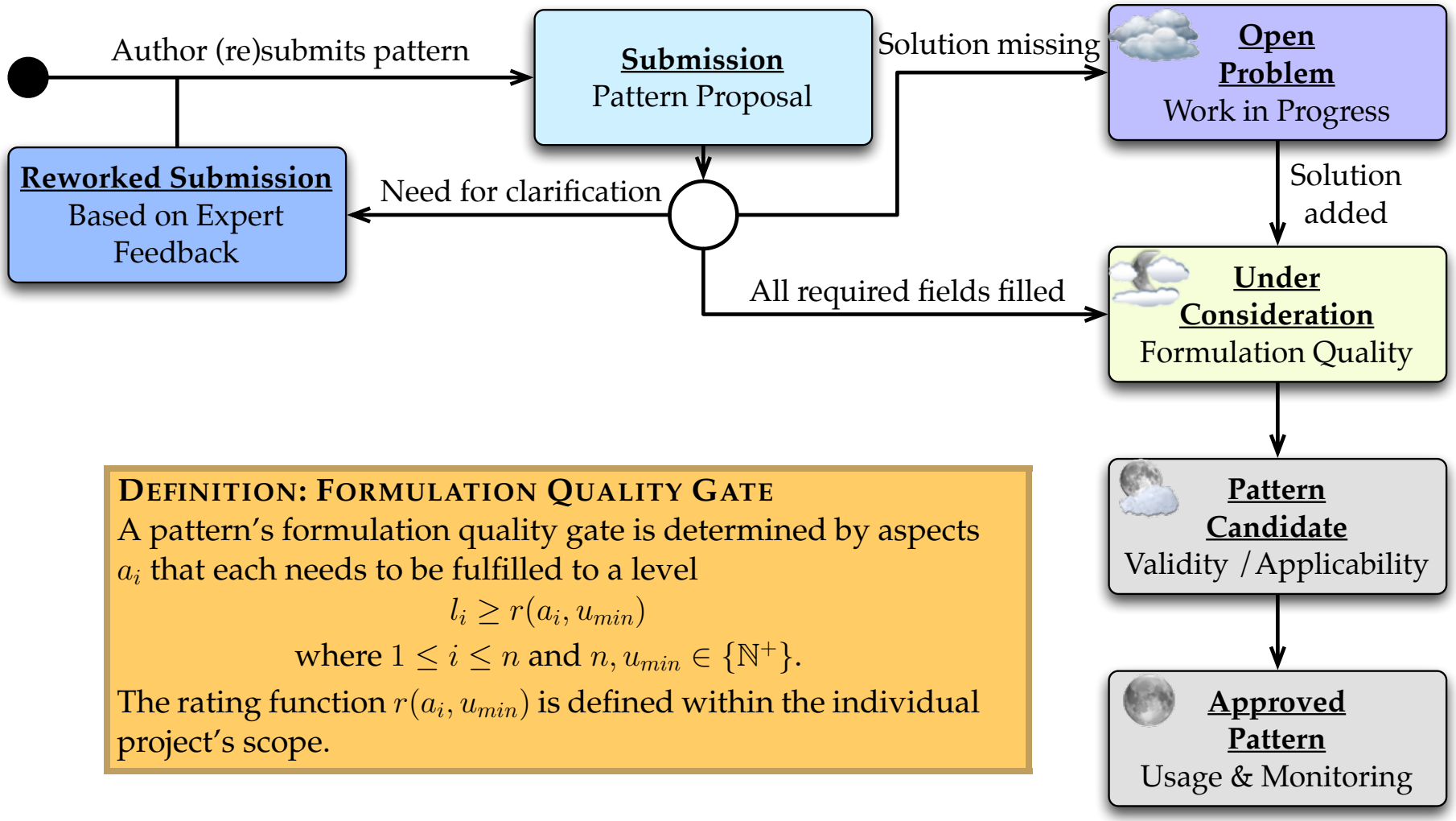


The Pattern Maturation Process - Submission



- Initial checks by the Submission Control Board:
  - Necessary fields filled?
  - Adequate formulations?
  - Does the problem fit into the project's scope?
- Eventual demand for rework
- Missing Solution
  - Publication as "Open Problem"
  - Documentation of ongoing work

The Pattern Maturation Process – Formulation Quality



DEFINITION: FORMULATION QUALITY GATE

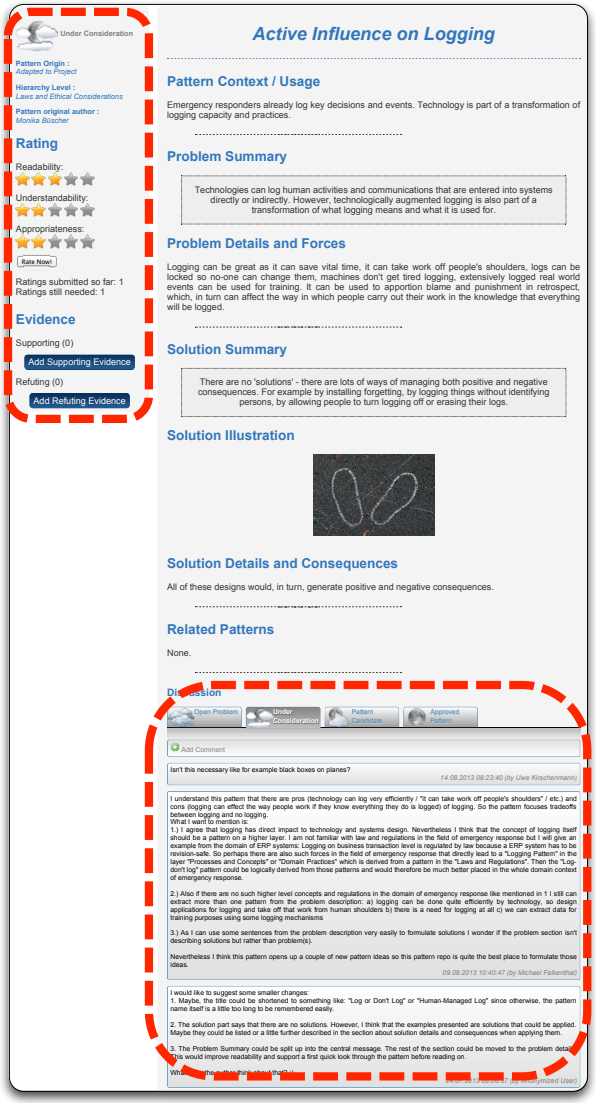
A pattern's formulation quality gate is determined by aspects a_i that each needs to be fulfilled to a level

$$l_i \geq r(a_i, u_{min})$$

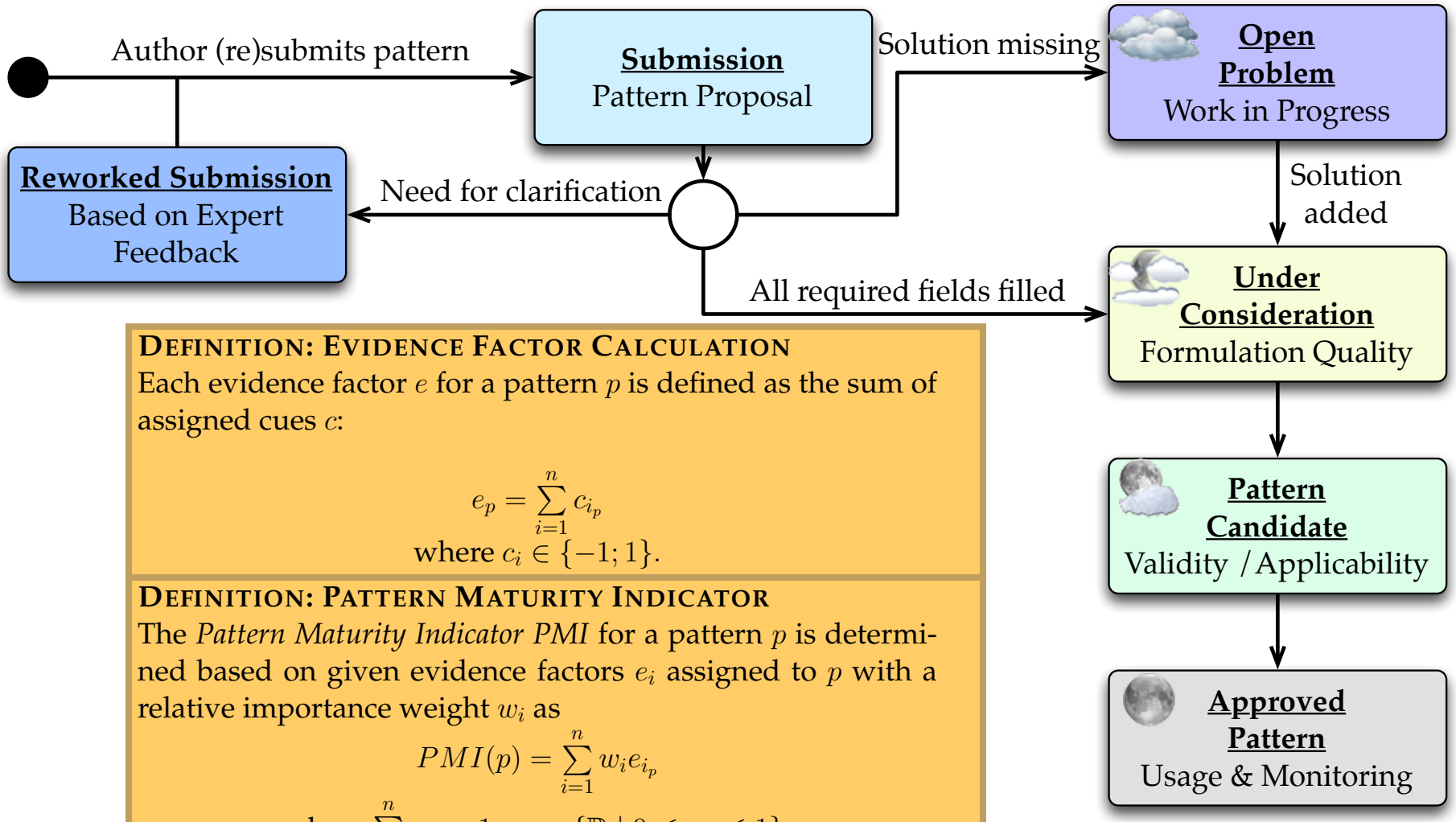
where $1 \leq i \leq n$ and $n, u_{min} \in \{\mathbb{N}^+\}$.

The rating function $r(a_i, u_{min})$ is defined within the individual project's scope.

A Pattern „Under Consideration“



The Pattern Maturation Process – Validity



DEFINITION: EVIDENCE FACTOR CALCULATION
Each evidence factor e for a pattern p is defined as the sum of assigned cues c:

$$e_p = \sum_{i=1}^{n} c_{i_p}$$

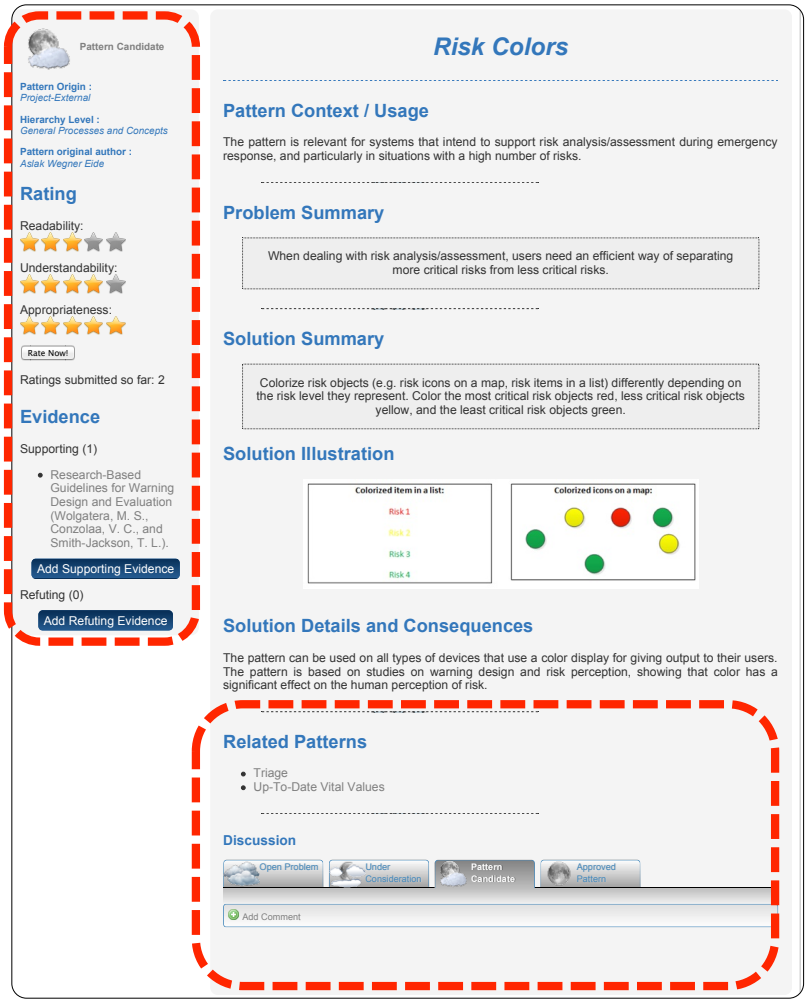
where $c_i \in \{-1; 1\}$.

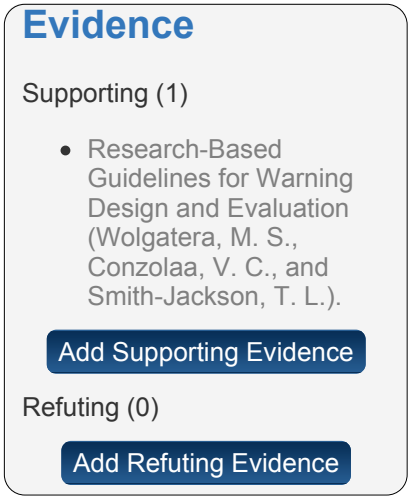
DEFINITION: PATTERN MATURITY INDICATOR
The *Pattern Maturity Indicator PMI* for a pattern p is determined based on given evidence factors e_i assigned to p with a relative importance weight w_i as

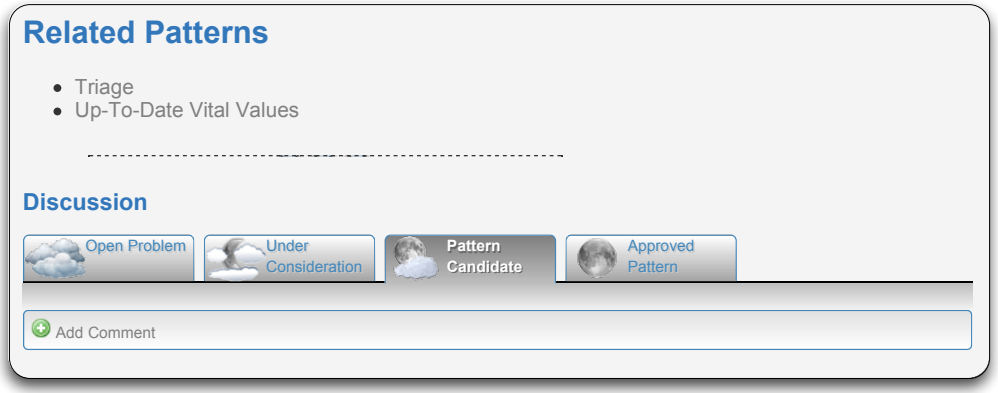
$$PMI(p) = \sum_{i=1}^{n} w_i e_{i_p}$$

where $\sum_{i=1}^{n} w_i = 1, w_i \in \{\mathbb{R} \mid 0 \leq w_i \leq 1\}$.

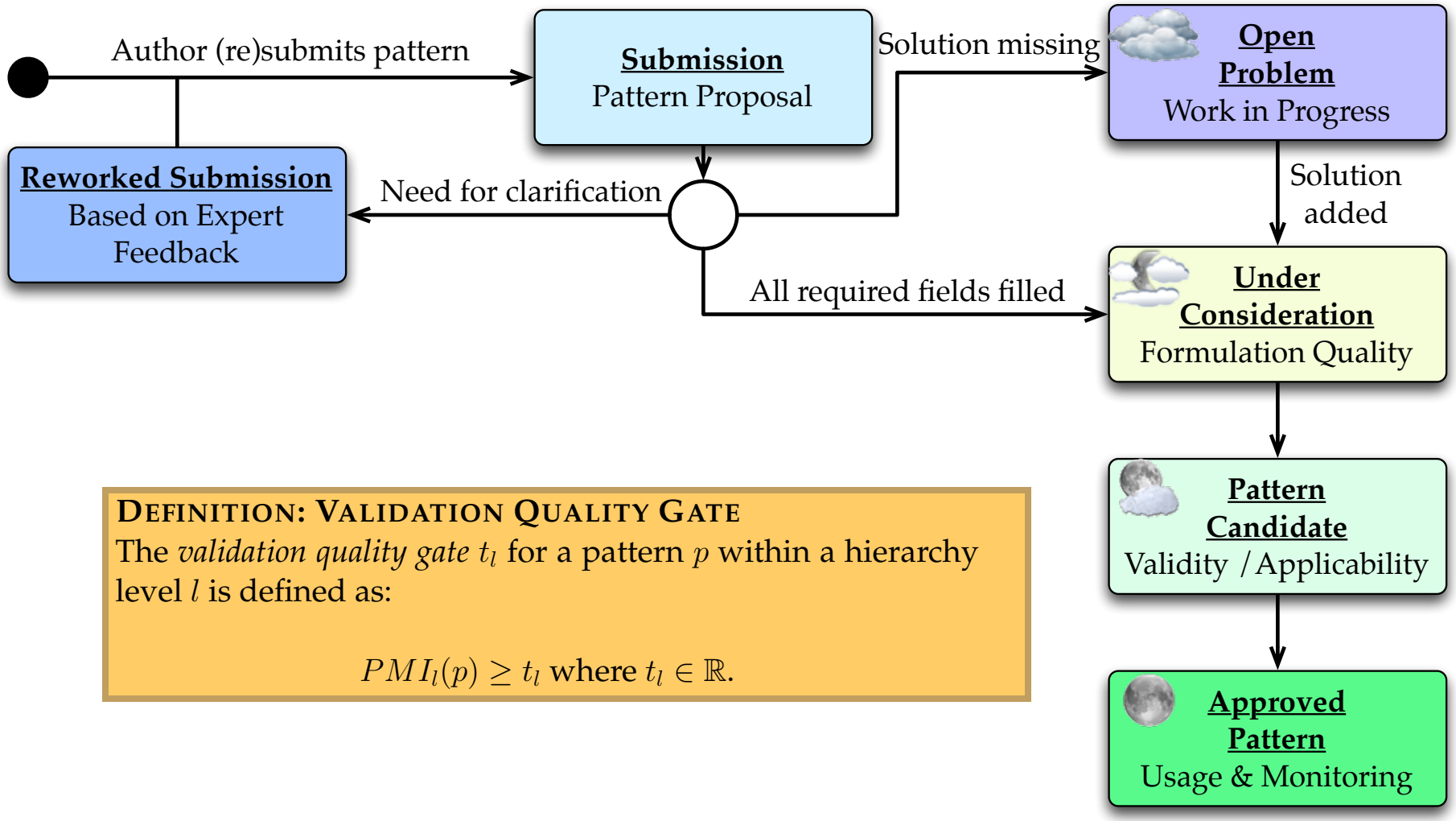
A „Pattern Candidate“







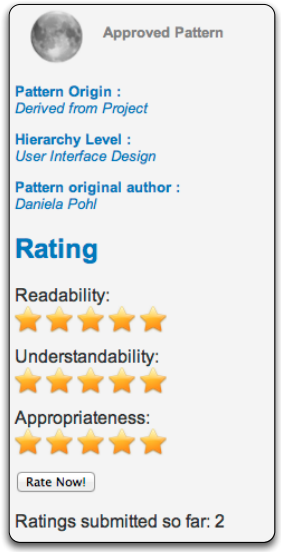
The Pattern Maturation Process - Approval

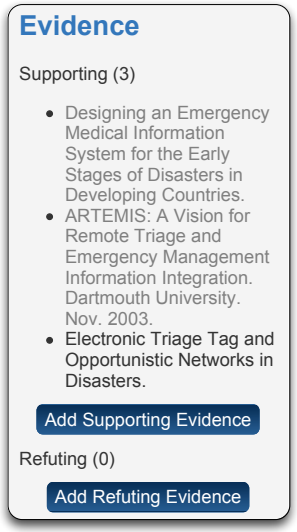


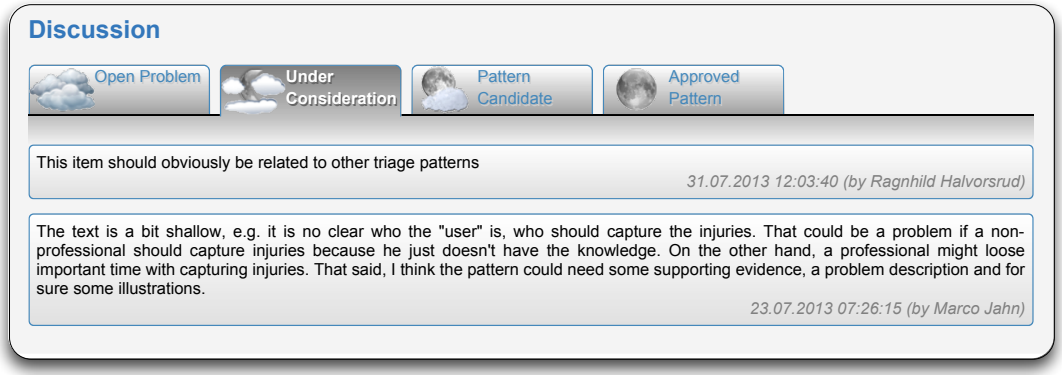
DEFINITION: VALIDATION QUALITY GATE
The *validation quality gate* t_l for a pattern p within a hierarchy level l is defined as:

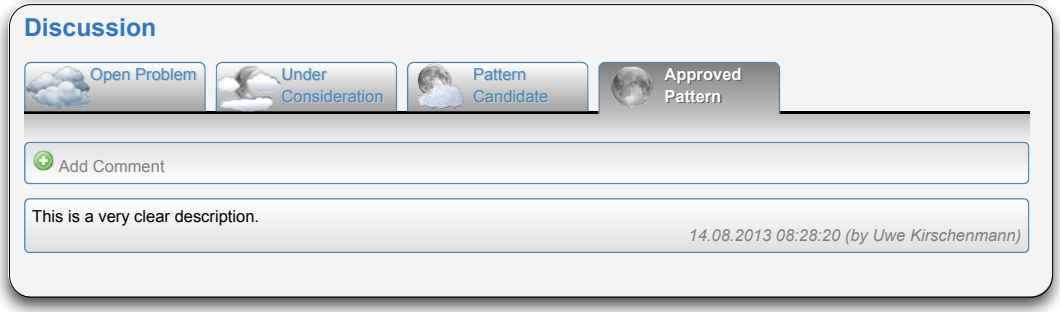
$$PMI_l(p) \geq t_l \text{ where } t_l \in \mathbb{R}.$$

An „Approved Pattern“



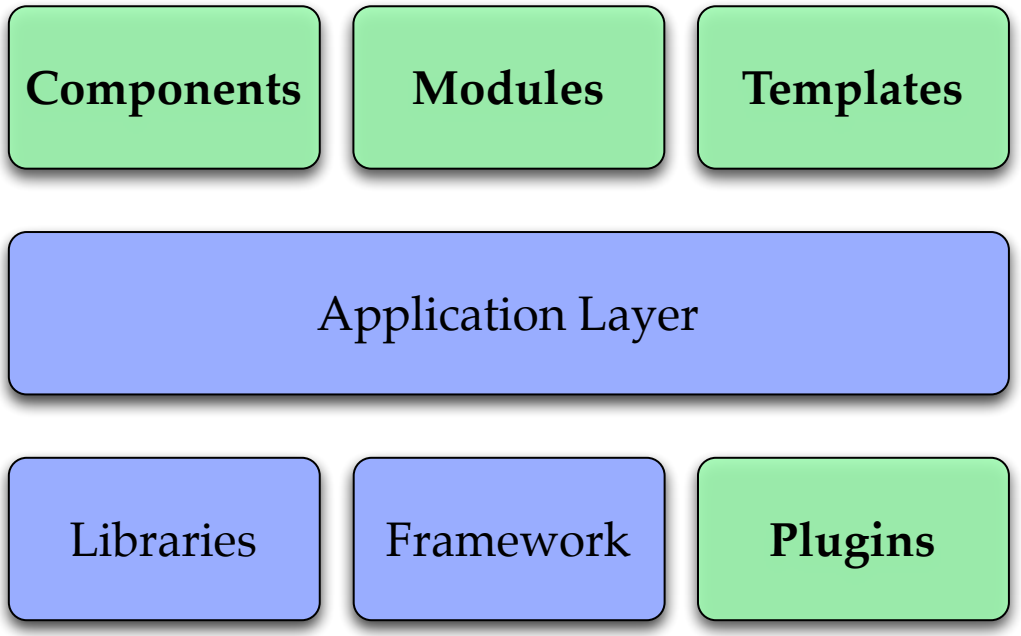




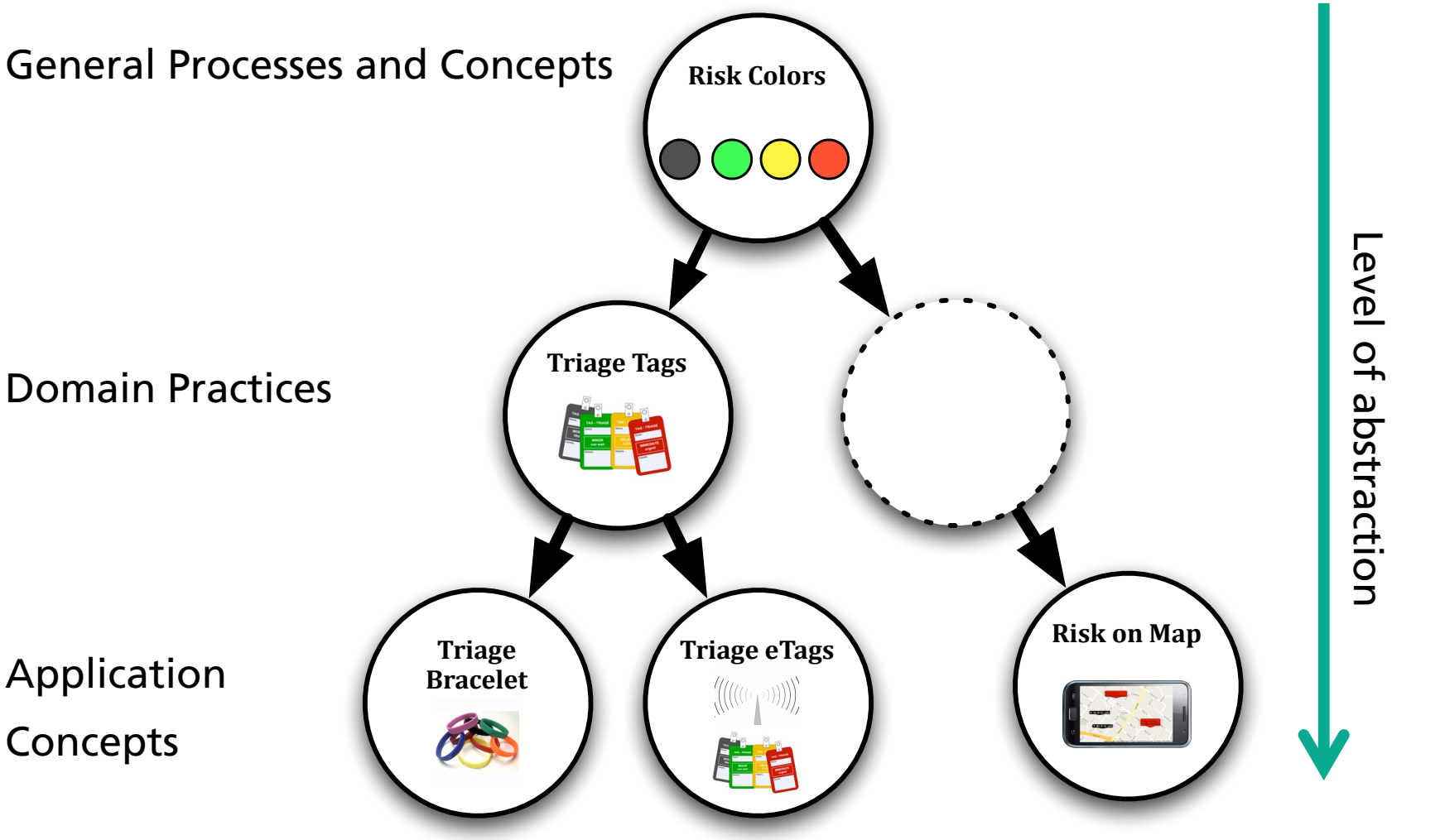


Pattern Library Prototype – Extending the Joomla! CMS

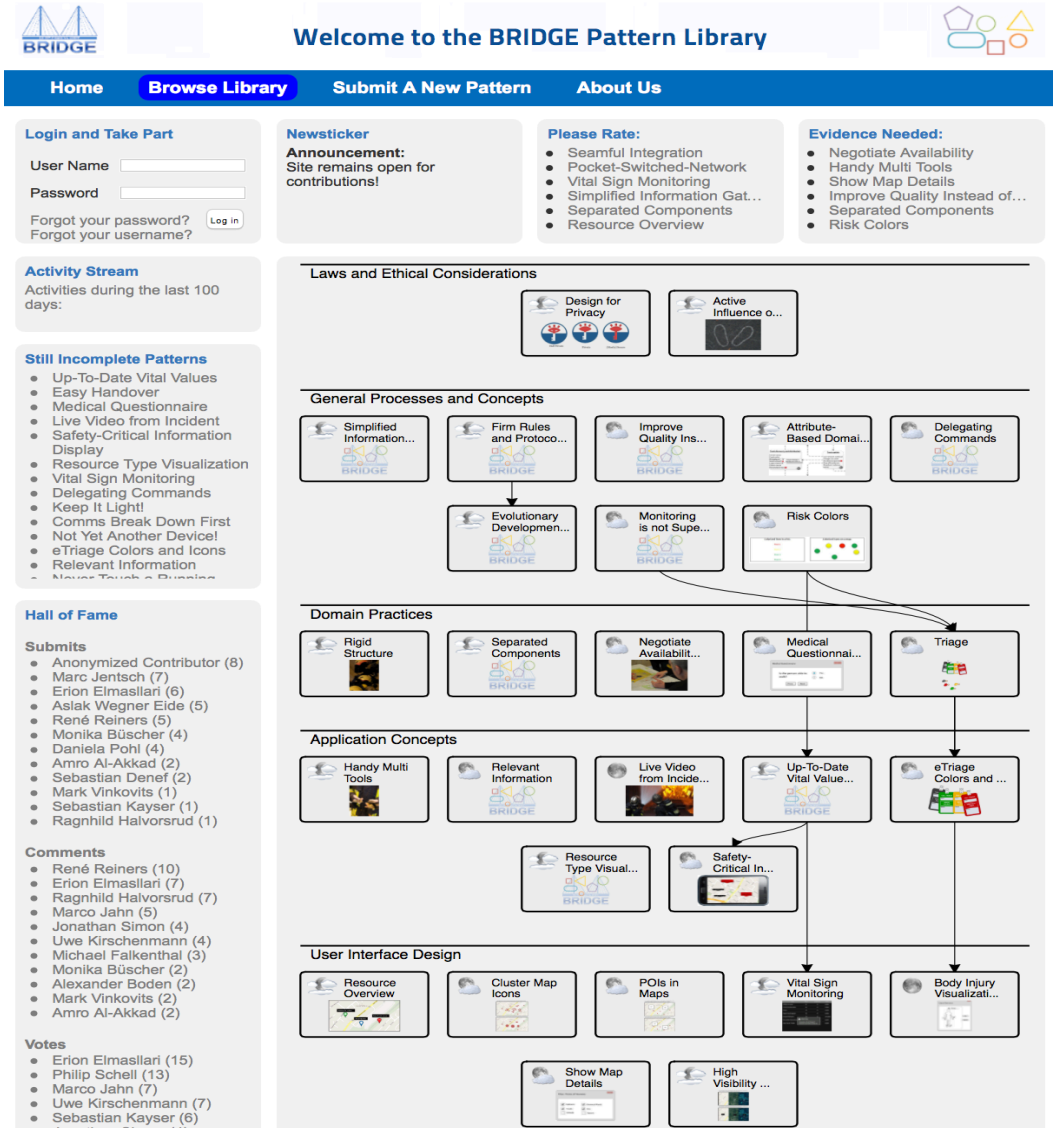
- Pattern library as component
- Widgets as modules
  - Announcements
  - Activity stream
  - Call for ratings and evidence
  - Incomplete patterns
  - Hall of fame
  - Who is online?
- Visualization as DAG and detail view
- Rule engine as plugin



Structure: Pattern Organization as DAG



Screenshot of the BRIDGE DPL



Contribution Summary

I

Pattern Maturation Process

- Distributed, asynchronous and incremental pattern formulation
- Collaborative review and feedback
- Formulation quality criteria and validity measures
- Dynamic structure
- Participation of ***all*** project members
- Rules and roles

II

Pattern Library Prototype

- CMS extension
- Low learning curve
- Means for browsing, contributing and providing feedback
- Visualization of structure and activity
- Embedded into project context
- Flexible rule engine
- Exchangeable L&F

III

Project-Related Case Study

- EPL concept accepted and understood
- Benefits of usage
- Suited as tool within project work
- Reflection of current R&D activities
- Reflects domain knowledge
- Learning aspects
- Seeding for future contributions

Outlook

- Discussed concepts (not yet validated)
  - Extended relations (OR, AND, XOR)
  - Pattern sequences
  - Traceability and history
- Future Work
  - Common authorship and identification of experts *[Prause 2013]*
  - Incentives and motivation *[Prause et al. 2010]*
  - Transfer to different project scales and types