An Architecture Framework for Collective Intelligence Systems

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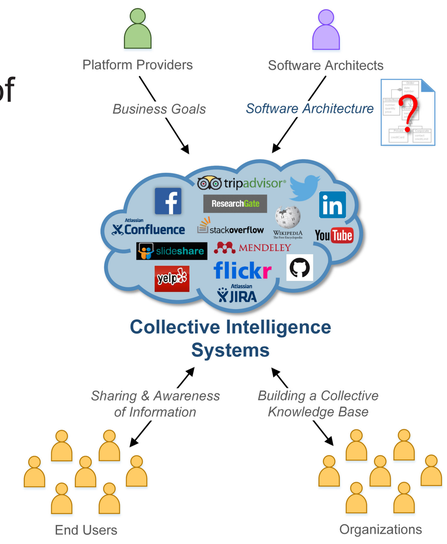
Context & Motivation

- **Collective intelligence (CI)** emerges from social interaction and contributions of groups of individuals.
- **Growing adoption** in various domains.

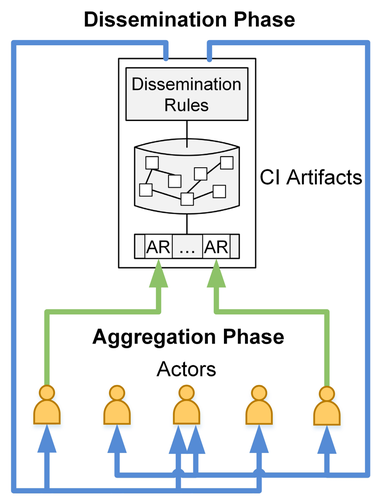
Architecting Challenges

- Lack of **consolidated knowledge** of architectural principles and practices.
- Lack of **guidance**: trial & error, clone & own.
- **Unfamiliarity** with CIS **domain**.



CIS Characteristics

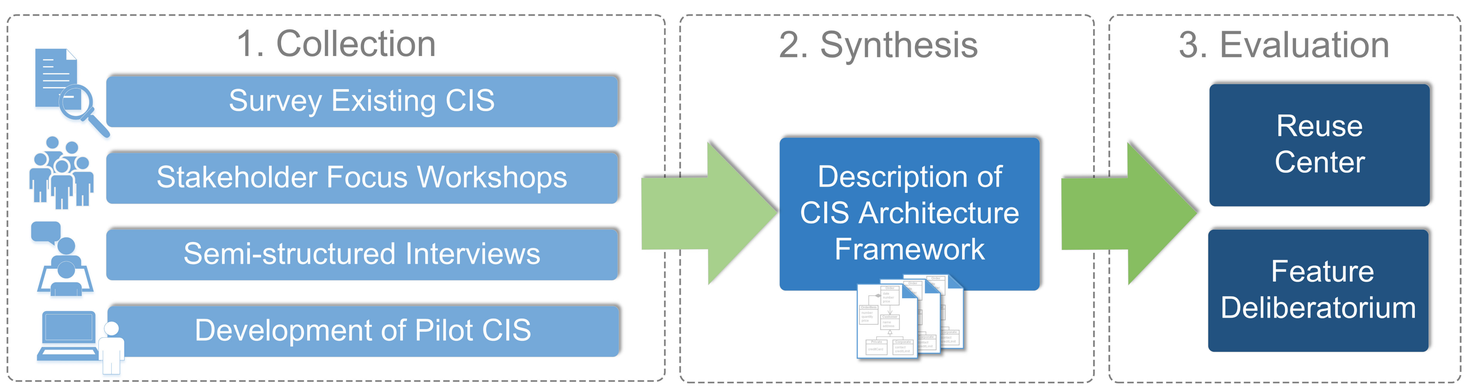
- **Bottom-up information sharing** and **knowledge aggregation**.
- **Stigmergic process:** Perpetual feedback loop between actors and coordination infrastructure.
- Coordination infrastructure:
  (1) **Artifacts** store shared content in **network structure**,
  (2) **Rules** of **interaction** and **coordination**.
- Success factor: **Continuous flow of user contributions**.



Research Questions & Approach

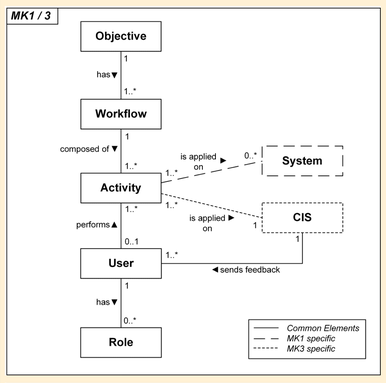
RQ 1. Identification of important CIS-specific architectural principles?

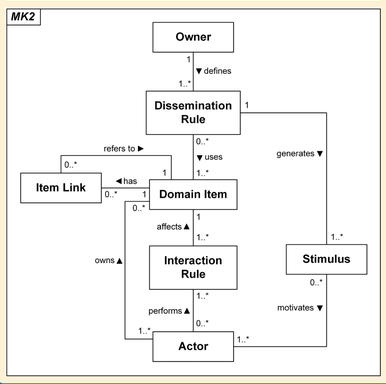
RQ 2. How to codify these architectural principles to make them useful for engineering CIS?



Architecture Framework for Collective Intelligence Systems

I. CI Context Viewpoint





Overview

Designs CI-specific system capabilities and defines models for new CIS construction and capture of design decisions.

Stakeholders

Architect(s), Owner(s), Actors

Concerns

Usefulness - Process limitations addressable with CIS?

Perpetuality - Identify stigmergic process for the application scenario?

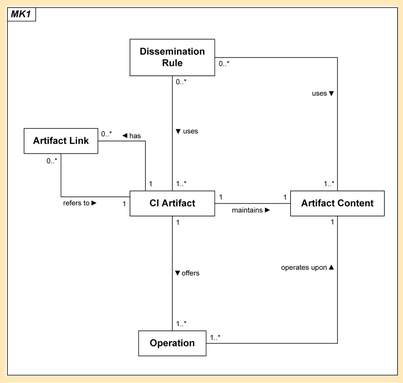
Model Kinds

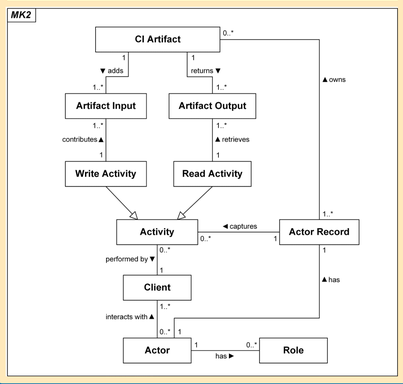
MK1 - As-Is Workflow: Current workflow of interest in the organization.

MK2 - Stigmergic Coordination: Describes domain items of interest in organization, the rules to interact with the domain items, and the feedback loop that provides stimuli to users.

MK3 - To-Be Workflow: Describes activities performed by users and CIS, and its feedback mechanisms.

II. CI Technical Realization Viewpoint





Overview

CIS realization and defines models to model collective knowledge, the aggregation of data and stigmergy-based dissemination of knowledge.

Stakeholders

Architect(s), Owner(s), Builder(s), Actors

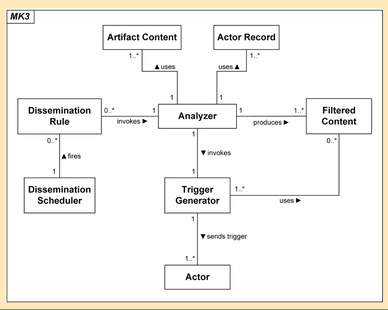
Concerns *Data Aggregation, Knowledge Dissemination,* Interactivity

Model Kinds

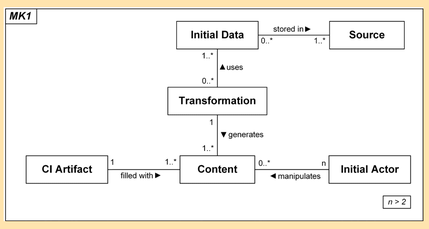
MK1 - Artifact Definition: Details CI artifact structure, linking, and the operations to interact with artifact content.

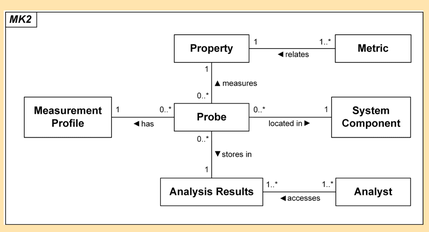
MK2 - Aggregation: Describes actor activities, what kind of data is aggregated from actors, and activity logging.

MK3 - Dissemination: Details dissemination content and rules.



III. CI Operation Viewpoint





Overview

CIS operation startup and defines models to identify initial content, actor groups, and measures for CIS aggregation and dissemination performance.

Stakeholders

Manager(s), Analyst(s)

Concerns

Kickstart - How to derive initial content from existing data?

Monitoring - Detail metrics and probes for monitoring?

Model Kinds

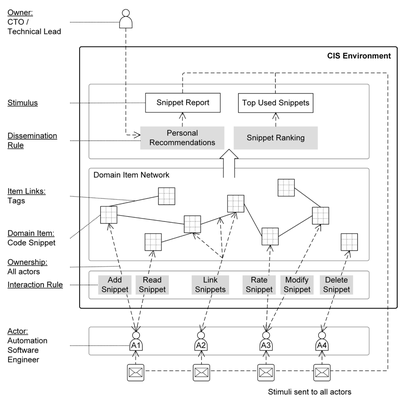
MK1 - Initial Content Acquisition: Describes sources of initial content for artifacts and initial actor groups for community building.

MK2 - CI Analytics: Describes metrics and probes to capture necessary data for measure calculation.

Evaluation & Results

Qualitative evaluation in **2 industrial cases**:
(1) Reuse Center
(2) Feature Deliberatorium

+ **Increased understanding and competency** in CI principles of stakeholders.
+ **Shared vocabulary** and **stakeholder guidance**.
+ **Kickstarting support.** Strategies for startup of CIS in organizations.



Conclusion & Future Work

- Potential of AF to **focus on CIS core elements and processes.**
- Introduce architects about principles of CIS domain.

Future Work

- Exploring **tool-support** for CIS-AF.
- **Extending CIS-AF**: actor engagement, trust, growth of user-generated content, platform evolution.
- **Survey CIS** for variations and architecture-relevant features.

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