

# Collective Intelligence Aspects of Cyber-Physical Social Systems: Results of a Systematic Mapping Study

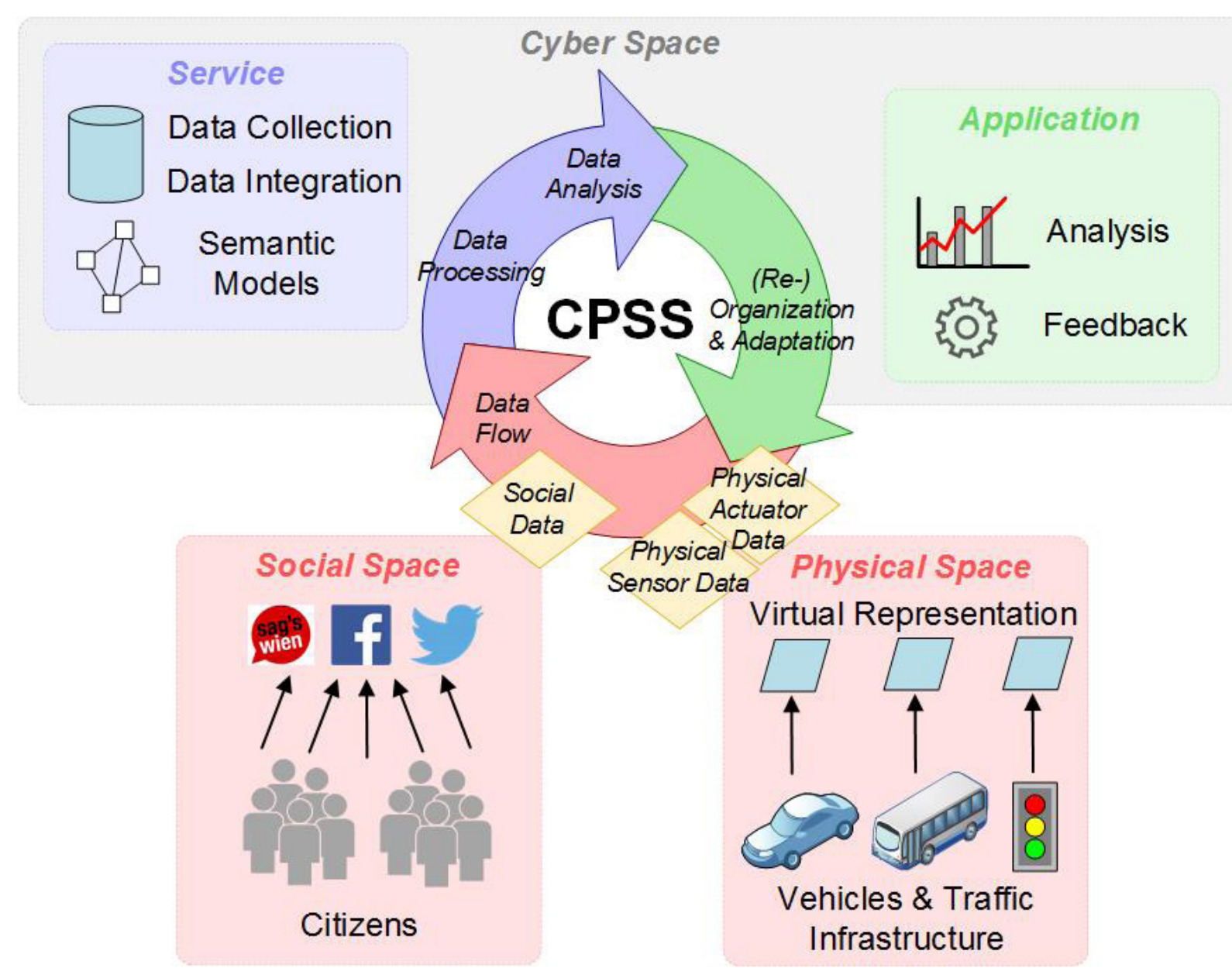
Marta Sabou, Angelika Musil, Juergen Musil, Stefan Biffi

Institute of Information Systems Engineering, TU Wien, Vienna, Austria

## Context

**Cyber-Physical Social Systems (CPSS)** span the cyber, physical and social space.

These systems take into account human behavior and provided social data and aim to influence both the physical and the social space.



## Research Questions

**RQ 1. CPSS Definition:** What is an overarching definition of CPSS?

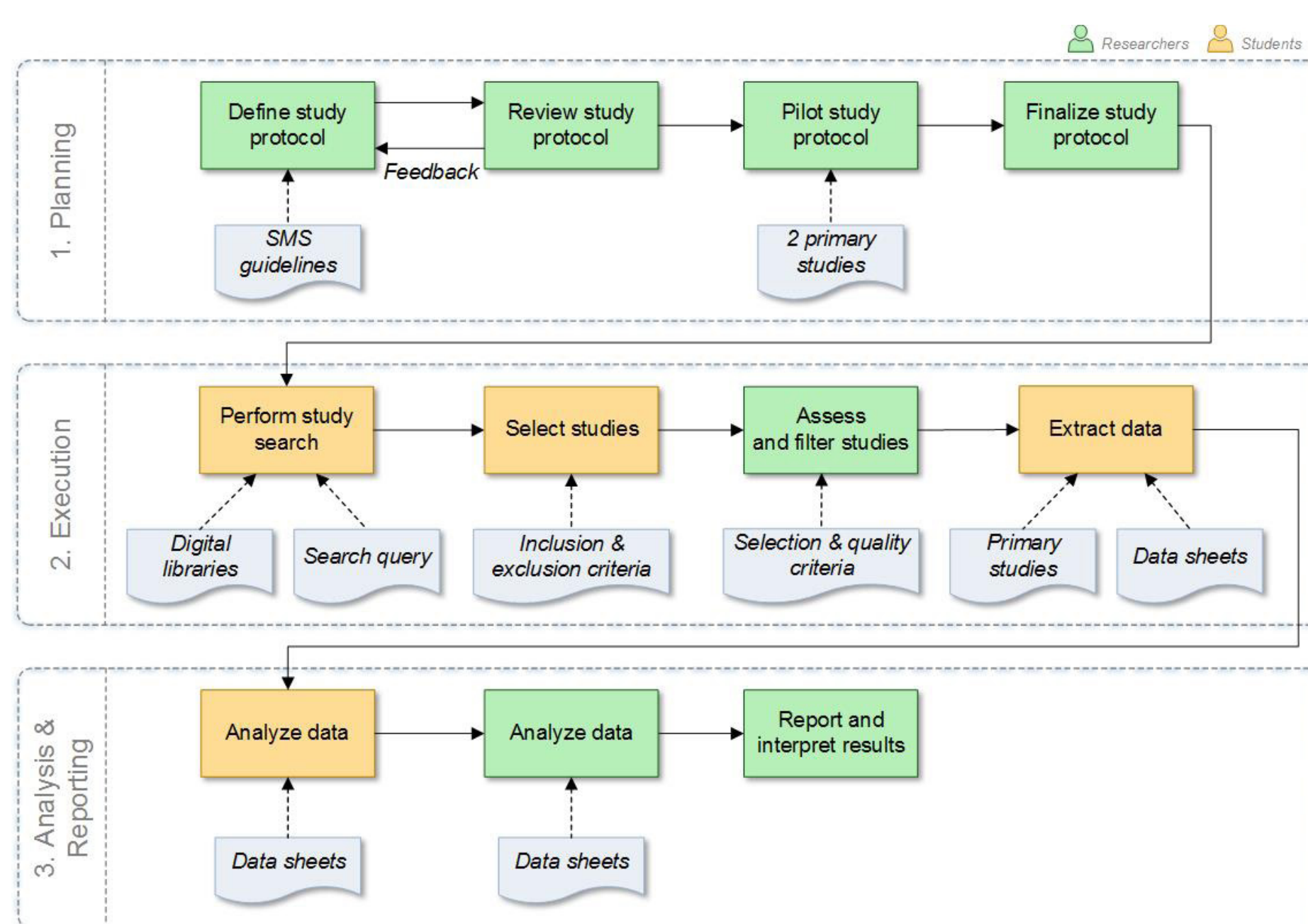
**RQ 2. CPSS Concept:** What are the main CPSS characteristics and processes?

**RQ 3. CPSS Architecture:** What architectural approaches are applied to design and describe CPSS?

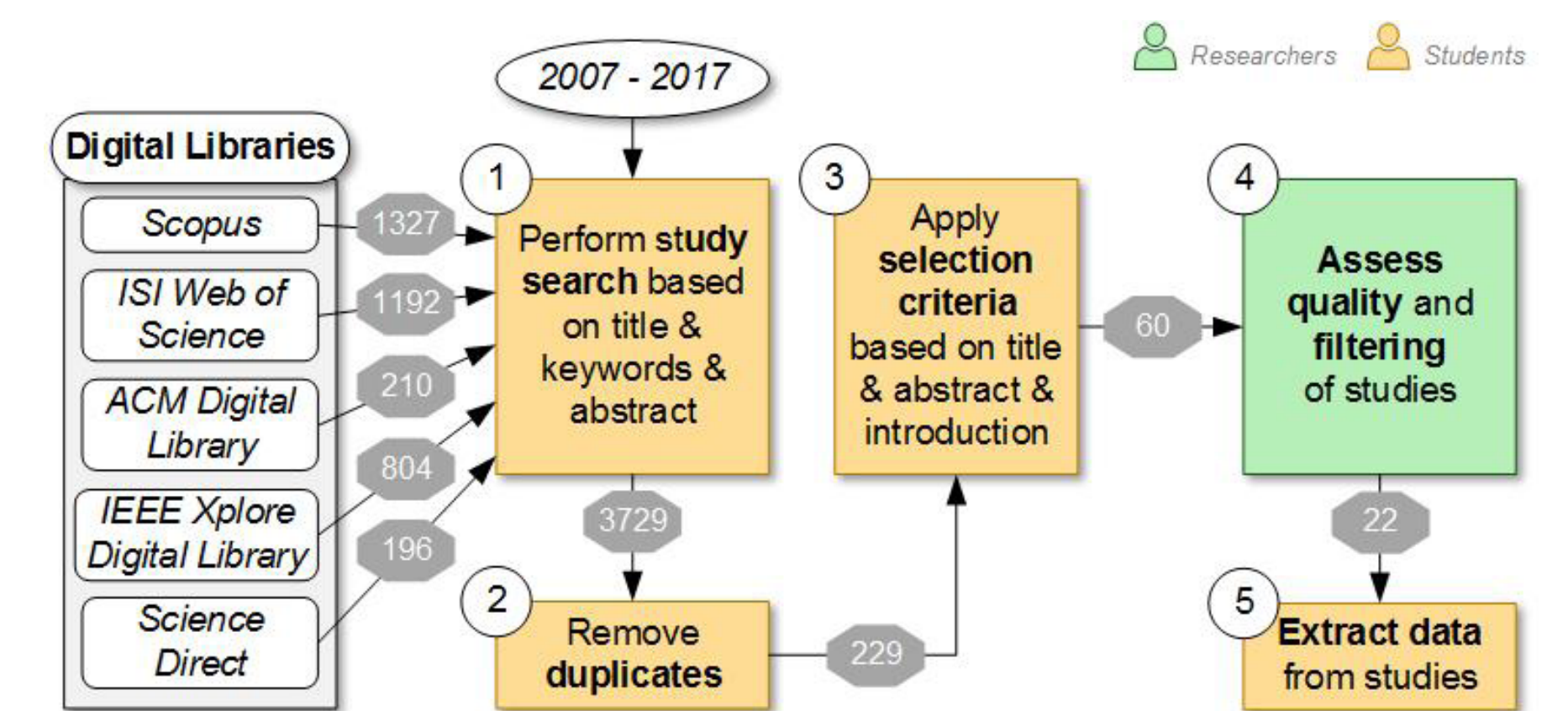
**RQ 4. CPSS Research:** What is the focus of current CPSS research?

**RQ 5. CPSS Application:** What are typical application domains and concrete examples of CPSS?

## Method - Systematic Mapping Study



Search Query:  
(cyber AND physical AND (soci\* OR human OR distributed OR participatory))



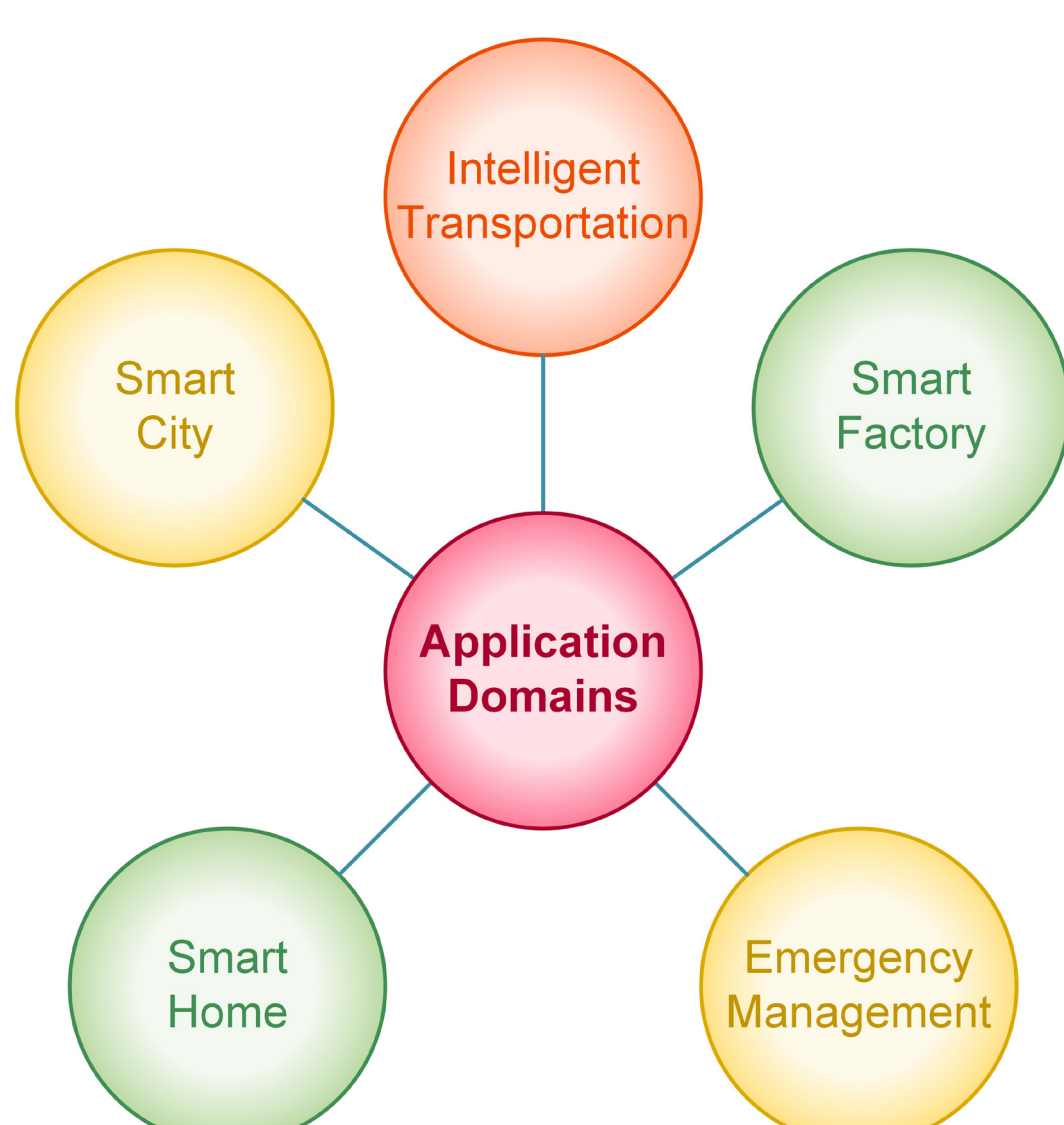
## Preliminary Results & Conclusions

**CPSS is a system-of-systems integrating cyber, physical, and social systems**

More research needed w.r.t. how dissemination mechanisms can be enhanced with human actuators to **close the feedback loop**.

Challenge to provide **appropriate mixture of crowdsourcing and CI approaches** to enhance information collection and coordination.

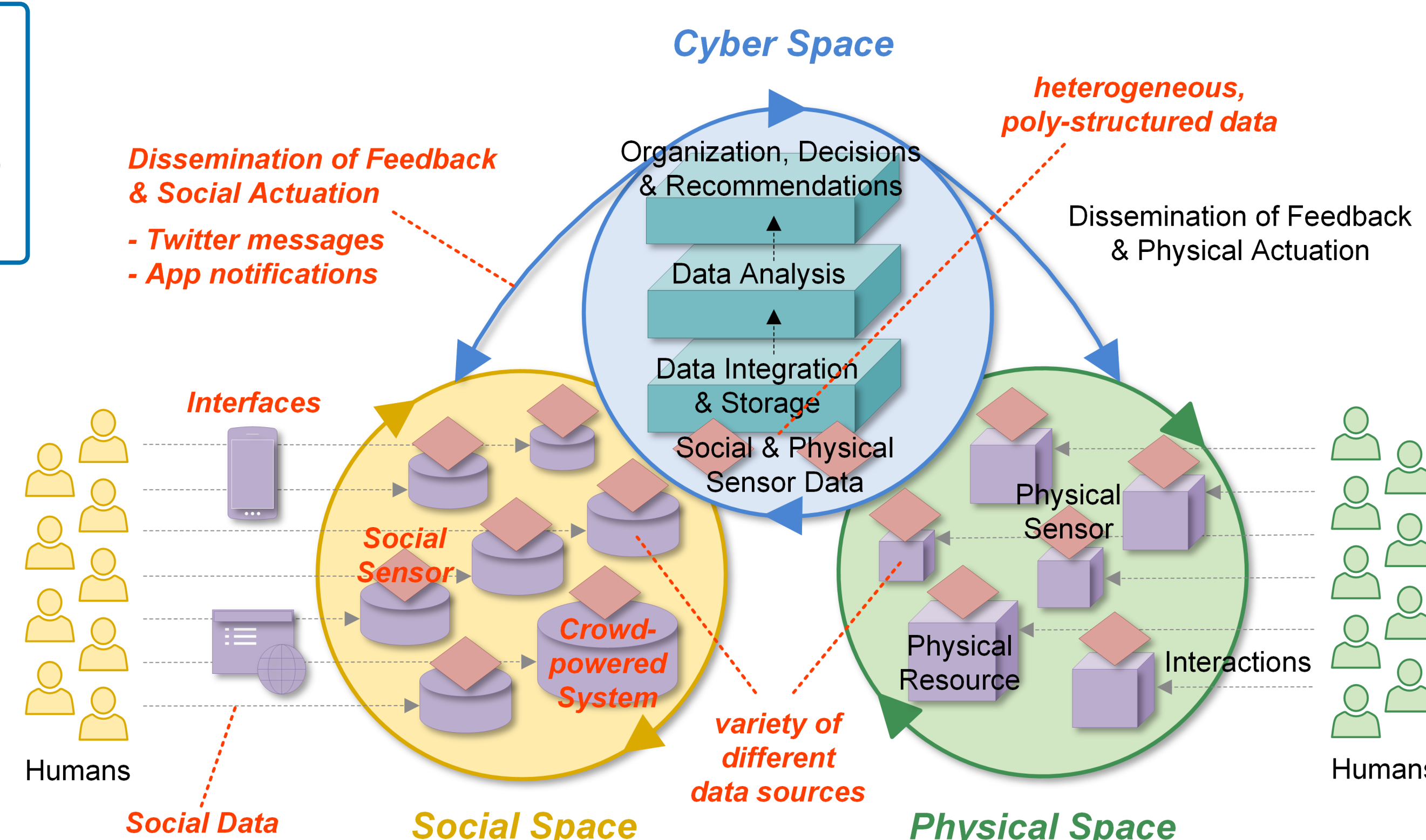
### Application Domains for CPSS



Most CPSS applications simply enhance **typical CPS applications with crowd-powered approaches**.

Many CPSS use social platforms **only as passive data sources**.

**Diverse interpretation of the CPSS concept** and in particular its 'social' part exist.



There is a **lack of methods to analyze and design** data integration, dissemination and actuation in the context of orchestrated machine and human interaction.

In existing CPSS feedback is **mostly targeted towards physical actuators**. Social actuation is rarely used.

### CPSS-related Terms

smart services, artificial systems, cyber-physical system, social environment, human-centric computing, human system integration, people-centric applications, human-centered system, human-in-the-loop, human-centric-cyber-physical system, cyber physical social sensing, anthropocentric cyber-physical system, human-centered computing system, ubiquitous sensing, human-in-the-loop cyber-physical system, cyber-physical-social interconnection, self-aware and self-adapting systems, people centric internet of things, cyber-physical-human space, user centric data, cyber-physical social system, human-centric framework, cyber-physical-socio space, socio-cyberphysical system, decision support systems, mental space, cyber-physical-social space, human behavior, computing for human, cyber-social system, predictive learning, internet of things.