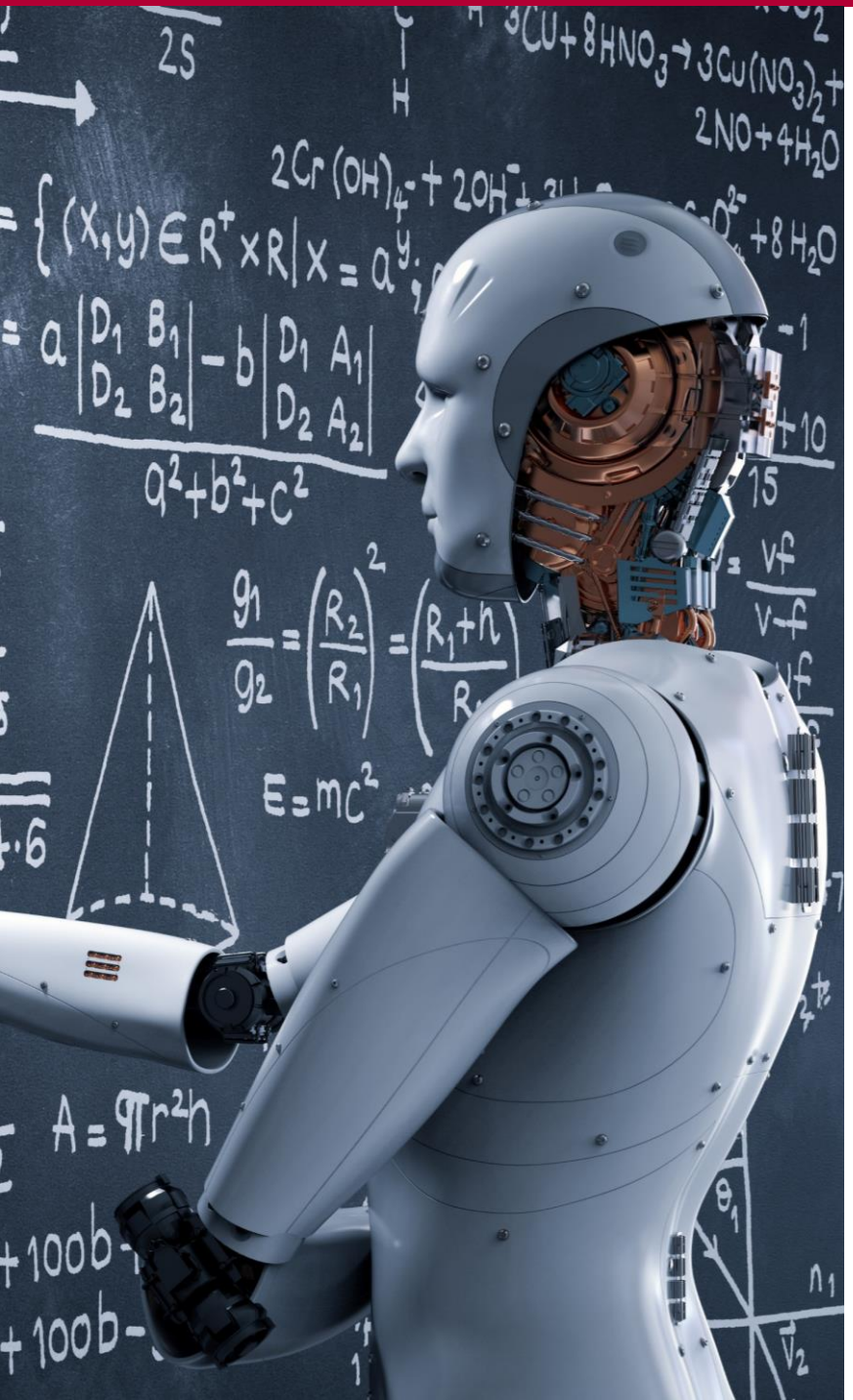

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Teaming up with Intelligent Agents – A Work System Perspective on the Collaboration with Intelligent Agents

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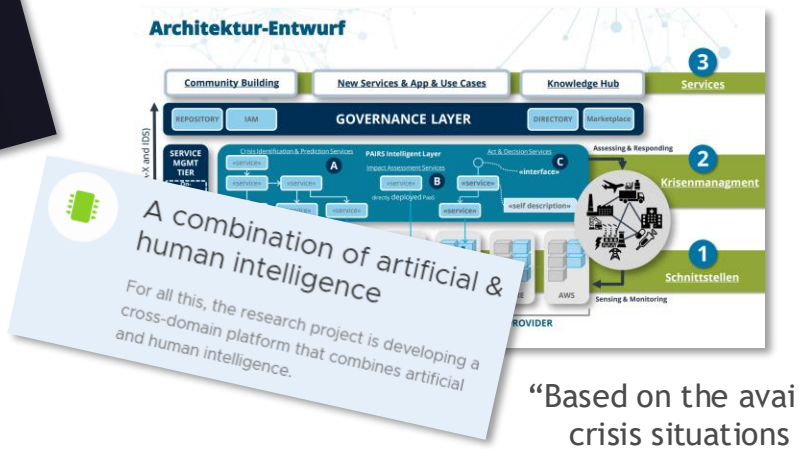
As intelligent agents are acquiring more capabilities, humans are teaming up with them in ever more circumstances

SAP is partnering with Mistral AI to allow customers to integrate LLMs into core business processes.



"Based on the available data, the AI hybrid technology identifies crisis situations and their effects and develops appropriate response measures." (PAIRS Project)

"This is going to bring us closer to realizing our vision in which Siri moves through the system in concert with you." (Apple)

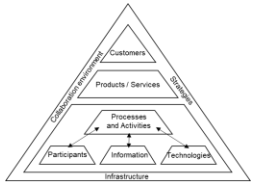
In-app actions

"Siri will take actions inside apps on your behalf." (Apple)

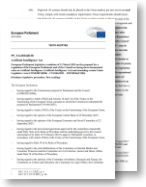
We consider an **intelligent agent** as "a computer system that is capable of flexible autonomous action in order to meet its design objectives" (Jennings and Wooldridge, 1998, p. 4).

SAP, Apple, PAIRS Project

Research and practice still face uncertainties and difficulties when implementing intelligent agents into work systems



A **system perspective** is important for designing work systems with collaboration between human and intelligent agents beyond simple bilateral settings



This system perspective is becoming even more important with **AI regulation** such as the EU AI act getting adopted

Yet, we face challenges regarding this system perspective:

1. Most research to date focuses on **individual** human-computer **interactions**
2. A **lack of knowledge about how to describe** such settings, their design choices, and dependencies hampers our ability to identify and understand issues of collaboration between human and intelligent agents in work systems
3. The agency of current and future intelligent agents may **blur the boundaries between participants and technology** and **reverse typical task-delegation flows**

RQ: How can we conceptualize the collaboration between humans and intelligent agents in work systems?

Alter (2013), Baird & Maruping (2021), EU AI Act (2024)

Work system theory enables us to take such a system perspective in approaching our research goal

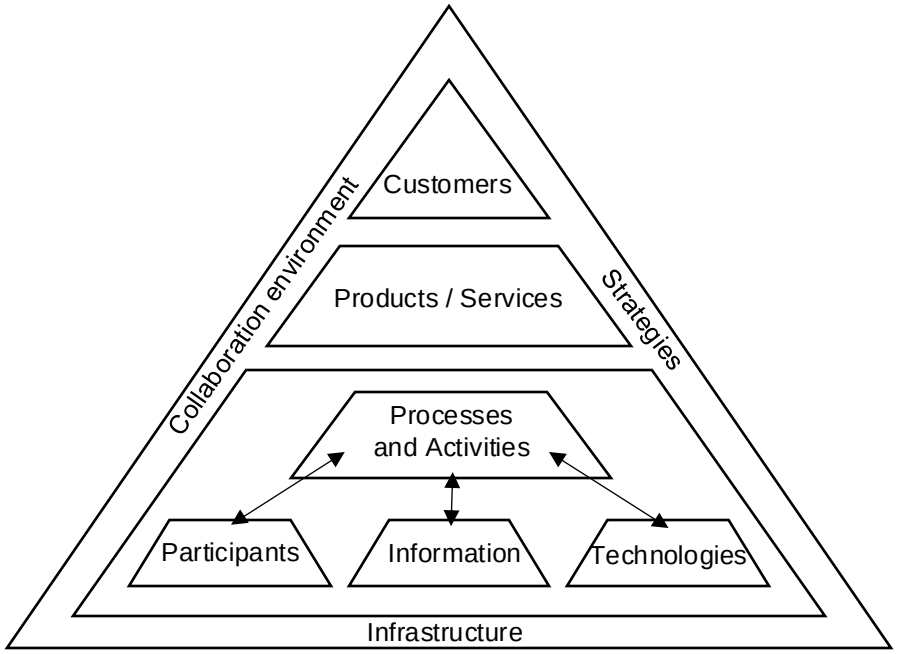


***Figure 1**: The components of a work system, based on Alter (2013).*

*"A work system is a system in which human **participants** and/or machines perform **work** (processes and activities) using **information**, **technology**, and **other resources** to produce specific products/services for specific internal and/or external customers."* (Alter 2013, p. 75)

Work systems comprise both a **social** and a **technical** system, that may interact to achieve the work system's goals.

Processes and activities serve as the component in a work system that participants, technologies, and information have to be **aligned to.**

This fits well with our system-level, task-centric perspective on the collaboration of human and intelligent agents.

Alter (2013), Bostrom & Heinen (1977), Laumer et al. (2016)

We conducted a literature review and took the work system perspective to develop a framework

Literature search & selection

- Literature searched in AISeL, Web of Science, and EBSCOhost, due to interdisciplinarity of topic
- **Iterative development of search string** resulted in a search centered around *human robot interaction* and *artificial intelligence*

Coding & analysis

- Started with a **concept matrix** based on the dimensions of the existing framework by Hinsen et al. (2022)
- Iteratively added newly emerging dimensions throughout the coding process
- Ultimately, coding resulted in a concept matrix with **16 dimensions**, of which seven newly emerged

Framework development

- Developed a framework as an initial effort to **make sense of the identified dimensions** from the literature and to set them into relation
- Used the elements of **work system theory** to guide the framework development

Hinsen et al. (2022), Webster & Watson (2002)

We identified 16 important design dimensions of collaboration between human and intelligent agents in work systems

#	Dimension
1	Number of interactors
2	Interaction transparency *
3	Interaction dependency *
4	Team roles
5	Action channel *
6	Action direction *
7	Interaction frequency *
8	Action frequency *
9	Interaction impulse *
10	Action space
11	Interaction environment *
12	Interaction result *
13	Collaboration control
14	Delegation
15	Collaboration strategy
16	Turn taking

Agents and the **team** of agents that are collaborating in the work system

Exchanging of information between collaborating agents

Environment in which the collaboration is taking place

Collaborative **task processing** of human and intelligent agents

__Table 1__: Identified dimensions from the literature. Dimensions based on Hinsen et al. (2022) are marked with an asterisk.

We assembled a framework to describe and analyze work systems where human and intelligent agents collaborate

- Based on the identified 16 dimensions of task-centered collaboration of human and intelligent agents, we assembled a **framework**.
- We propose this framework as an **initial step of theorizing** and setting the identified dimensions into relation to each other.
- With the framework, we aim to **facilitate describing and analyzing** work systems of human and intelligent agents' collaboration.
- The framework is depicted using an entity-relationship model. It comprises of **dynamic and structural components**.

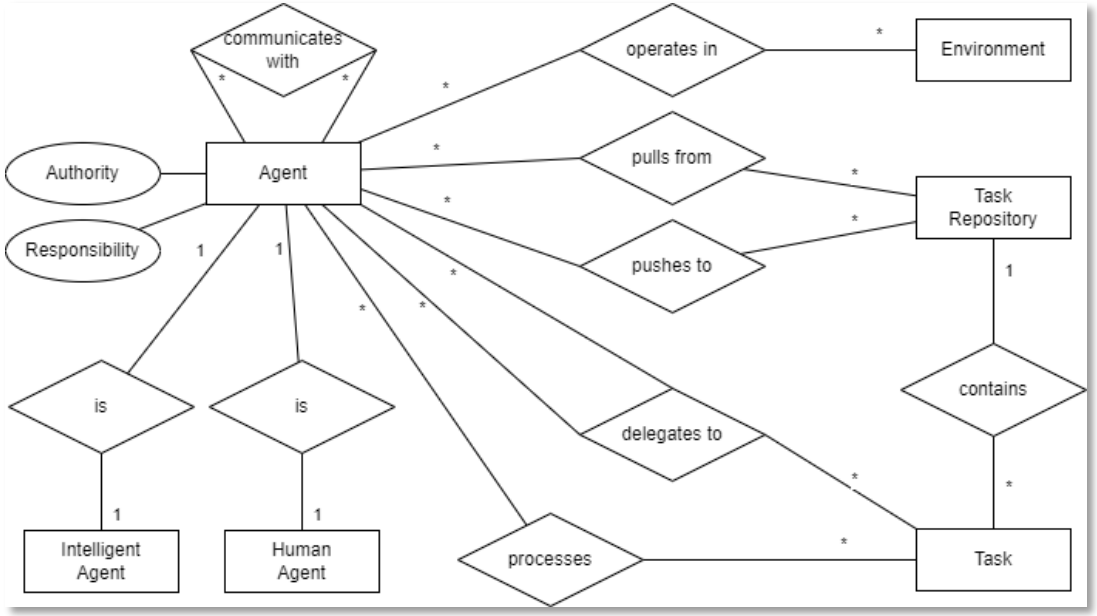


Figure 2: Entity-relationship model of the framework's components.

The frameworks' structural components

Our understanding of agents encompasses both **participants** (i.e., human agents) and **technologies** (i.e., intelligent agents) of work system theory.

1. Agents can proactively take action, process a task, or communicate with other agents.
2. Agents have responsibilities and authorities.
3. Agents perceive their environment and are aware of other agents, their intentions, and their characteristics.

Agents

We conceptualize **tasks** and **task repositories**:

1. Tasks represent a central component of alignment for the agents in our framework, in line with work system theory.
2. Task repository is an auxiliary concept to explain a task's whereabouts when it is not being processed by an agent.

Tasks and task repositories

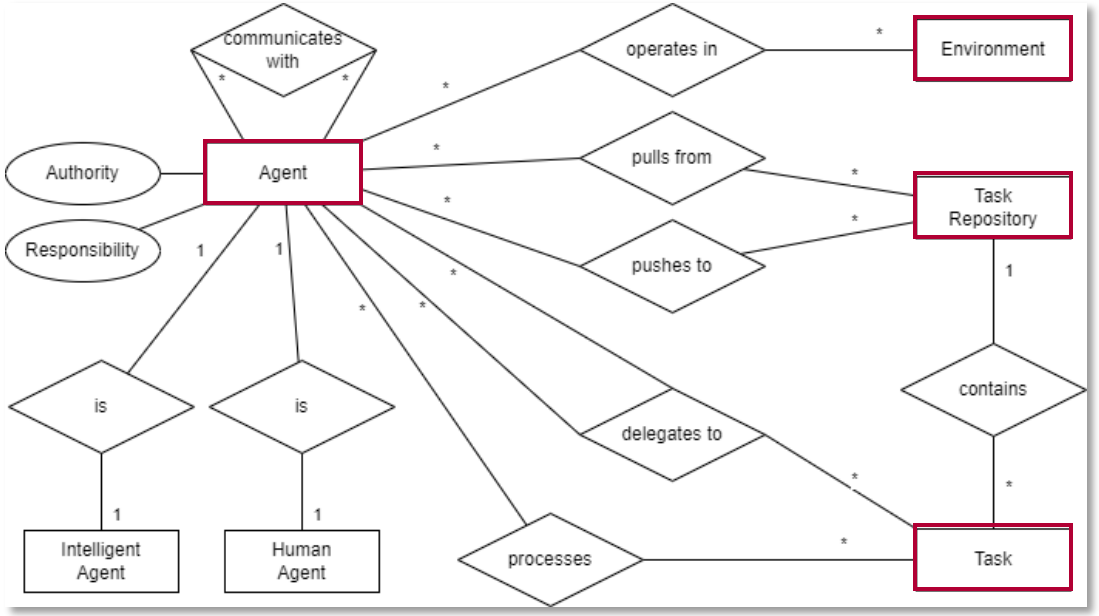


***Figure 2**: Entity-relationship model of the framework's components (structural components highlighted).*

Structural component "environment" omitted for the sake of brevity.

The frameworks' dynamic components describe the behavior of the structural components

Processing tasks requires agents to perform activities for the tasks state to proceed. This dynamic is based on our task-centered approach.

Task processing

Our framework allows both human and intelligent agents to initiate a collaboration and, thus, the **delegation of tasks** in both directions. The delegation happens via a task repository.

Delegation

The **communication** dynamic of our framework allows for exchanging information between agents. Information is a central component to any work system and plays a key role in agents' collaboration.

Communication

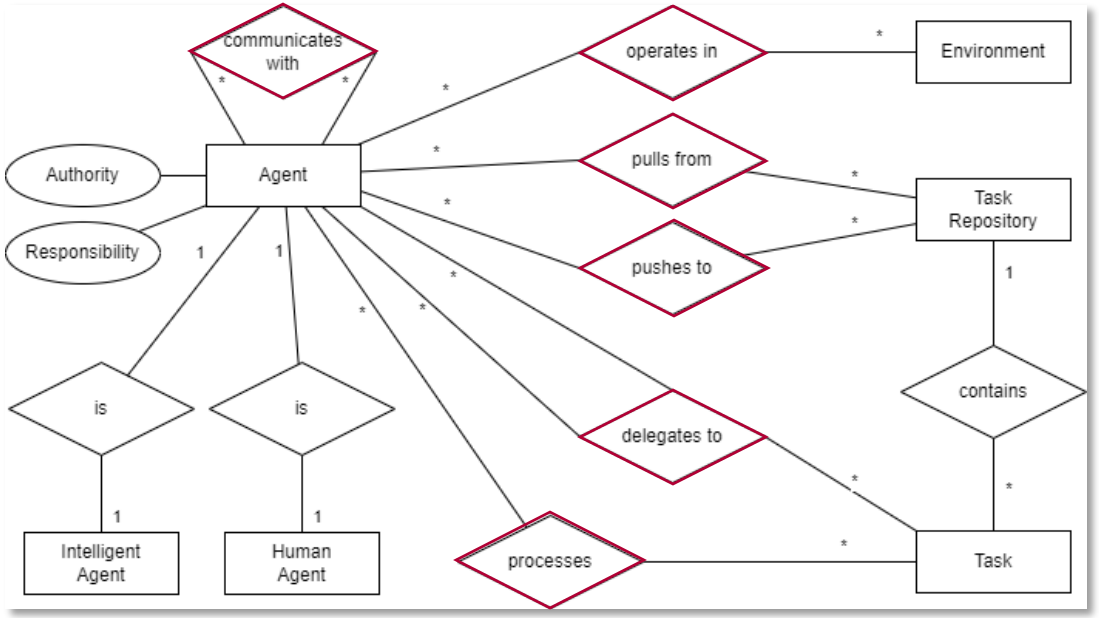


***Figure 2**: Entity-relationship model of the framework's components (dynamic components highlighted).*

In future research, we intend to build on these theoretical insights to develop a practical modelling tool

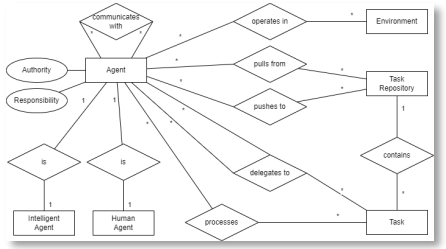
Outlook on task-centered collaboration of human and intelligent agents

- Framework developed from dimensions seeks to **theorize on and relate the generated insights to each other**
- Helps us understand peculiarities and design choices of task-centered collaboration of human and intelligent agents in work systems
- One could use our framework's components to describe and design specific work system constellation

- We intend to build on these theoretical insights to **develop a practical modelling tool** that may help organizations to achieve transparency about intelligent agents, their tasks, and their interactions in work systems
- To help users decide where to use intelligent agents while retaining clarity about the usage's implications across an organization and to help organizations in **complying with regulation such as the EU AI act** (e.g., Article 11(1) and Annex IV)

Contribution

16 identified dimensions contribute to the knowledge base on the collaboration of human and intelligent agents



Theoretical framework structuring relevant dimensions of the collaboration of human and intelligent agents in work systems

EU AI Act (2024)

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Thank you for listening!

We are happy to discuss our research.

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