



**HAL**  
open science

## Cooperation: Adaptability of shared functions between Humans and Machines -Design and evaluation

Sridath Tula, Marie-Pierre Pacaux-Lemoine, Emmanuelle Grislin-Le Strugeon,  
Paulo Santos, Anna Ma-Wyatt

### ► To cite this version:

Sridath Tula, Marie-Pierre Pacaux-Lemoine, Emmanuelle Grislin-Le Strugeon, Paulo Santos, Anna Ma-Wyatt. Cooperation: Adaptability of shared functions between Humans and Machines -Design and evaluation. Mardi des Chercheurs, Mar 2024, Mons, Belgium. hal-04554391

**HAL Id: hal-04554391**

**<https://hal.science/hal-04554391>**

Submitted on 22 Apr 2024

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Copyright

Sridath TULA

# Human-Robot Cooperation: Agent's Cooperation Levels to Enhance Human-Robot Teaming

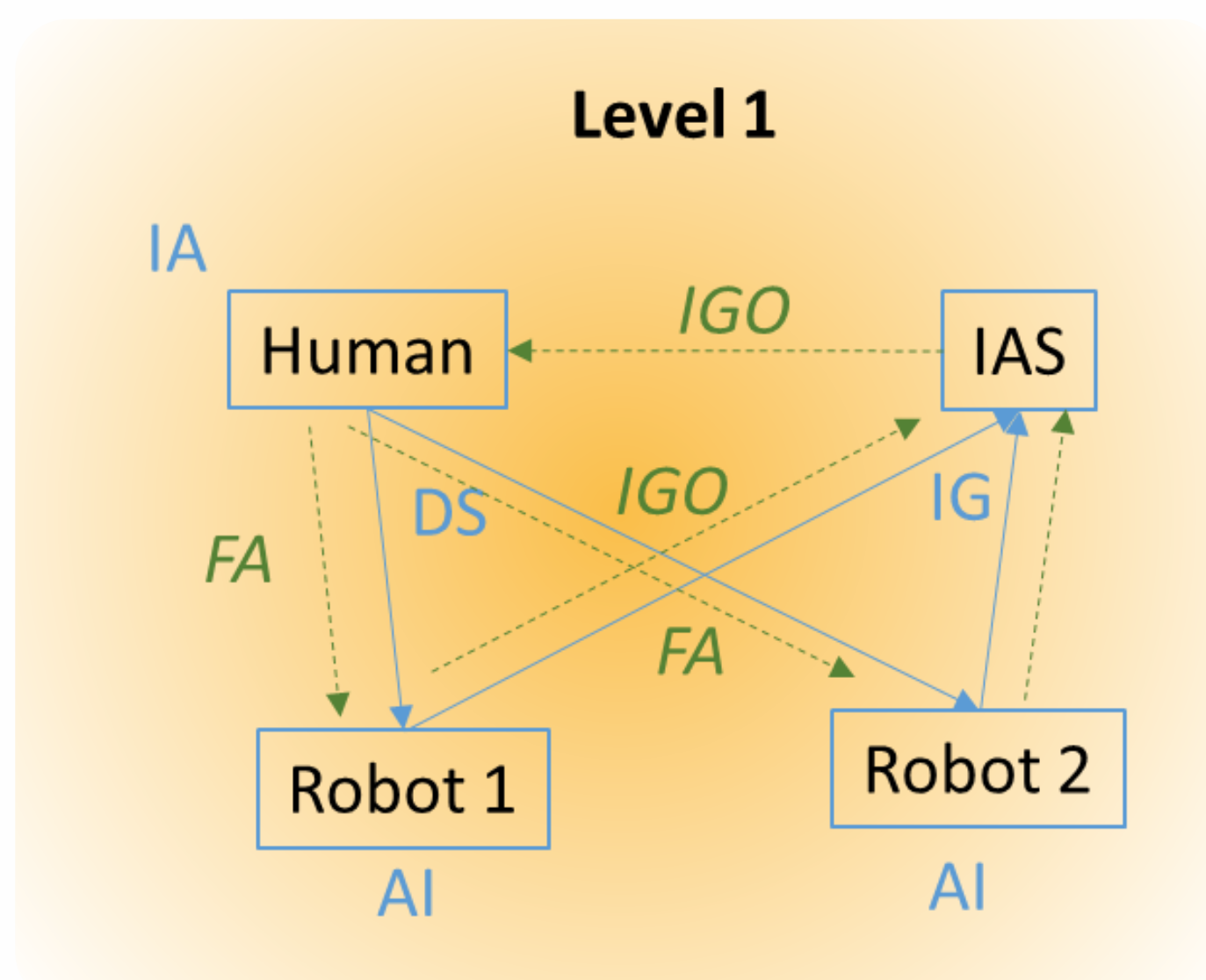
Supervisors: M-P. Pacaux-Lemoine, E. Grislin-Le Strugeon, P. E. Santos, A. Ma-Wyatt

Context:

- To Improve Human-Robot Cooperation in Crisis Management.

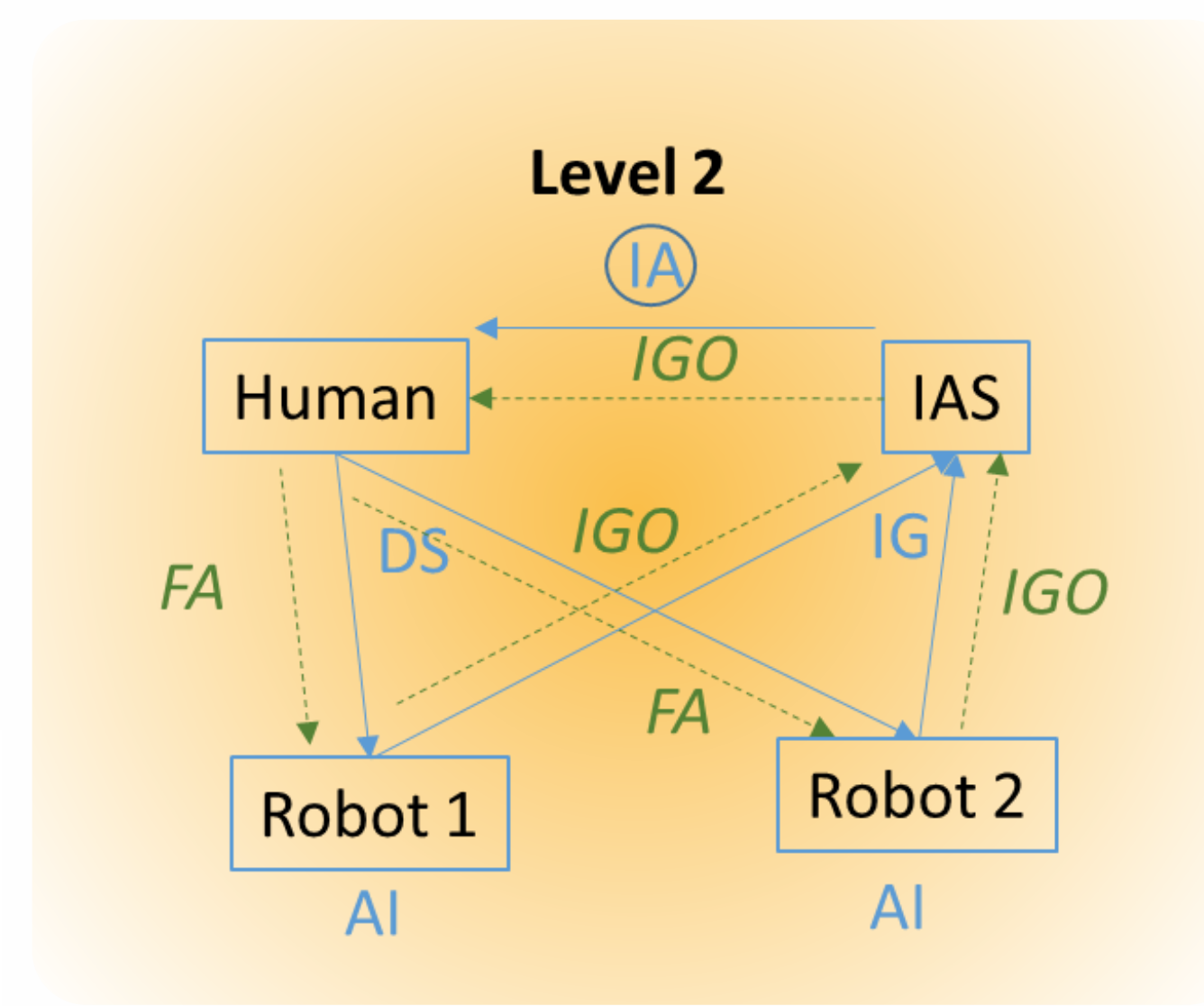
Objective:

- To make use of Human Machine cooperation model, Multi-Agent system approaches to define and adapt levels of cooperation to enhance Human-Robot Cooperation [2].



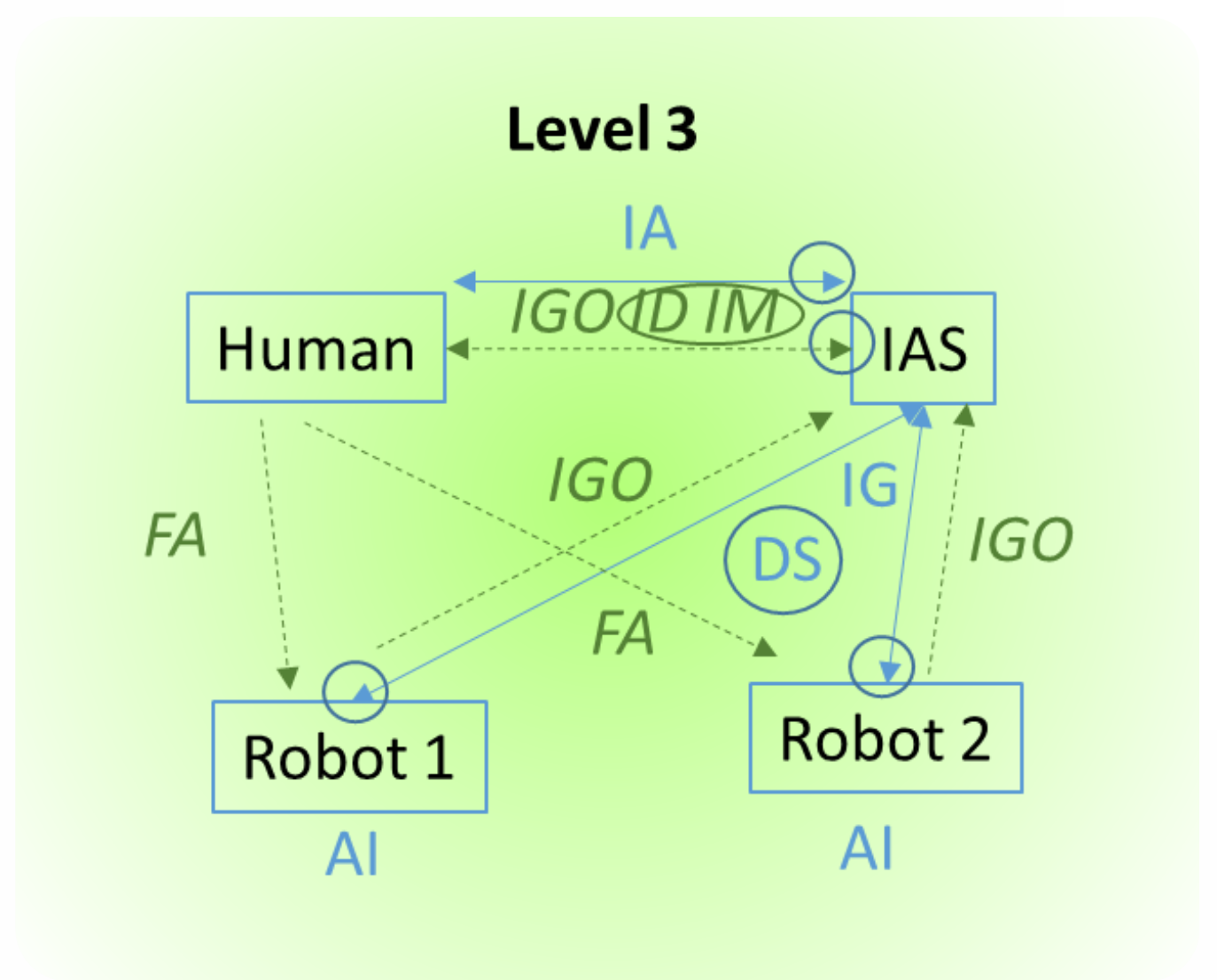
Level 1: Teleoperation

The Intelligent Assistance system (IAS) acts as an interface for teleoperation between the human and robots.



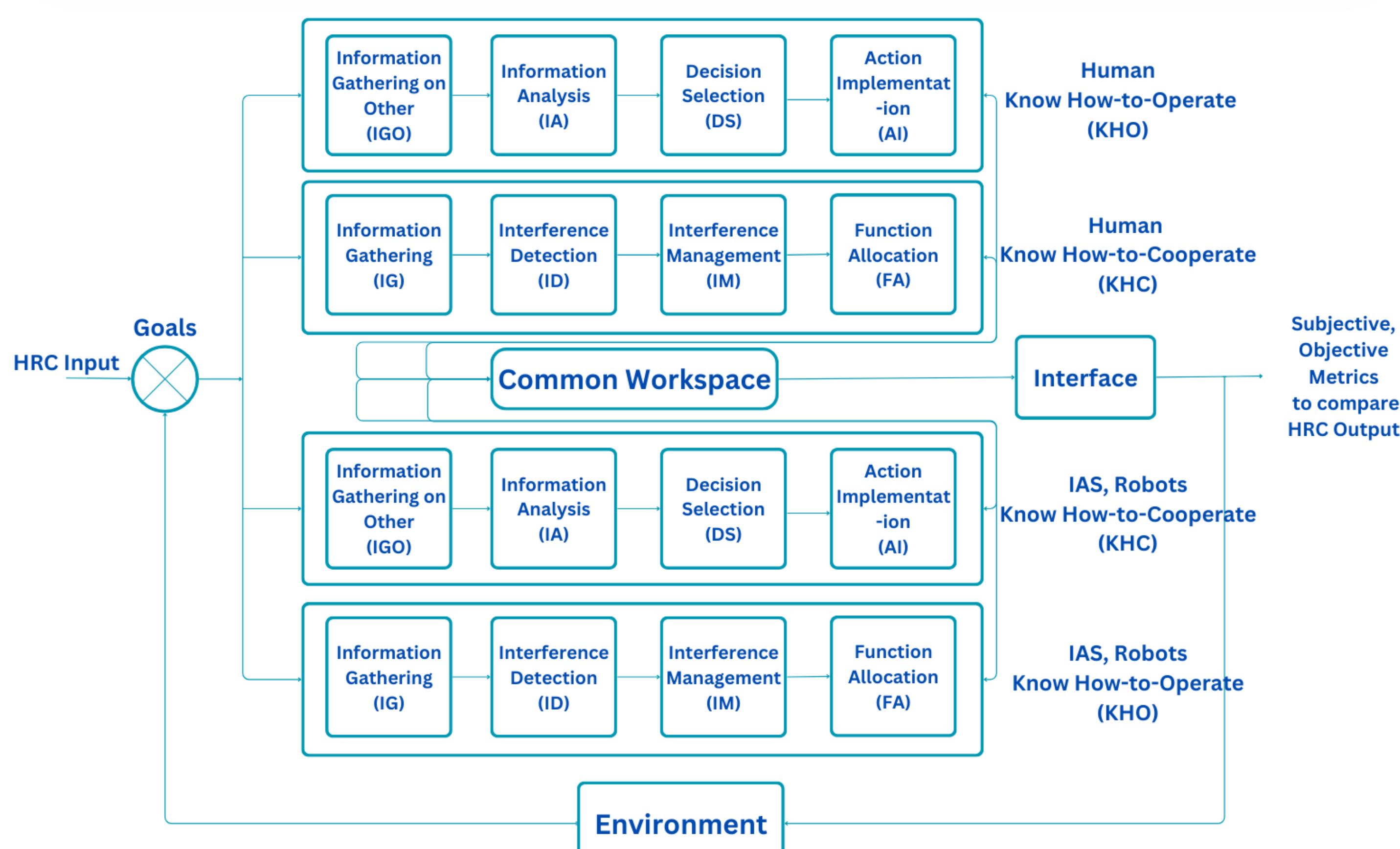
Level 2: Decision Support

IAS enhances the capabilities of the human operator by providing predefined strategies tailored to the task at hand.

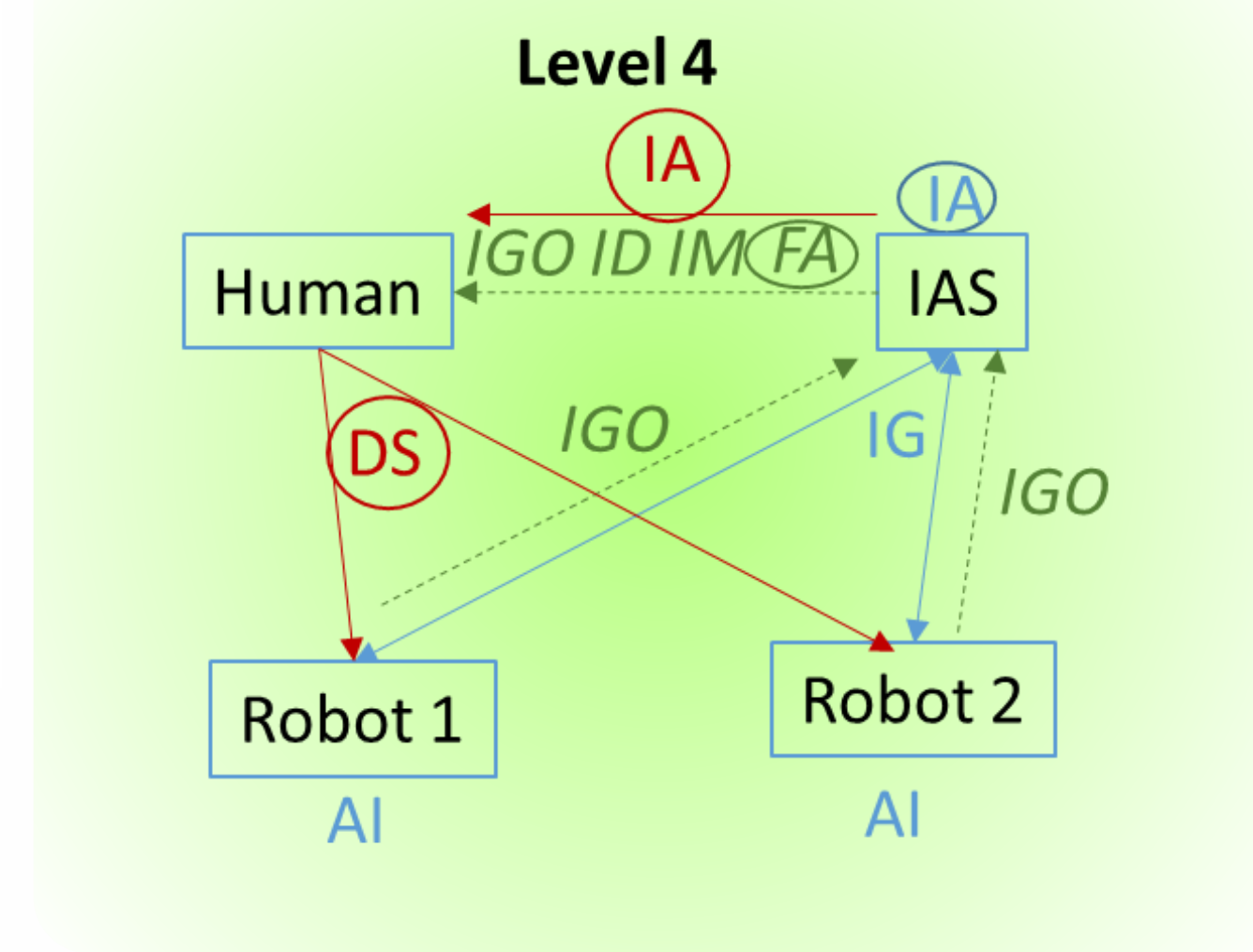
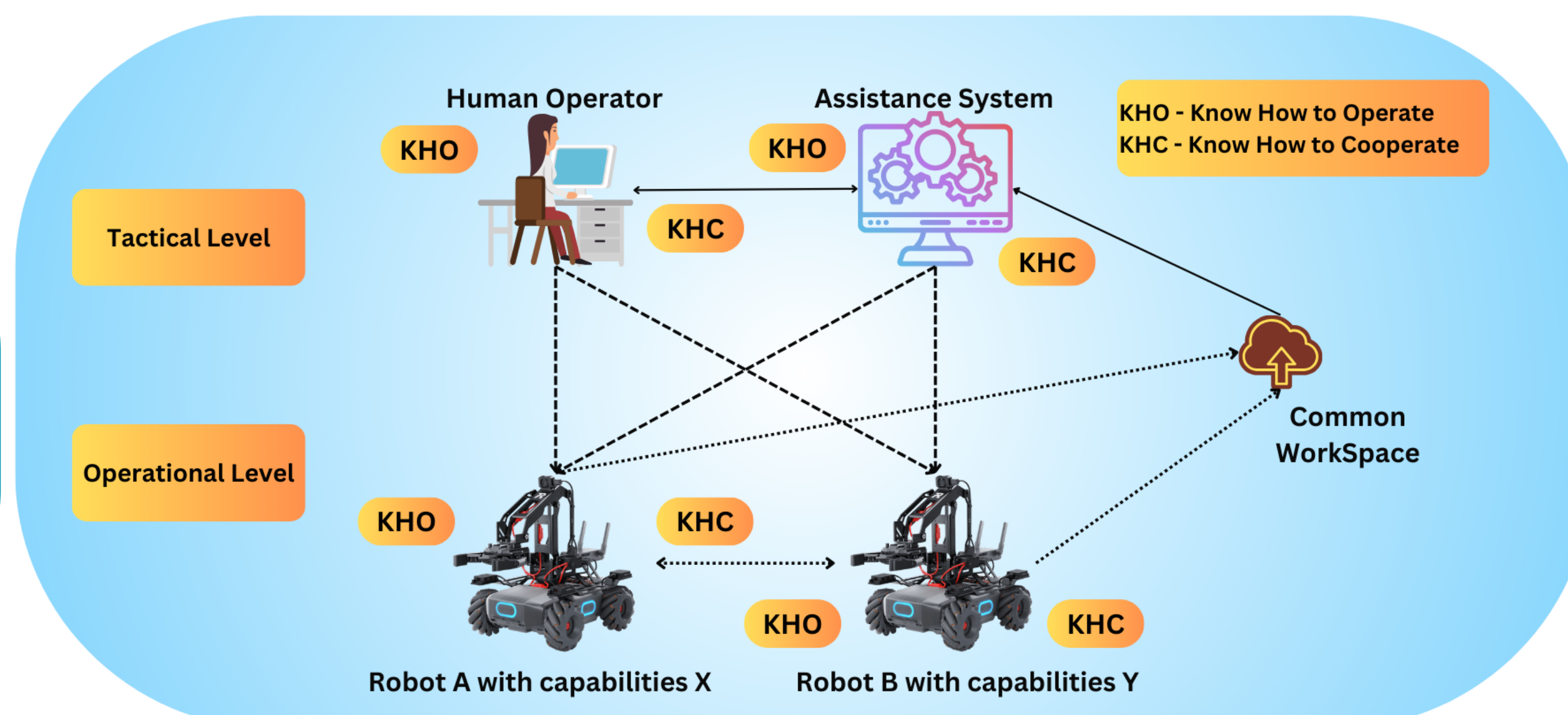


Level 3: Autonomous decision making

The IAS gains authority to make decisions autonomously among the predefined strategies.



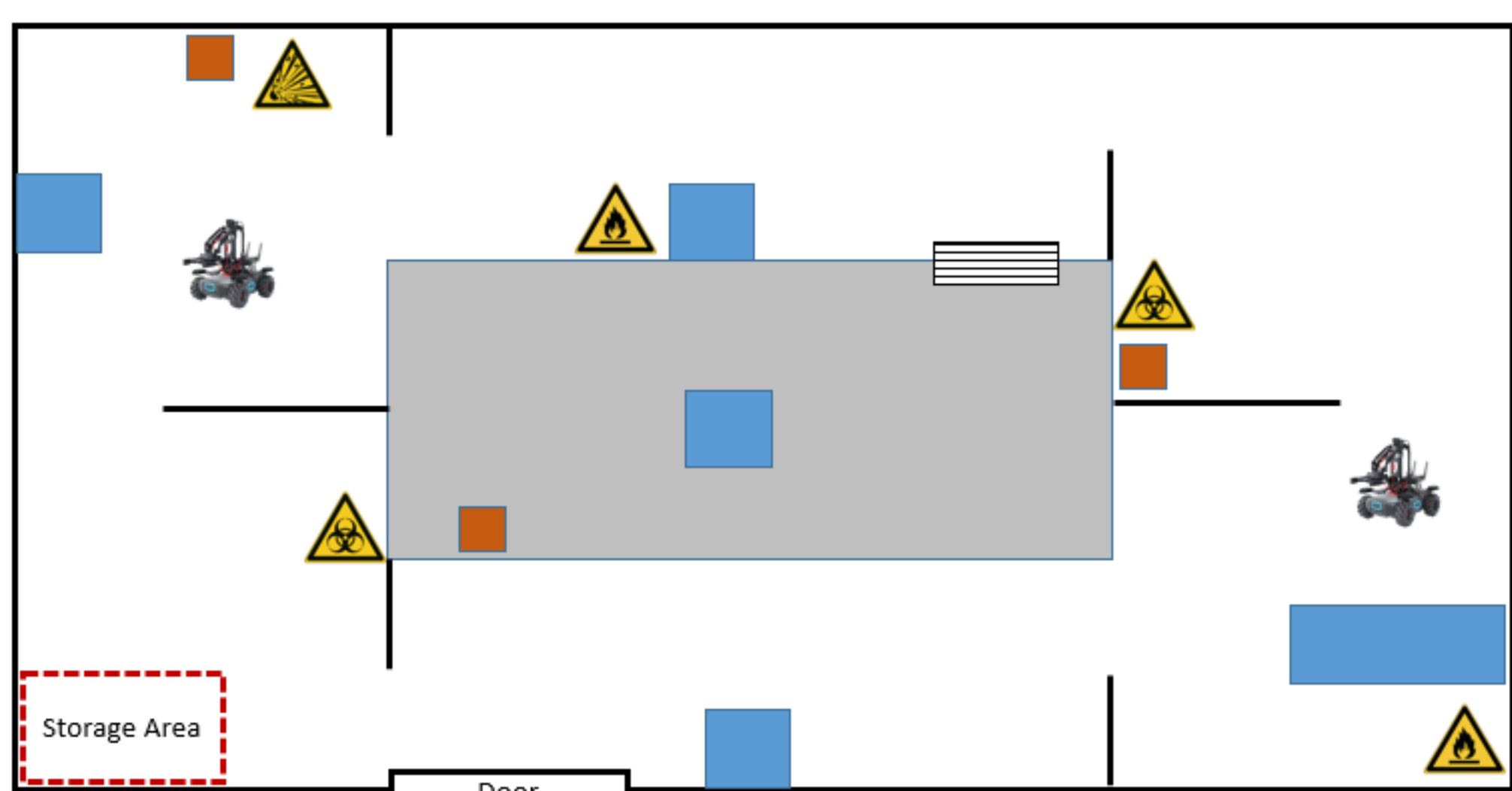
Organization of cooperation model [1]



Level 4: Supervised Autonomy

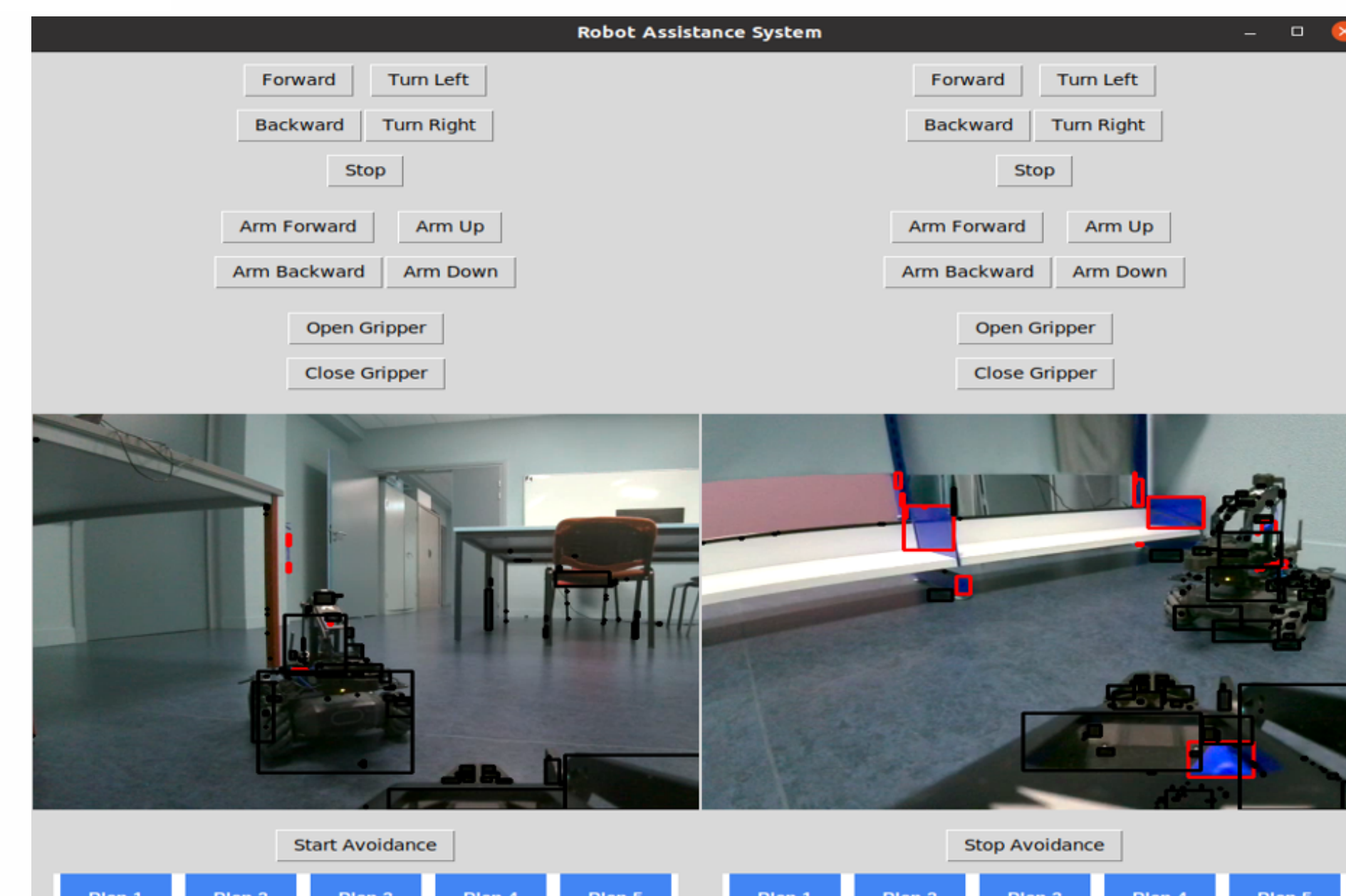
The IAS has the highest level of autonomy, assuming full control over the robots.

## Experimental Setup:



Environment setup inside a room

- A fire accident situation in a controlled setting.
- The experimental setup aims to validate and evaluate the proposed cooperation levels.
- Among the cooperative tasks are pick-and-place tasks between two robots.



Human-Robot Interface

References:

- [1] Pacaux-Lemoine MP, Flemisch F. Layers of shared and cooperative control, assistance, and automation. *Cognition, Technology & Work*. 2019 Nov;21(4):579-91.
- [2] Pacaux-Lemoine MP, Vanderhaegen F. Towards levels of cooperation. In: *2013 IEEE International Conference on Systems, Man, and Cybernetics 2013* Oct 13 (pp. 291-296). IEEE.
- [3] Pacaux-Lemoine M.-P. (2020). Human-Machine Cooperation: Adaptability of shared functions between Humans and Machines - Design and evaluation aspects, Habilitation à Diriger des Recherches, Université Polytechnique Hauts-de-France, Valenciennes, France, August.

