



Second Workshop on Affordances:  
Visual Perception of Affordances and  
Functional Visual Primitives for Scene Analysis

David Cabañeros Blanco  
Ana Belén Rodríguez Arias  
Víctor Fernández-Carbajales Cañete  
Joaquín Canseco Suárez

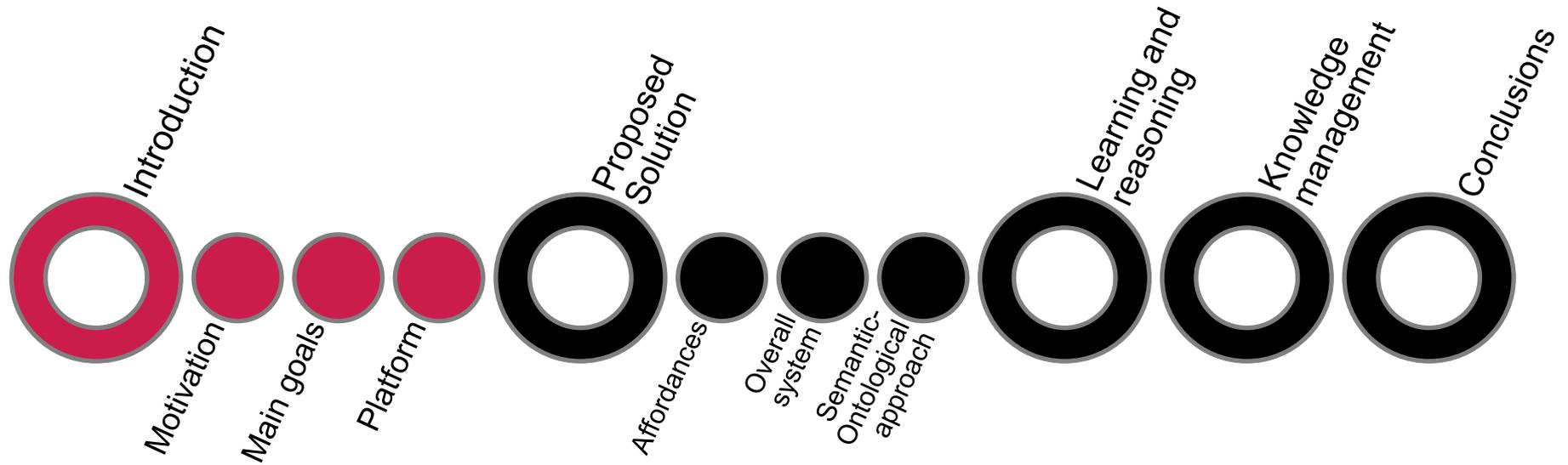
# OBELISK

Novel Knowledgebase of Object  
Features and Exchange Strategies



ICT-2011-7-2.1  
287888

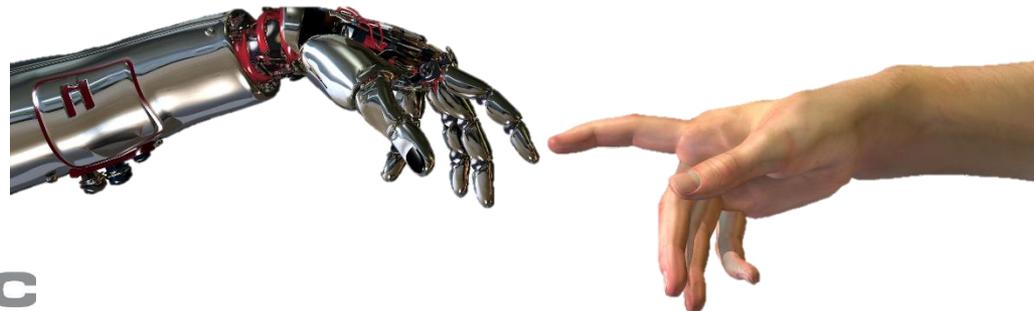




Current techniques of human-robot object transfer usually consist in following a trajectory completely defined before the motion starts, limiting thus the capacity to adapt the motion plan to the uncontrolled human behavior.

The robotic arm motions usually do not rely on characteristics of the human motion dynamics, while the object transfer itself is generally realized without using sensing information as the human does with his hand.

- To design a model of the cognition of fluent object exchange using a human-human set-up in which it is considered a representative sample of the kinds of normal **variations**, **un-modelled**, and **unpredictable** events and situations.
- To **model** how the goals and intentions of the exchange motions can be reliably detected, recognized and used to **drive** the on-going object exchange **interaction**.

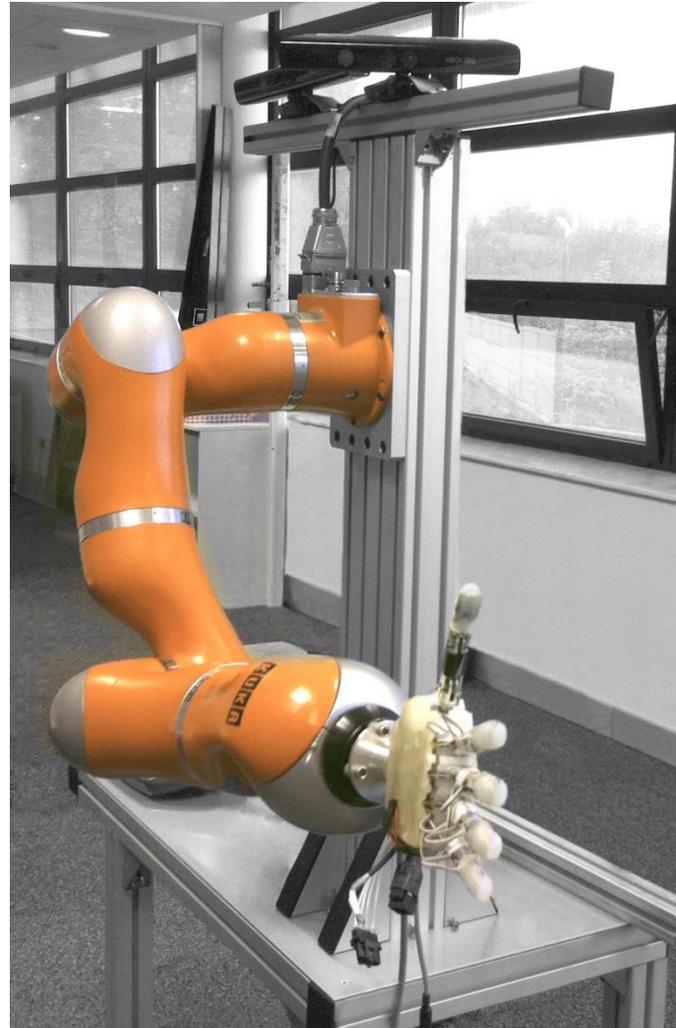


# OBEliSK

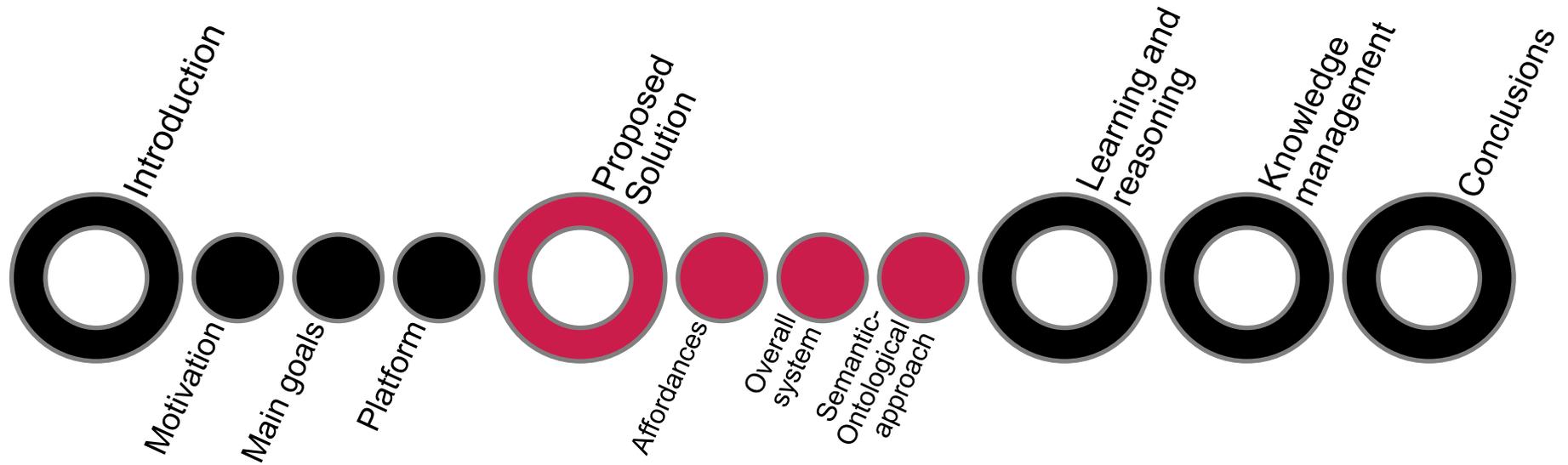
# Platform



**KUKA LWR**  
KUKA GmbH, Germany

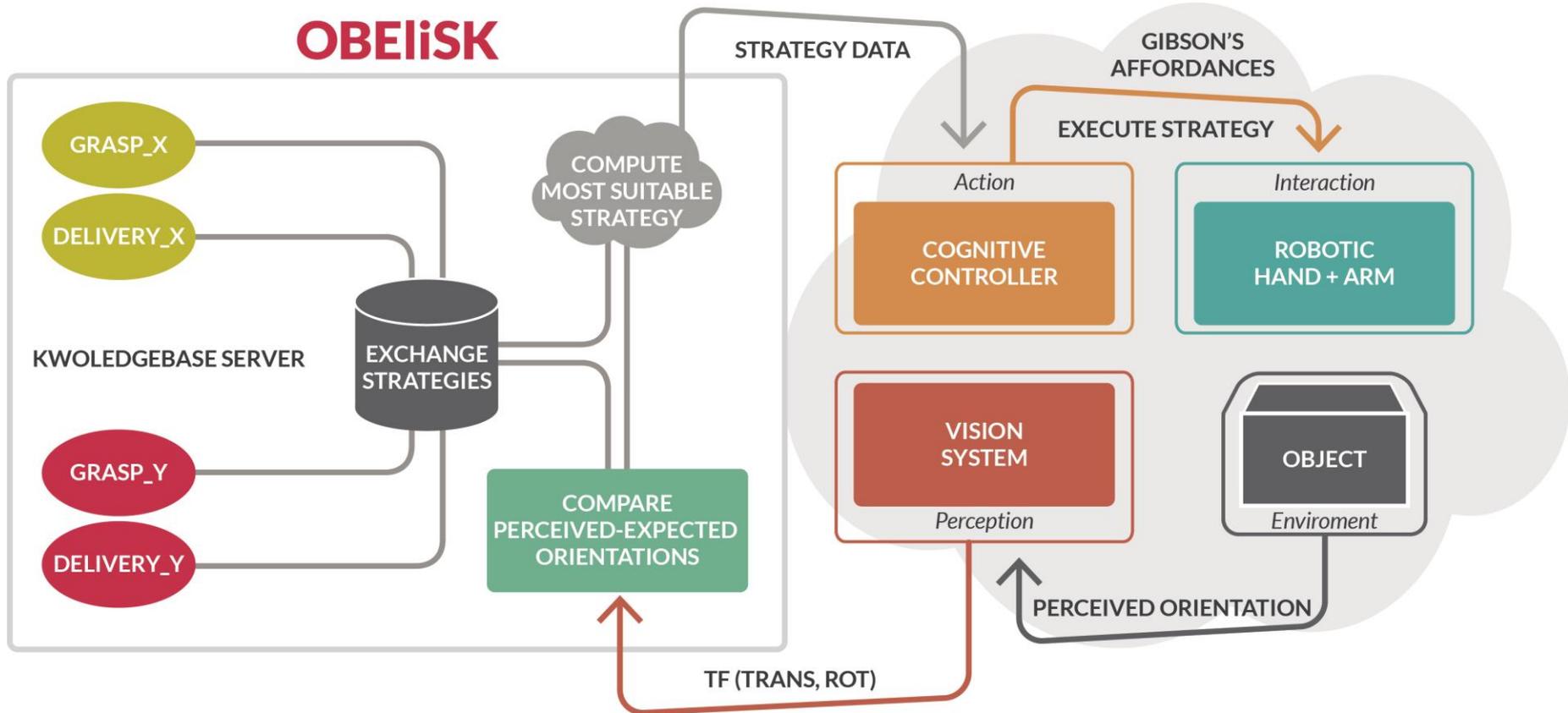


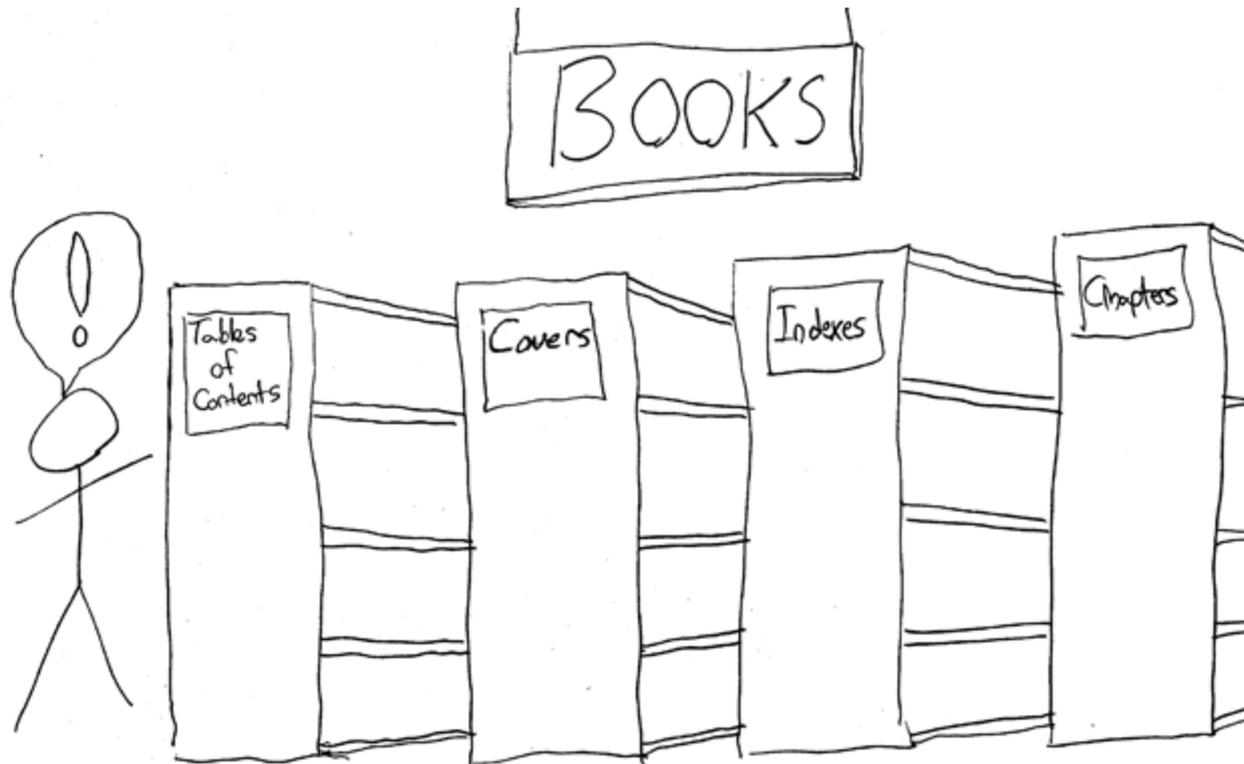
**IH2 AZZURRA**  
Prensilia SRL, Italy



“Gibson developed an **interactionist** view of **perception** and **action** that focused on information that is available in the **environment**”

*Greeno, J. G. (1994). Gibson's affordances. Psychological Review, Vol. 101(2), Apr 1994, 336-342.*



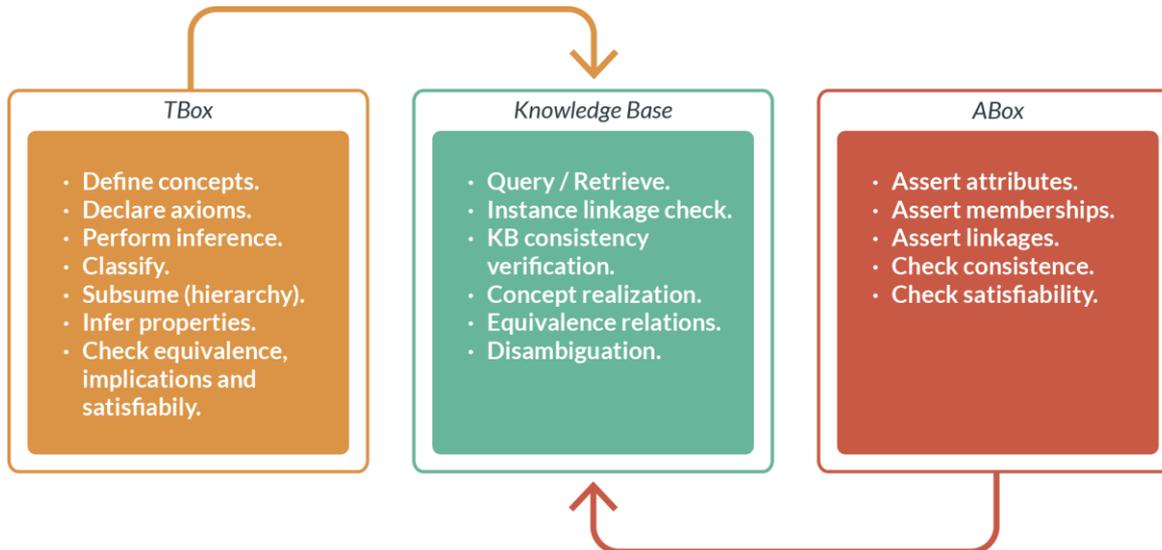


If libraries were like relational databases

<https://www.flickr.com/photos/bpanulla/>

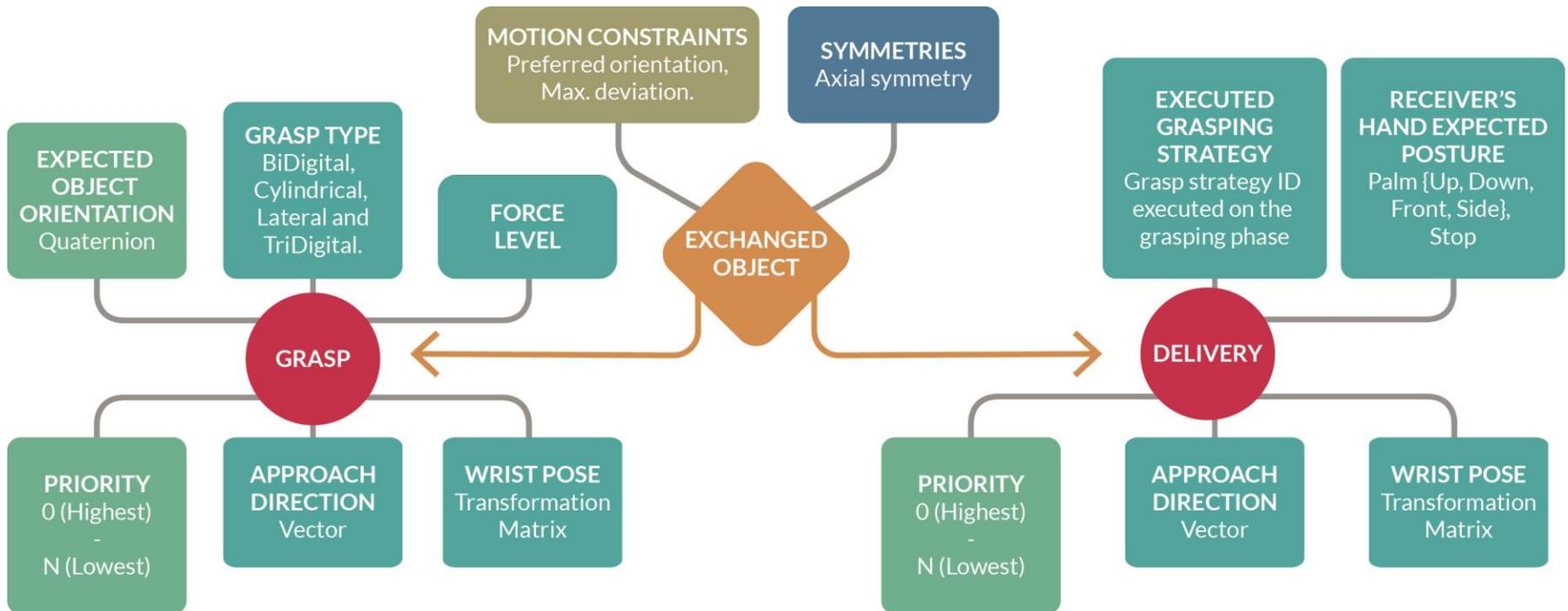
- A model of (some aspect of) the world
  - Introduces specific-domain vocabulary
- Often includes names for classes and relationships
  - Specifies intended meaning of vocabulary
- Designed using logical formalism
  - Description Logic languages – OWL-DL *SHOIN*
- Consists of two parts
  - Set of axioms describing structure of the model – A-Box ( $\mathcal{A}$ )
  - Set of facts describing some particular situation – T-Box ( $\mathcal{T}$ )

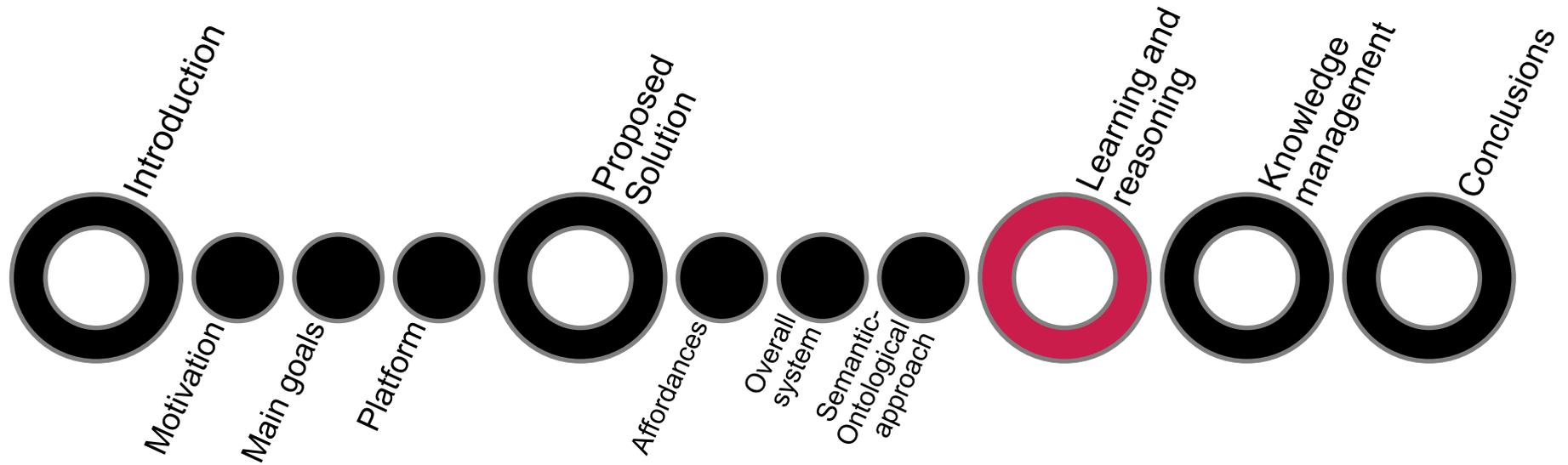
FOL	DL
Class	Concept
Property	Role
Object	Individual



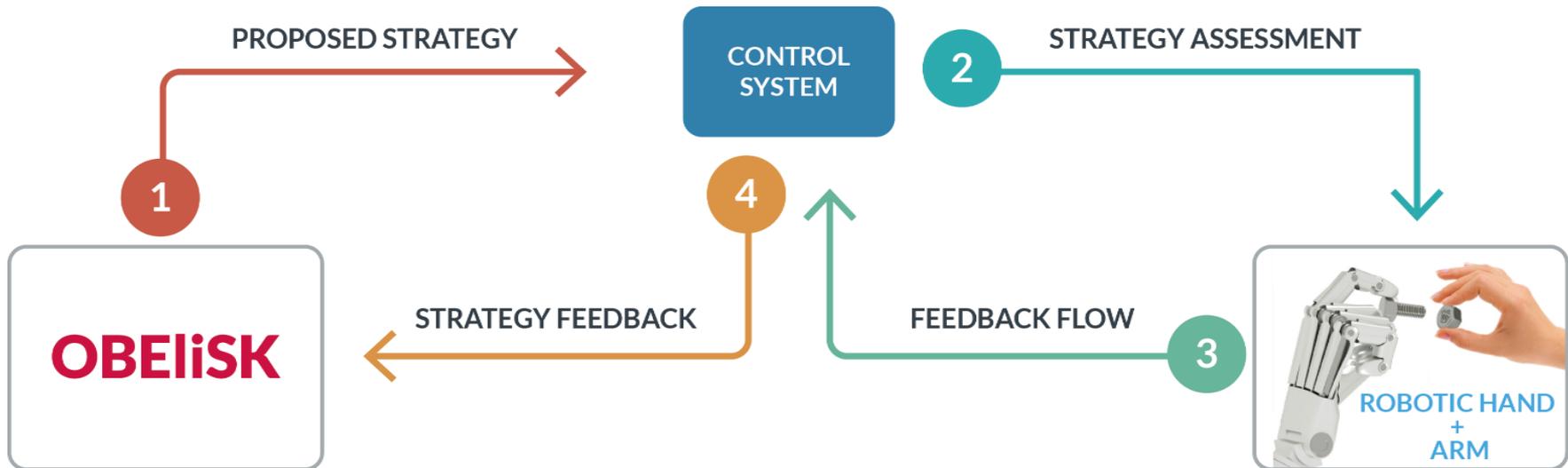
$$\mathcal{K} = (\mathcal{T}, \mathcal{A})$$

$$\mathcal{I} \models \mathcal{K} \Leftrightarrow \mathcal{I} \models \mathcal{T} \wedge \mathcal{I} \models \mathcal{A}$$

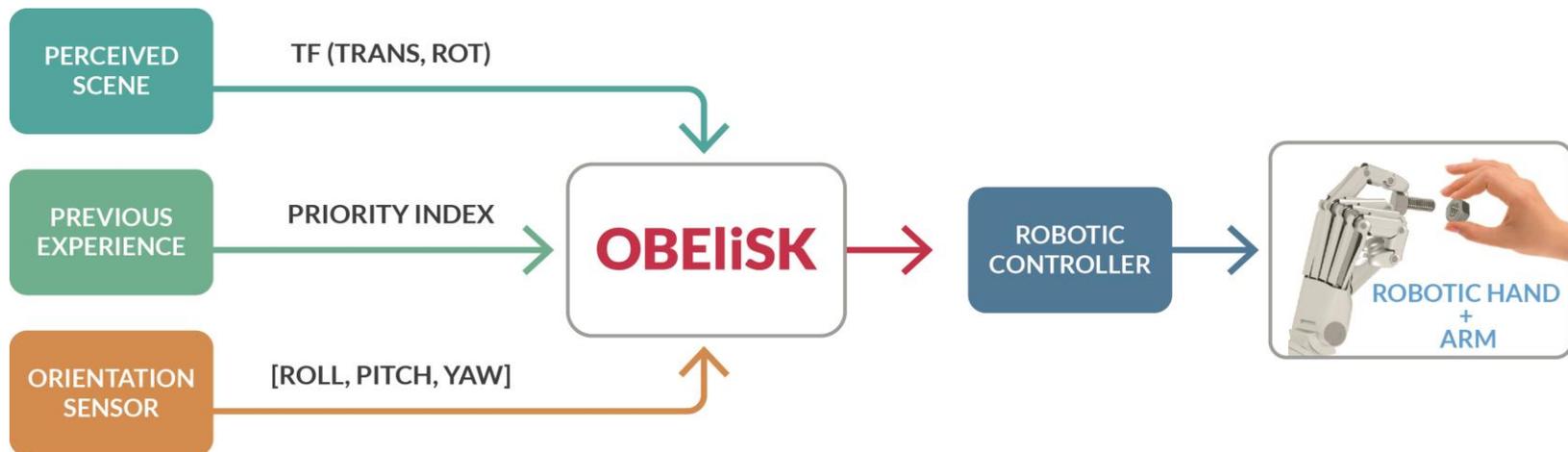


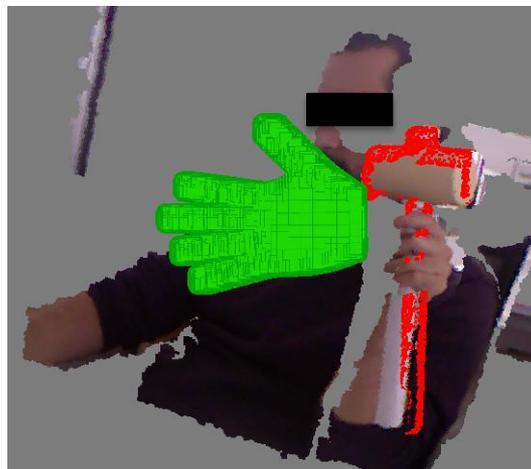
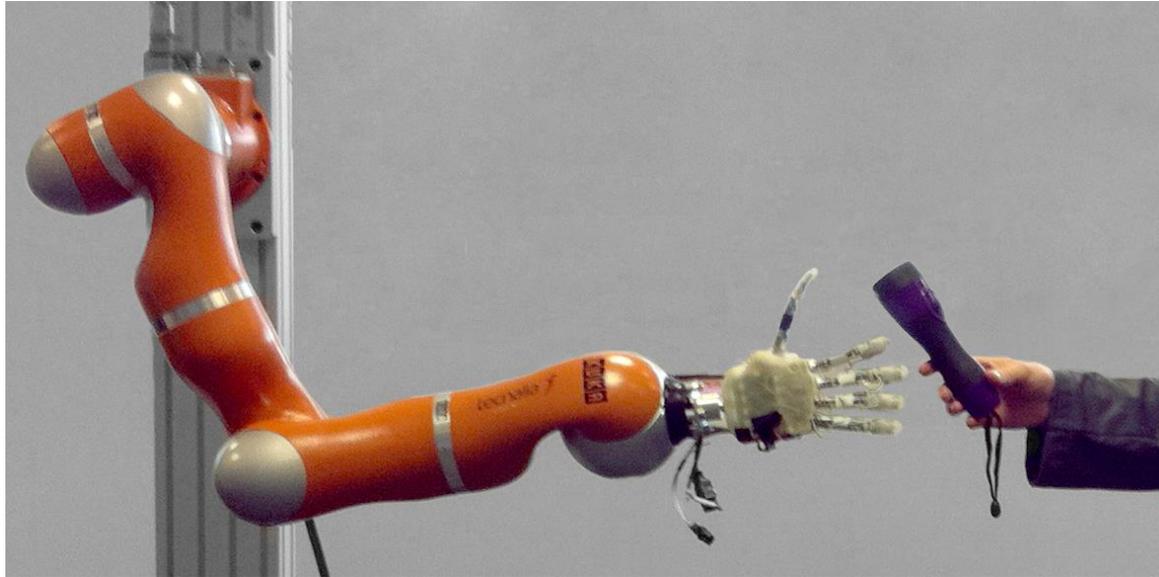


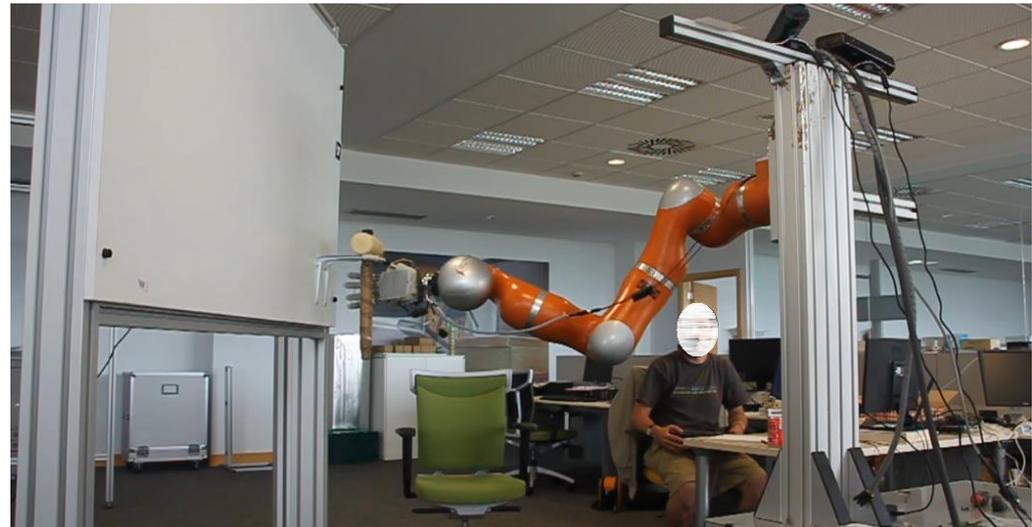
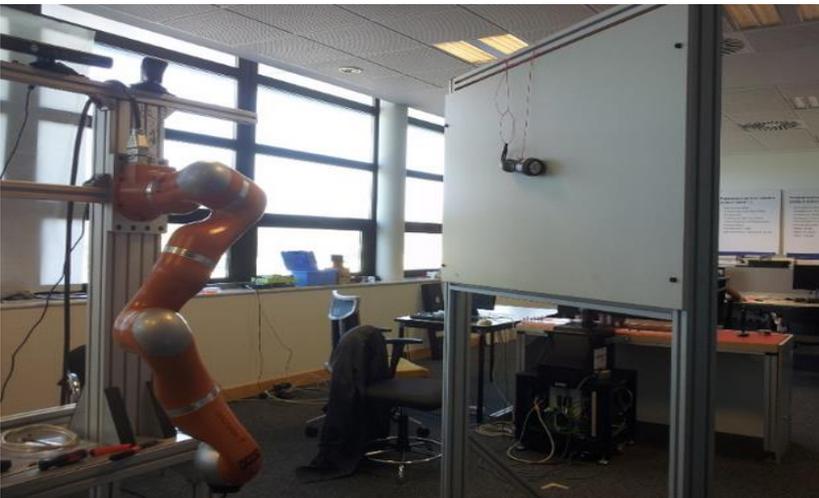
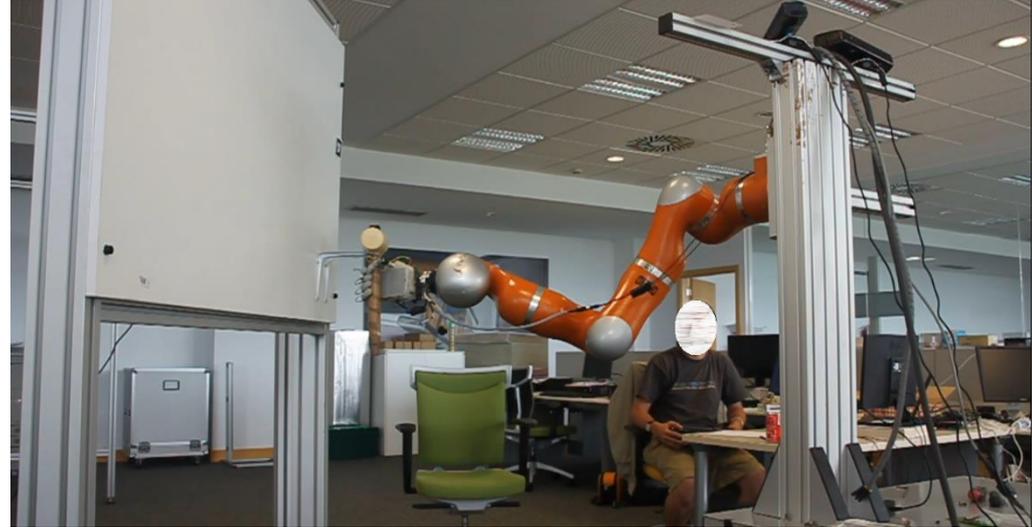
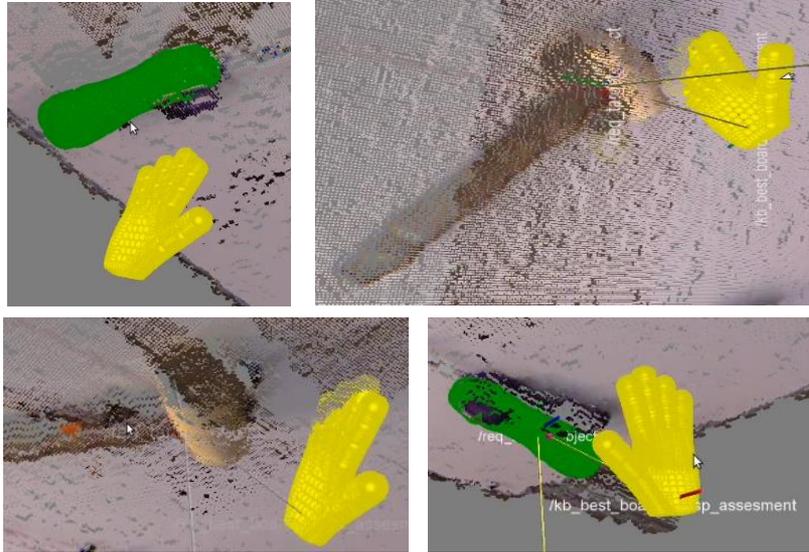
- Each robot-environment interaction produces feedback about the process
  - This information is stored and then used for reasoning about the most suitable strategy
  - The proposed strategy is evaluated and then prioritized among others, emulating a priority queue

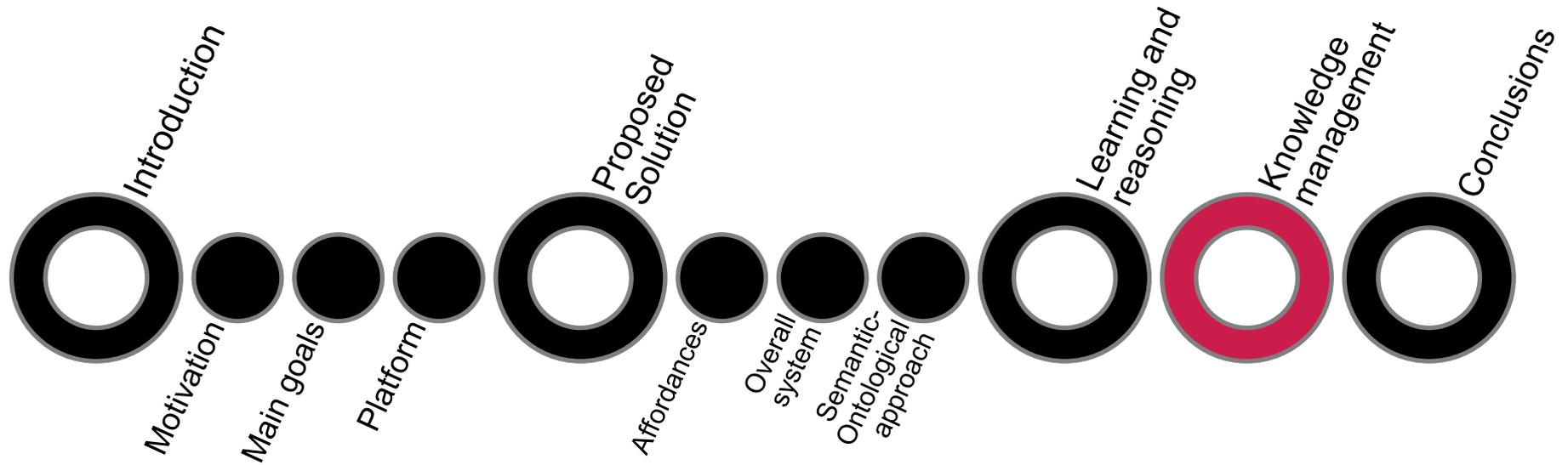


- For inferring the most suitable strategy, adapted to the current interaction environment, the following inputs are collected:
  - Scene perception → Segmentation, Detection, Tracking & Estimation
  - Experience from previous interactions → Feedback from the controller
  - Object-embedded orientation sensors → Custom solution
- Based on this data, the OBEliSK inference engine proposes an exchange strategy to be executed by the robotic setup controller









- Usually done through ontology editors, such as Protégé
  - Requires a strong background on logics and semantics
    - Intended to be used by researchers without expertise in this field
- Ad-hoc web-based management tool
  - To be used for handling experimental data
  - Transparent for end users
    - Reduces complexity and provides fail-safe data management
  - Standard communication languages/formats
    - OWL, XSD, RDF/XML, RDFS, SPARQL, JSON
    - Comprehensive, extensible, reusable

Manage exchanges for *Hand Torch*

Step 2 of 2

Instance Name: Hand Torch    Grasp Area: Body    Object Class: Torch    Symmetry Axis: y

Grasps + Add grasp

Name	Force Level	Grasp Type	Priority	Approach Direction	Wrist Pose	Exp. Orientation	Delete
torch_grasp_0001	medium	triDigital	0	[[[-0.059307061, 0.0018123596, -0.9838832, 0.06844516], [0.35850704, 0.93350303, -0.17870386, -0.072052452], [0.91813403, -0.36439115, 0.0062249857, 0.12450517], [0.000, 0.000, 0.000, 1.000]]	[0.0, 0.0, 1.0]	[0.41863196, -0.7498281, 0.31406375, 0.40480743]	✘
torch_grasp_0002	high	cylindrical	1	[[[-0.13372637, 0.088168487, -0.99024147, 0.025260433], [0.28017381, 0.96125311, -0.073845513, -0.046616463], [0.94536185, -0.27241156, -0.11818948, 0.092336731], [0.000, 0.000, 1.000]]	[0.0, 0.0, 1.0]	[0.22596278, -0.89466875, -0.13227163, 0.36195699]	✘

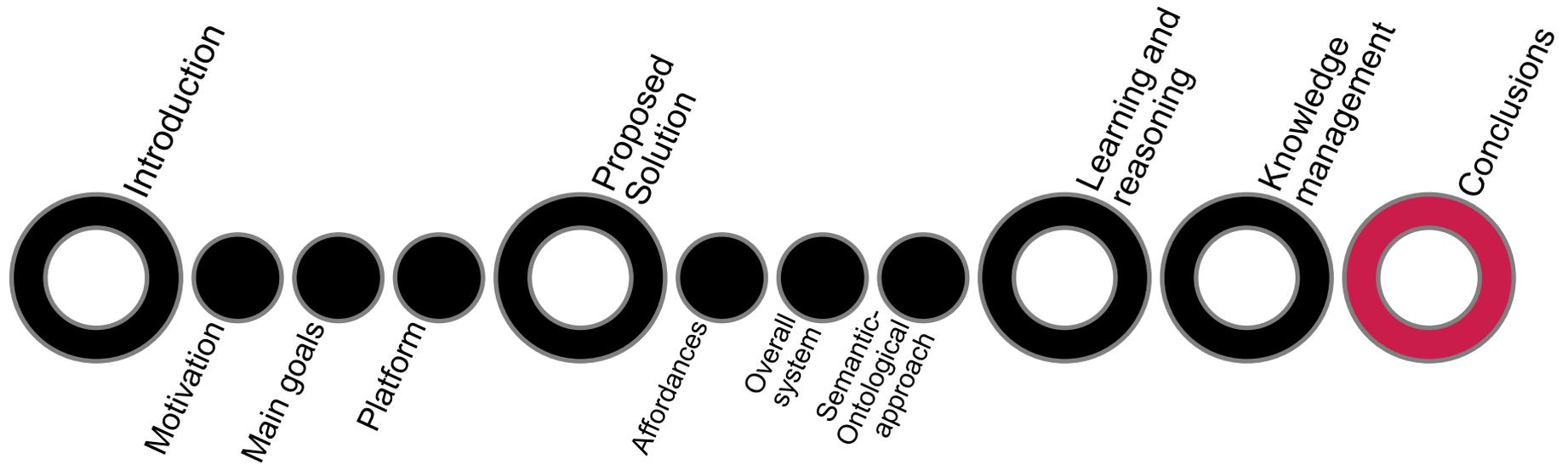
Deliveries + Add delivery

Name	Associated grasp	Priority	Receiver hand posture	Approach Direction	Wrist Pose	Delete
hand_torch_delivery_0002	torch_grasp_0001	1	palm_down	[[[-0.059307061, 0.0018123596, -0.9838832, 0.06844516], [0.35850704, 0.93350303, -0.17870386, -0.072052452], [0.91813403, -0.36439115, 0.0062249857, 0.12450517], [0.000, 0.000, 0.000, 1.000]]	[0.0, 0.0, 1.0]	✘
hand_torch_delivery_0001	torch_grasp_0001	0	palm_front	[[[-0.059307061, 0.0018123596, -0.9838832, 0.06844516], [0.35850704, 0.93350303, -0.17870386, -0.072052452], [0.91813403, -0.36439115, 0.0062249857, 0.12450517], [0.000, 0.000, 0.000, 1.000]]	[0.0, 0.0, 1.0]	✘
hand_torch_delivery_0003	torch_grasp_0001	2	palm_up	[[[-0.13372637, 0.088168487, -0.99024147, 0.025260433], [0.28017381, 0.96125311, -0.073845513, -0.046616463], [0.94536185, -0.27241156, -0.11818948, 0.092336731], [0.000, 0.000, 0.000, 1.000]]	[0.0, 0.0, 1.0]	✘

Motion Constraint + Add Motion Constraint

Name	Maximum Deviation	Preferred Orientation	Delete
motion_constraint_0001	0.123456	[0.0, 0.0, 0.0, 1.0]	✘

Finish



- Innovative approach, based on affine ideas from related and state of the art projects
- Merging Computer Vision and Semantic Web through handling affordances and cognitive science
- Human nature knowledge characterization
  - Main goal → Fluent interaction between humans and robots
  - Extensible and interoperable approach → Opens up new application fields
- Fully-featured model for human-common objects exchange
  - Data provided by human-human experiments carried out by experts
- Multisource, scene-aware inference & reasoning
  - Core part of a complex robotic set-up
    - Control algorithms rely on the knowledge provided by our approach
- Final evaluation → Early 2015

+34 902 286 386

 **tree logic**  
enjoy the change

# Thank You!



Second Workshop on Affordances:  
Visual Perception of Affordances and  
Functional Visual Primitives for  
Scene Analysis

#### MADRID

Avda. de Manoteras, 38  
Oficina C402  
28050 Madrid · España

#### ASTURIAS

Parque Tecnológico de Asturias  
Parcela 30  
33428 Llanera - Asturias · España

[central@tree logic.com](mailto:central@tree logic.com)

[www.tree logic.com](http://www.tree logic.com)

## OBEliSK

Novel Knowledgebase of Object  
Features and Exchange Strategies



ICT-2011-7-2.1  
287888

