欧盟地平线2020机器人计划之启示

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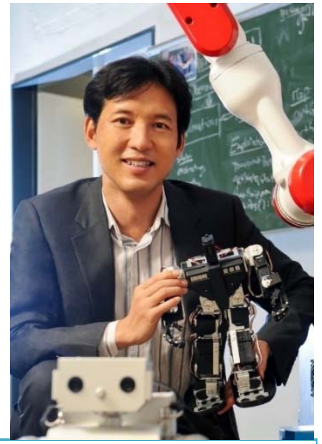
德国汉堡大学

2015自动化制造论坛—机器人与智能制造

3月26-27日 中国·上海

个人情况简介-履历



1981-1989	清华大学计算机系 - 计算机控制	工程学士（第一名）
1981-1989	清华大学计算机系 - 人工智能	工程硕士
1989-1994	德国卡尔斯鲁厄大学计算机系 - 机器人	博士
1994-2002	德国比利费尔德大学技术系 - 智能机器人，双臂装配，自然人机交互	C1教授
2002.08-	德国汉堡大学信息学系 - 服务机器人，认知技术，传感器融合，环境智能感知，机器人学习，多指机器手灵巧操作	C4教授 TAMS 研究所所长 德国汉堡科学院士

个人情况简介-社会任职

- IEEE 机器人与自动化专业协会 AdCom 核心成员
- 国际几份重要机器人刊物编辑
- 世界智能机器人重大国际会议组织人，2011年ICRA 程序委员会主席，2015年EEE RSJ IROS 总主席
- 考察欧洲、北美、日韩国家的主要机器人实验室和公司
- 历年欧盟未来与新兴技术、德国科学基金会、多个国家及地区信息技术与自动化领域的科研项目立项、评审、评估专家
- 多家欧洲著名企业的技术顾问，包括空中客车、德国大众汽车、巴斯勒视觉等
- 科技部火炬高技术产业计划海外专家
- 国家自然基金委信息科学海外专家
- 国务院侨办咨询委员会信息领域专家
- 中国侨联海外特聘专家
- 全国政协海外委员

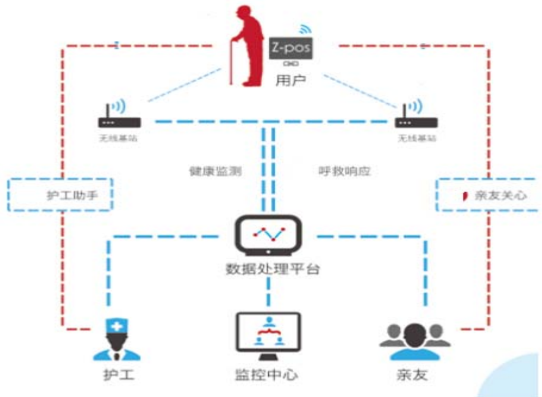
好博特机器人
HOMBOT

产品的市场定位

智慧家庭

智慧社区

智慧养老



酷博机器人
CUBO ROBOT

主要功能、特点

易用性

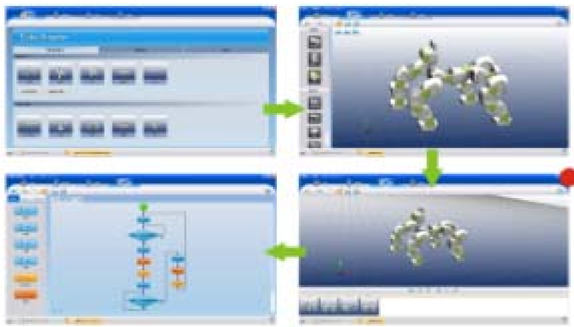
它可以看作是一种高级的智能积木。像拼积木一样，不需要借助任何外部工具，仅仅进行简单的拼插就可以组装成多种多样的机器人，大大增强其操作性和安全性，从而让用户更享受到自己动手带来的成就感。

仿生性

相比于传统的轮式机器人，酷博机器人使用“关节”的方式对自然界中的各种生物和运动进行仿生，这使我们的机器人更像一个机器人，而不是一辆小车。

智能性

配备多个红外传感器和接触传感器，为机器人的智能实现提供了基础，使机器人具备完成某些特定任务的能力。



图形化

通过配套Cubo Creator软件的图形化界面，可以轻松实现机器人在软件中的三维建模，从而通过构型搭建，动作编辑，任务编辑的流程，创造出属于自己的机器人。

康博特多功能轮椅

产品特点

- ➢多功能：
  - ✓电动轮椅功能
  - ✓下肢按摩功能
  - ✓辅助起坐功能
  - ✓辅助行走功能
- ➢具备语音提示功能的智能控制器
- ➢重力平衡设计，防止使用者摔倒

示范应用

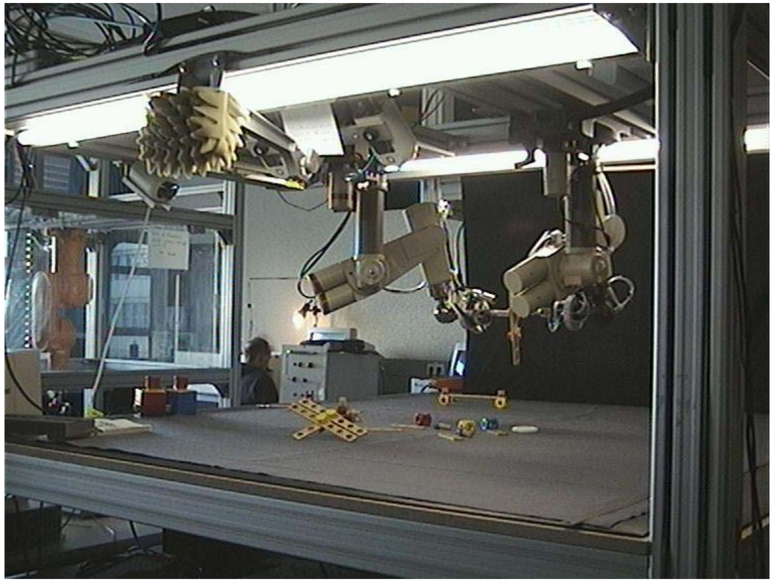
- ➢目标客户：运动机能较弱的老年人或有行走运动障碍的偏瘫、截瘫患者。
- ➢示范应用：

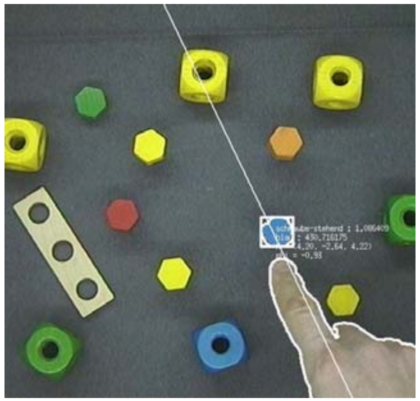
"智能机器人"服务养老院

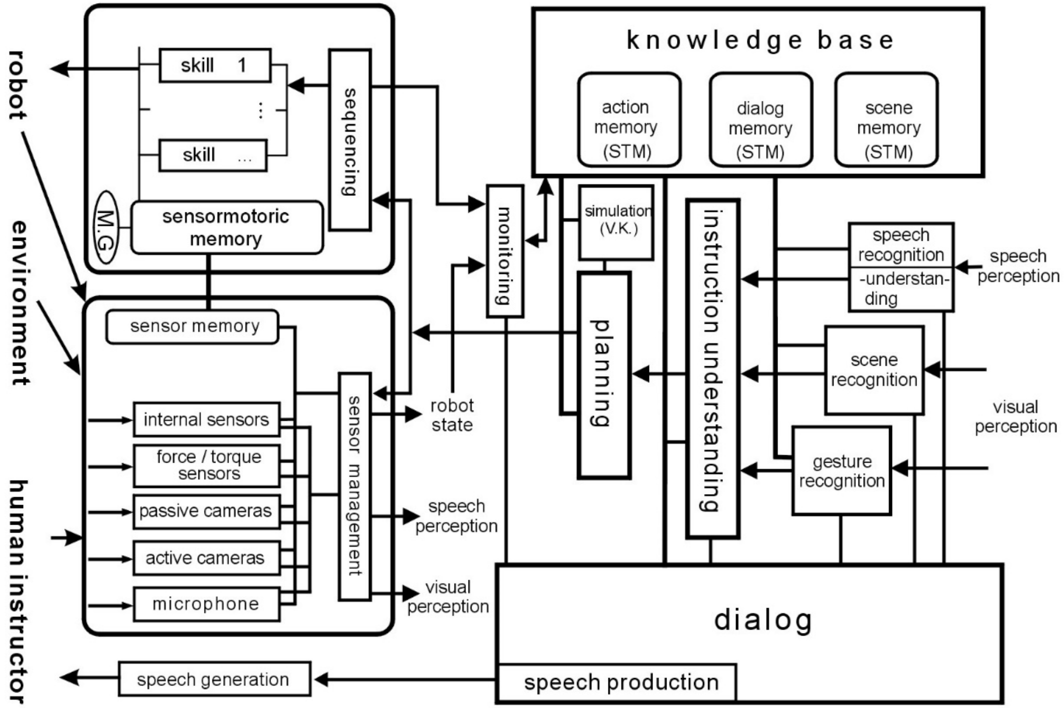
Current projects

- EU FP6: HANDLE: 机器人操作的发展方向—自主性和灵巧性
- EU FP7: RACE: 基于增强自主能力的机器人鲁棒性
- EU FP7: Robot-Era: 基于环绕智能架构增强助老服务的性能和可行性
- EU FP7: CareToy: 用于家庭婴儿康复的智能模块化玩具
- EU IRSE Eye2E/LIVECODE: 基于自然视觉信息处理的鲁棒冲突检测
- DFG CINACS: 自然及人工认知系统中的多模式交互
- DFG BICCA: 履带机器人的仿生控制

德国科学基金 SFB 360 Situated Artificial Communicators

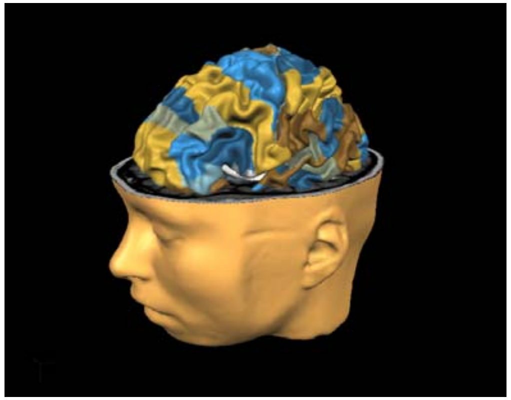


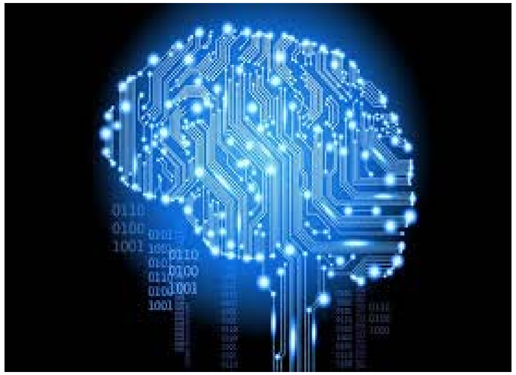


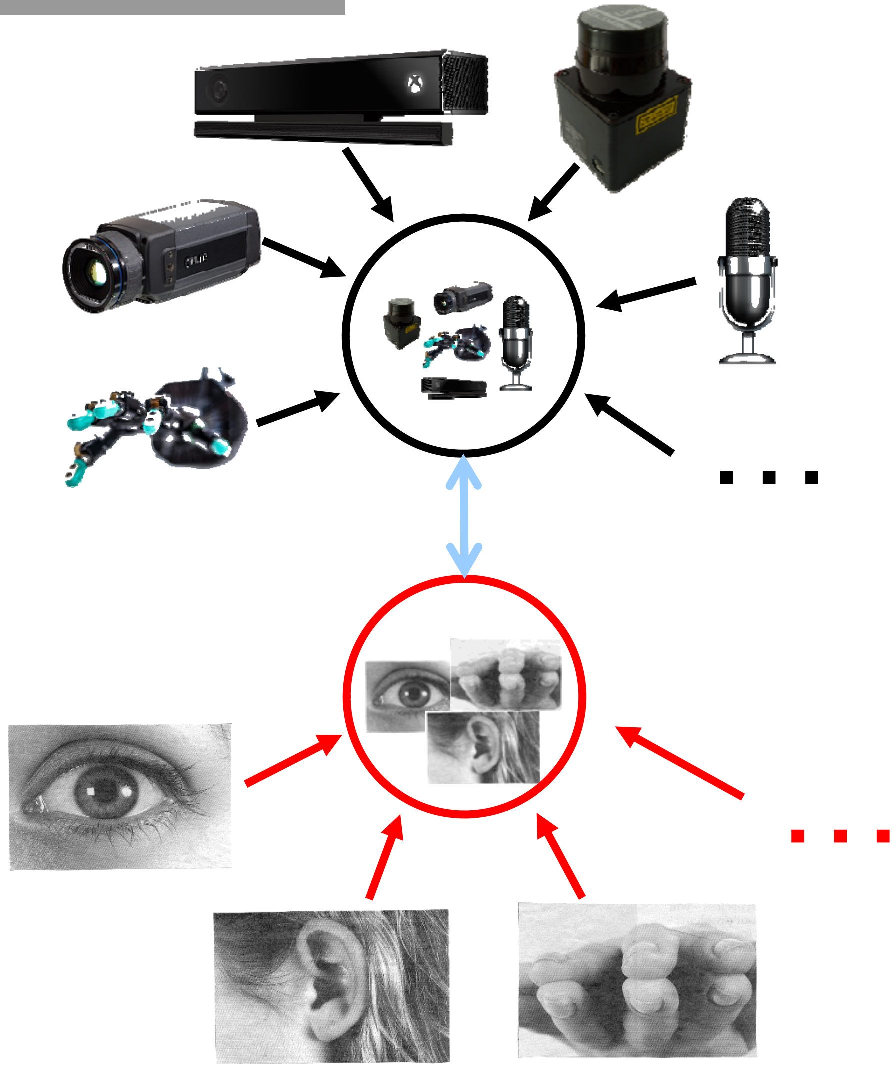


IEEE ROMAN Award 2002

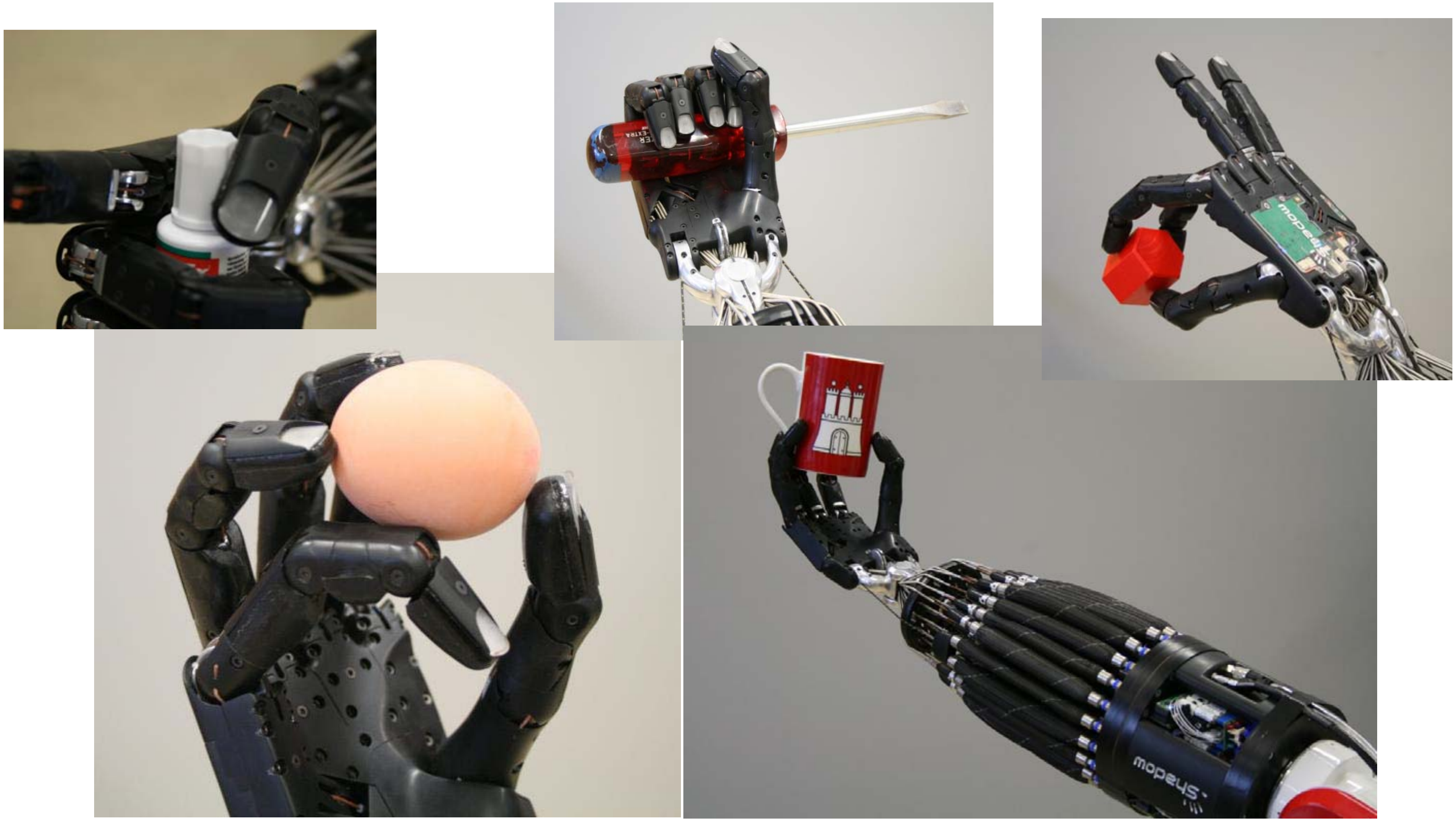
德国科学基金 CINACS 传感器融合



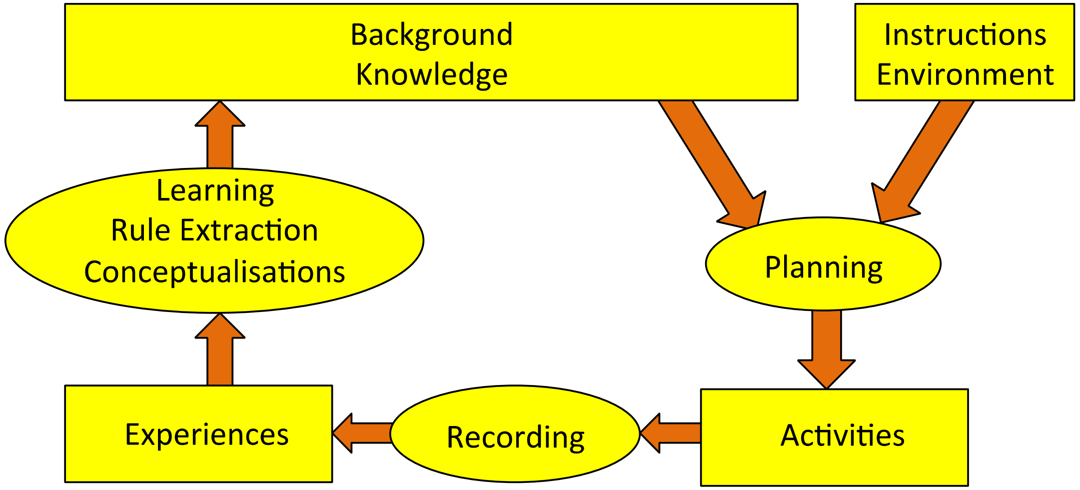


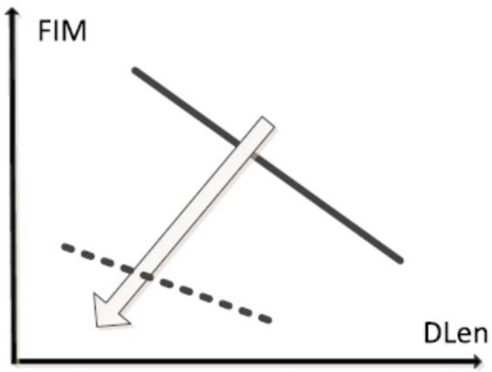


欧盟第六框架HANDLE灵巧操作



欧盟第七框架 RACE: 经验学习机器人





Knowledge Representation and Reasoning

- Ontological Knowledge
- Action Knowledge
- Temporal Knowledge
- Spatial Knowledge
- Object Category Knowledge
- Resource Knowledge
- Common-Sense Knowledge

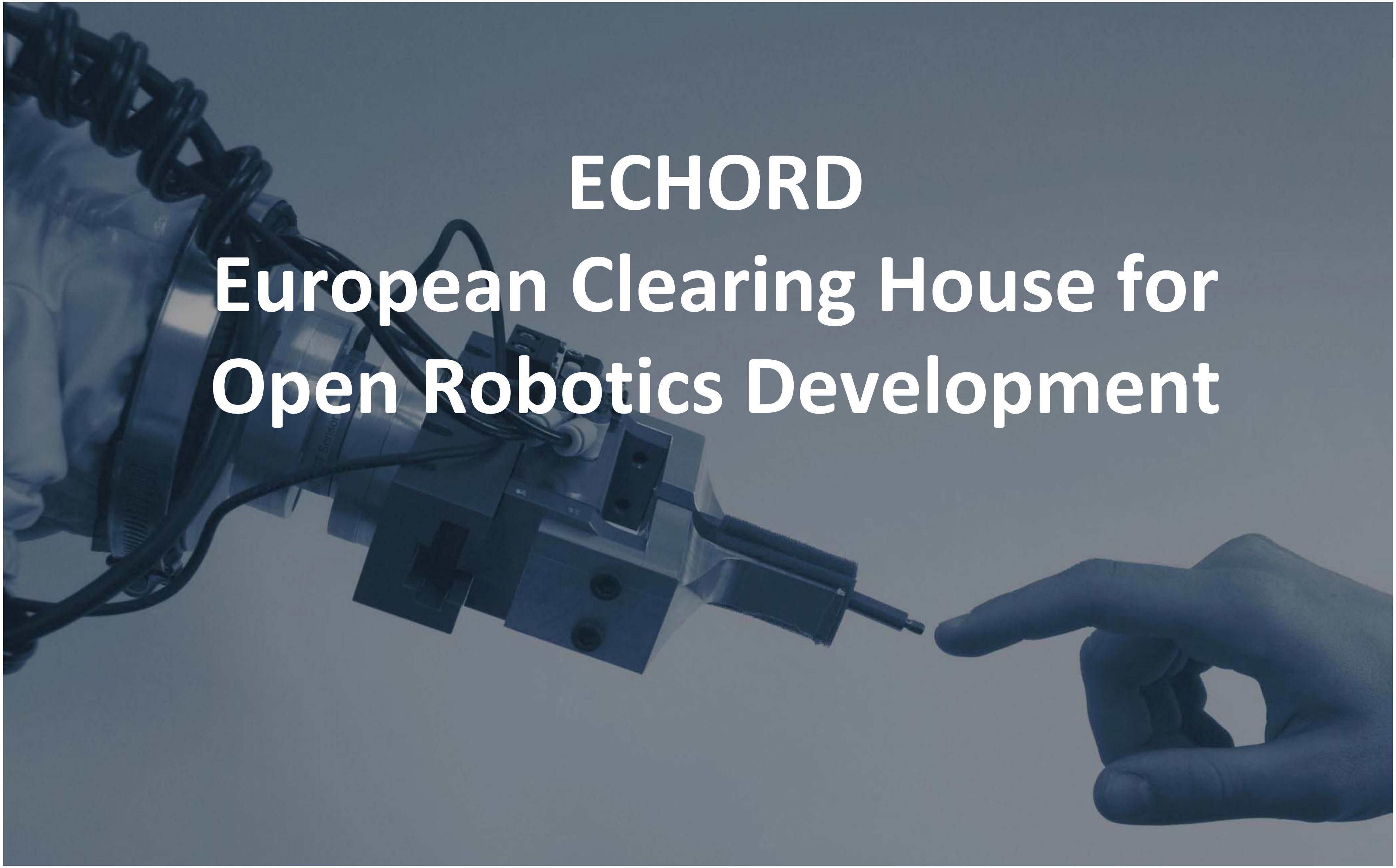
欧盟第七框架 Robot-Era: 家庭服务机器人

Domestic Robot: manipulation and cleaning services

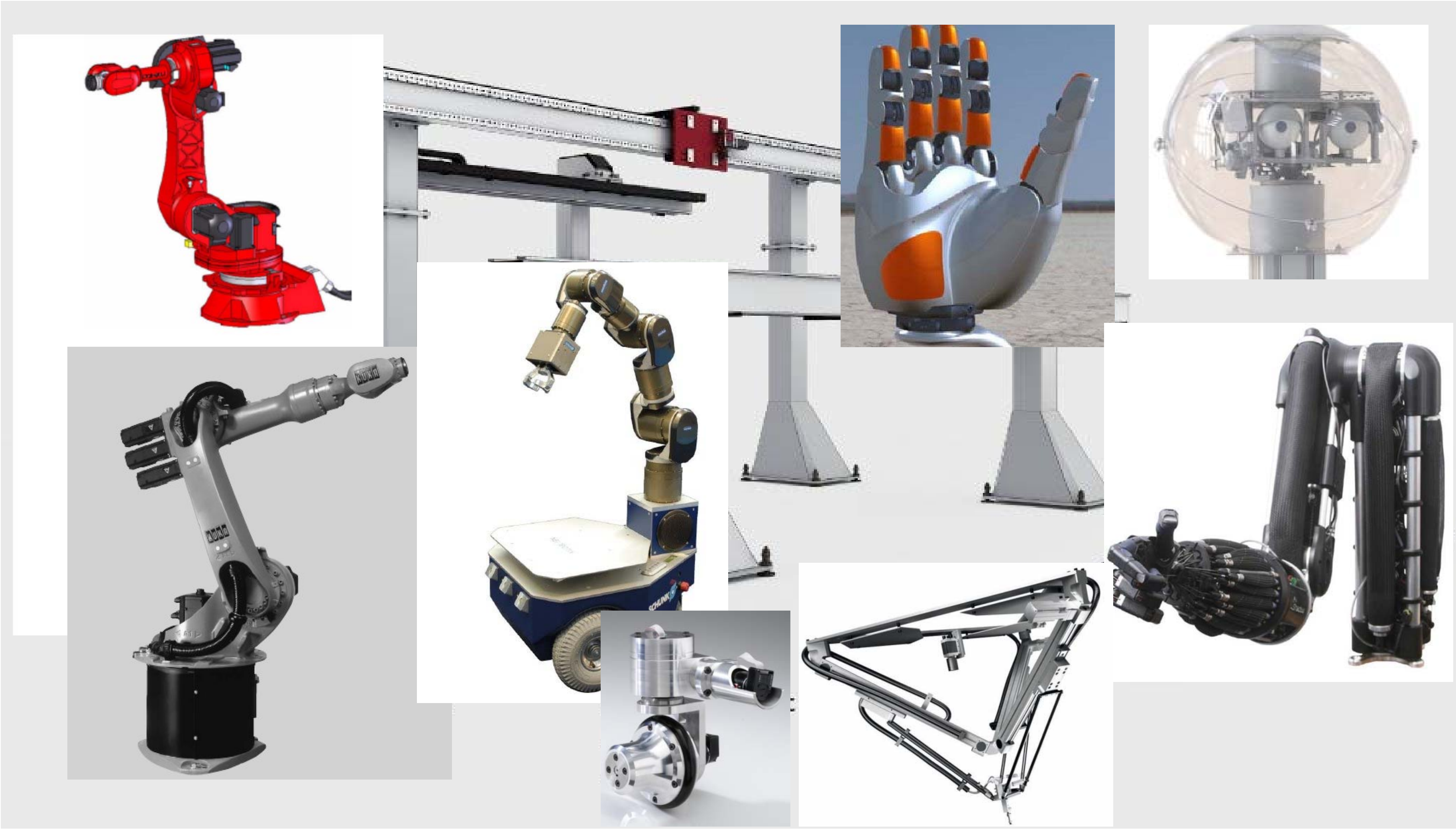
Robot — ERA
DOMESTIC

- differential-drive platform, sensor-head
- one Kinova Jaco arm with 3-finger gripper

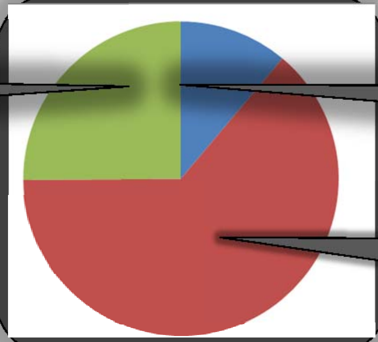
ECHORD
European Clearing House for Open Robotics Development



“Quotes for Equipment” – Equipment list



Experiments – scenarios, research foci and experiment types



Hyper-flexible cell 25%

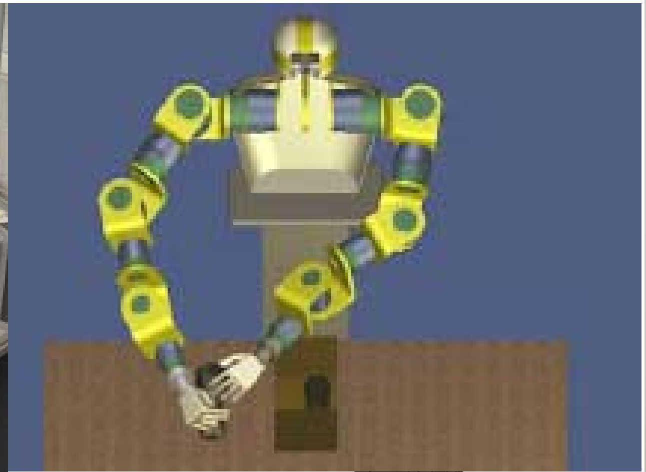
Cognitive factory 11%

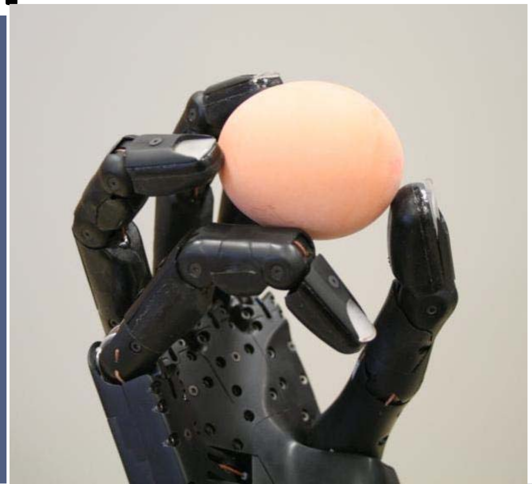
Human-robot co-worker 64%

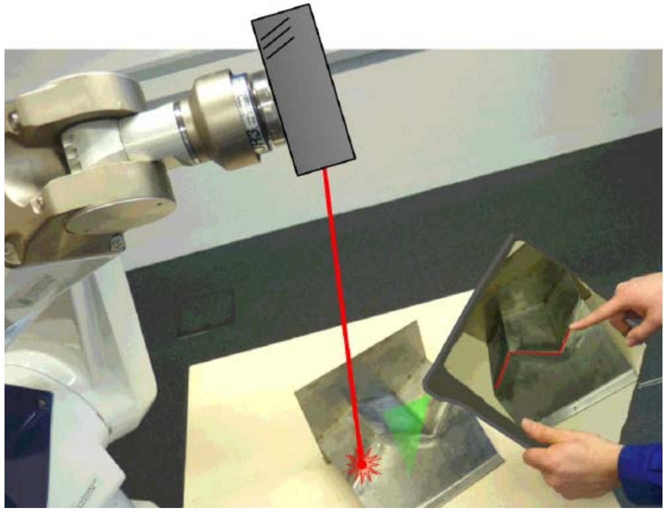
- Human-robot interfacing and safety 47%
- Robot hands and complex manipulation 32%
- Mobile manipulators and cooperation 14%
- Networked robots 7%

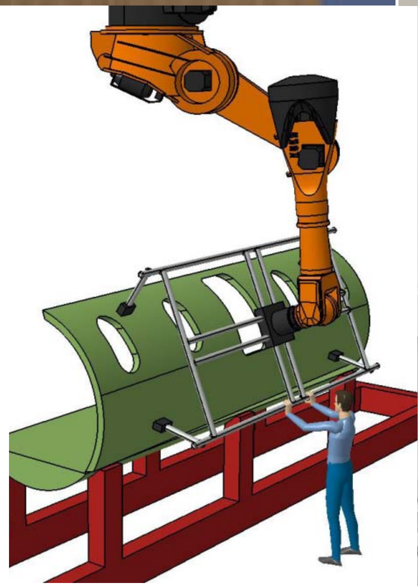
- Joint enabling technology development 42%
- Application development 34%
- Feasibility demonstration 24%

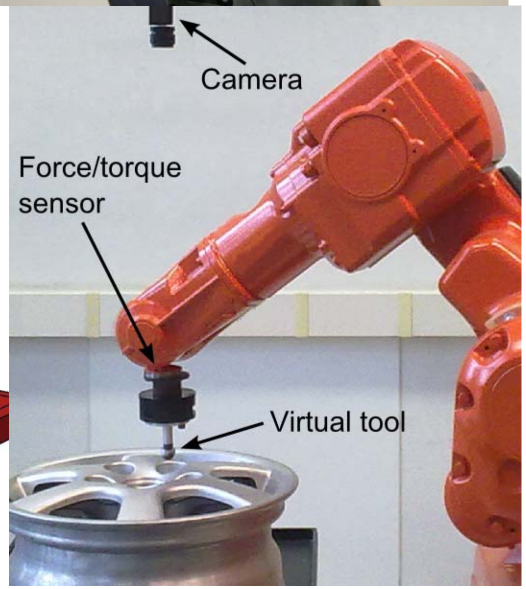
Experiments – a few examples





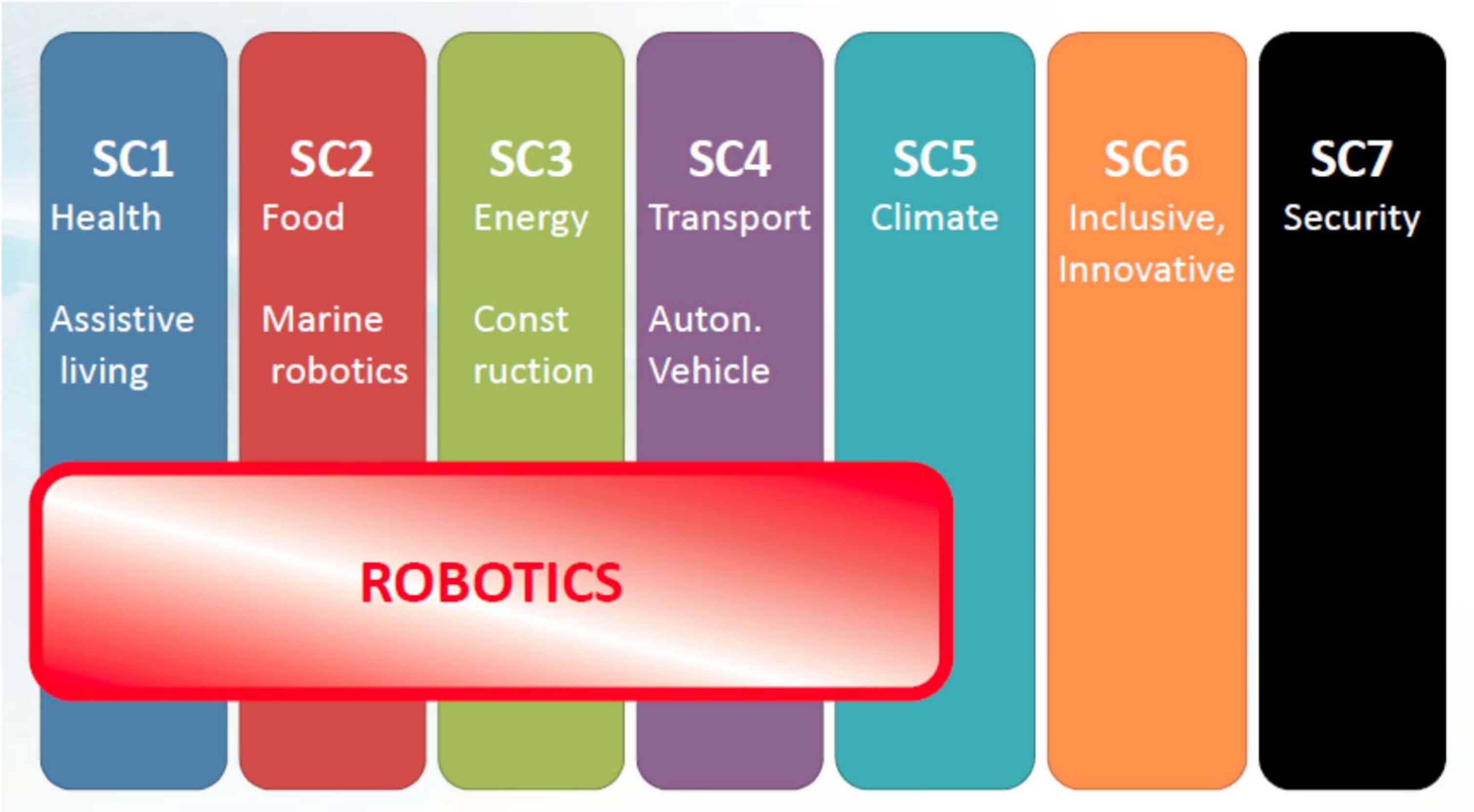






17

Robotics in H2020 Societal Challenges



euRobotics Topic Groups

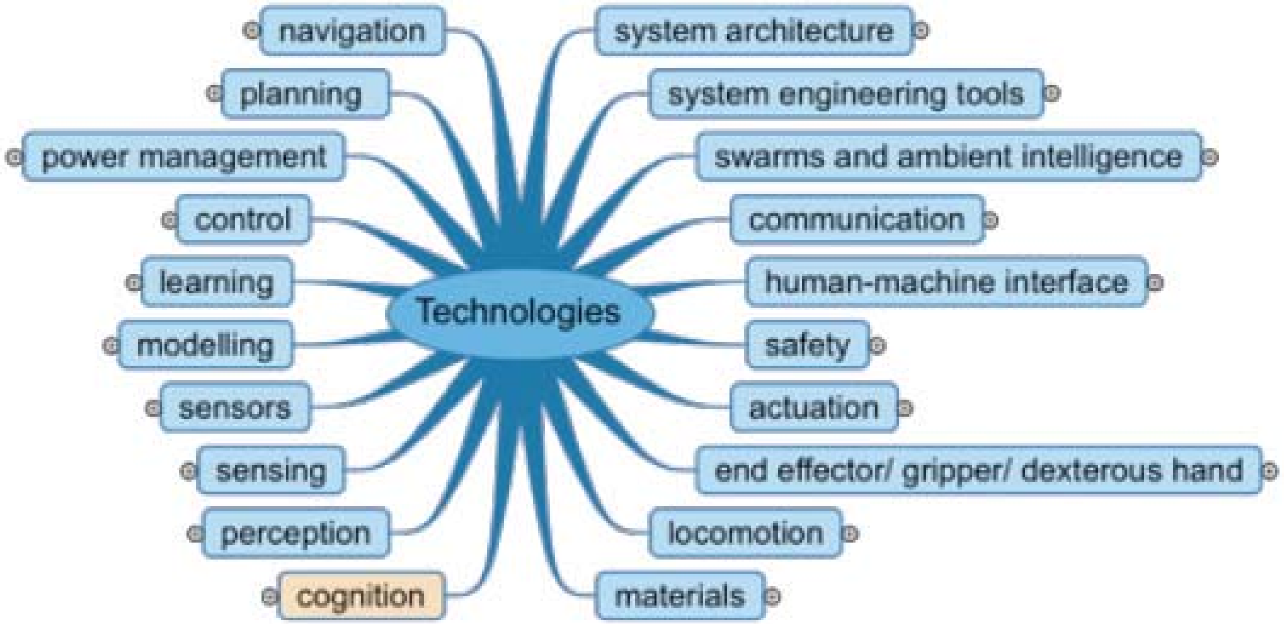
Aerial Robots
Agriculture
Autonomous Navigation
Benchmarking and Competitions
Bio-Inspired Robots
Civil Robots
Cognitive Systems and AI
Companion Robots
Healthcare
Industrial Robots
Maintenance and Inspection
Marine Robotics
Materials
Mechatronics
Miniaturised Robots
Natural Interaction with Social Robots
Perception
Physical Human Robot Interaction
Systems Engineering
Space Robotics
Telerobotics
Education
Entrepreneurship
Ethical-Legal-Societal Issues
Standardisation
Field/Service Robots in unstructured Environments

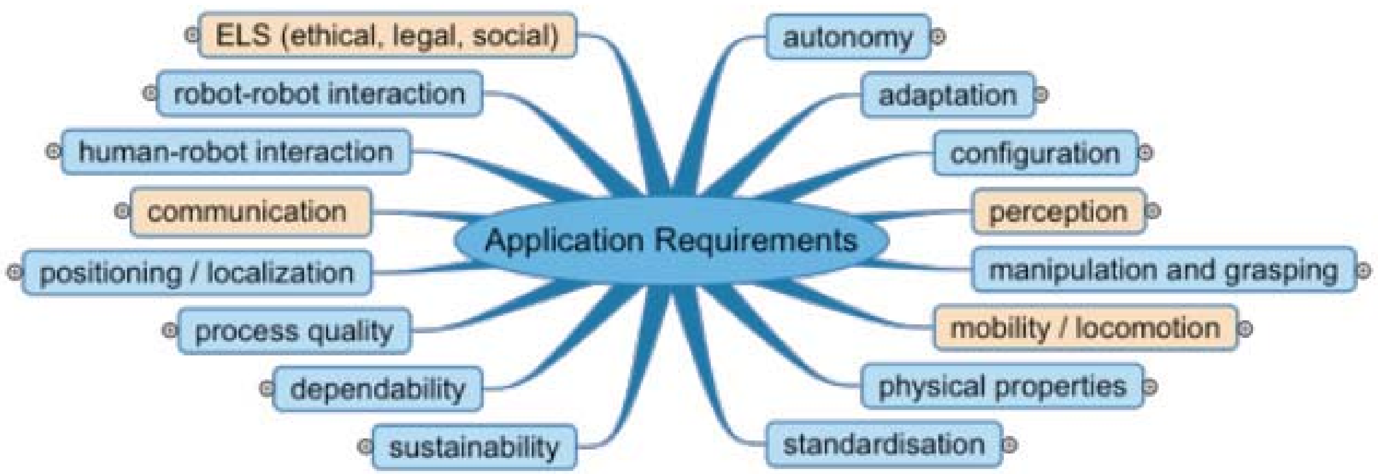
Robot Abilities

Abilities allow benchmarks for performance to be set

- Configurability
- Adaptability
- Interaction Capability
- Dependability
- Motion Capability
- Manipulation Ability
- Perception Ability
- Decisional Autonomy
- Cognitive Ability

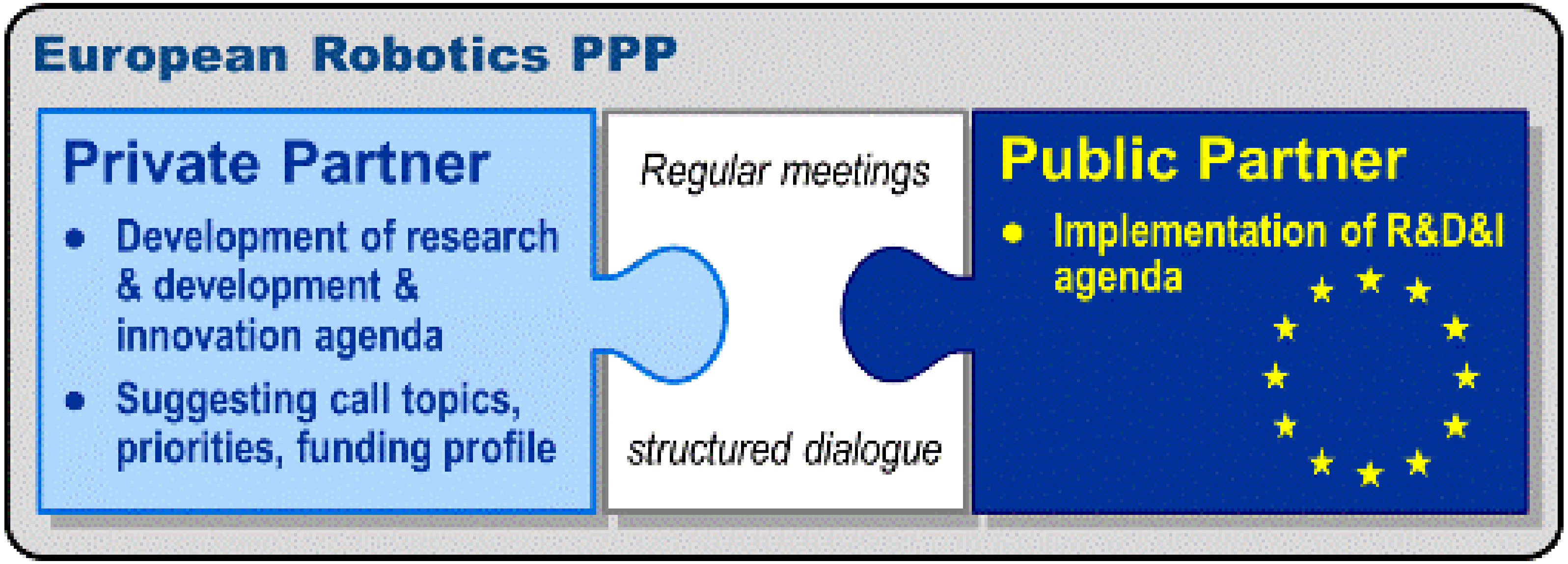
Technologies and Application Requirements (euRobotics)



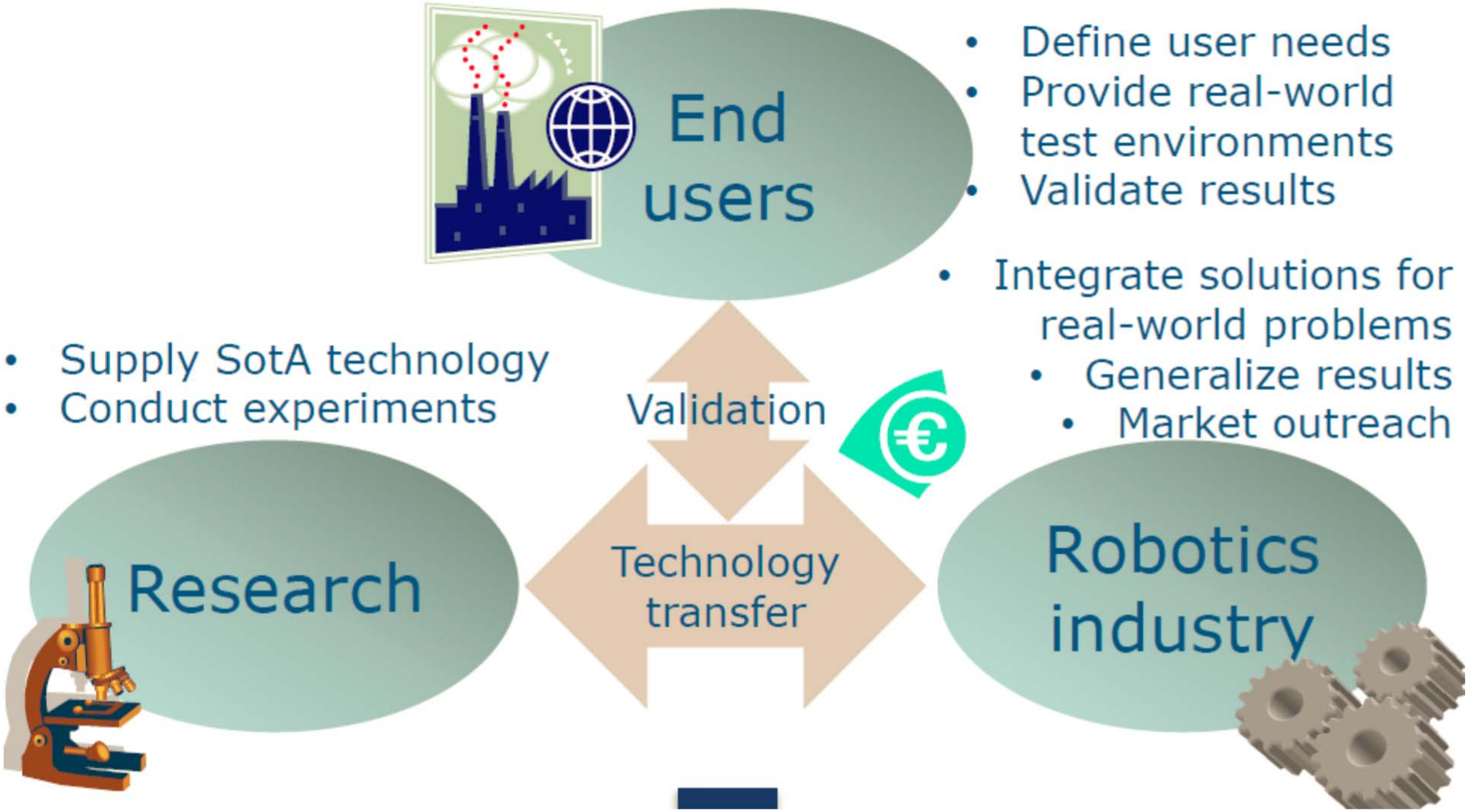


Horizon 2020: Robotics PPP
(Public-Private Partnership)

" means a partnership where private sector partners, the European Union and, where appropriate, other partners, commit to jointly support the development and implementation of a research and innovation programme or activities.

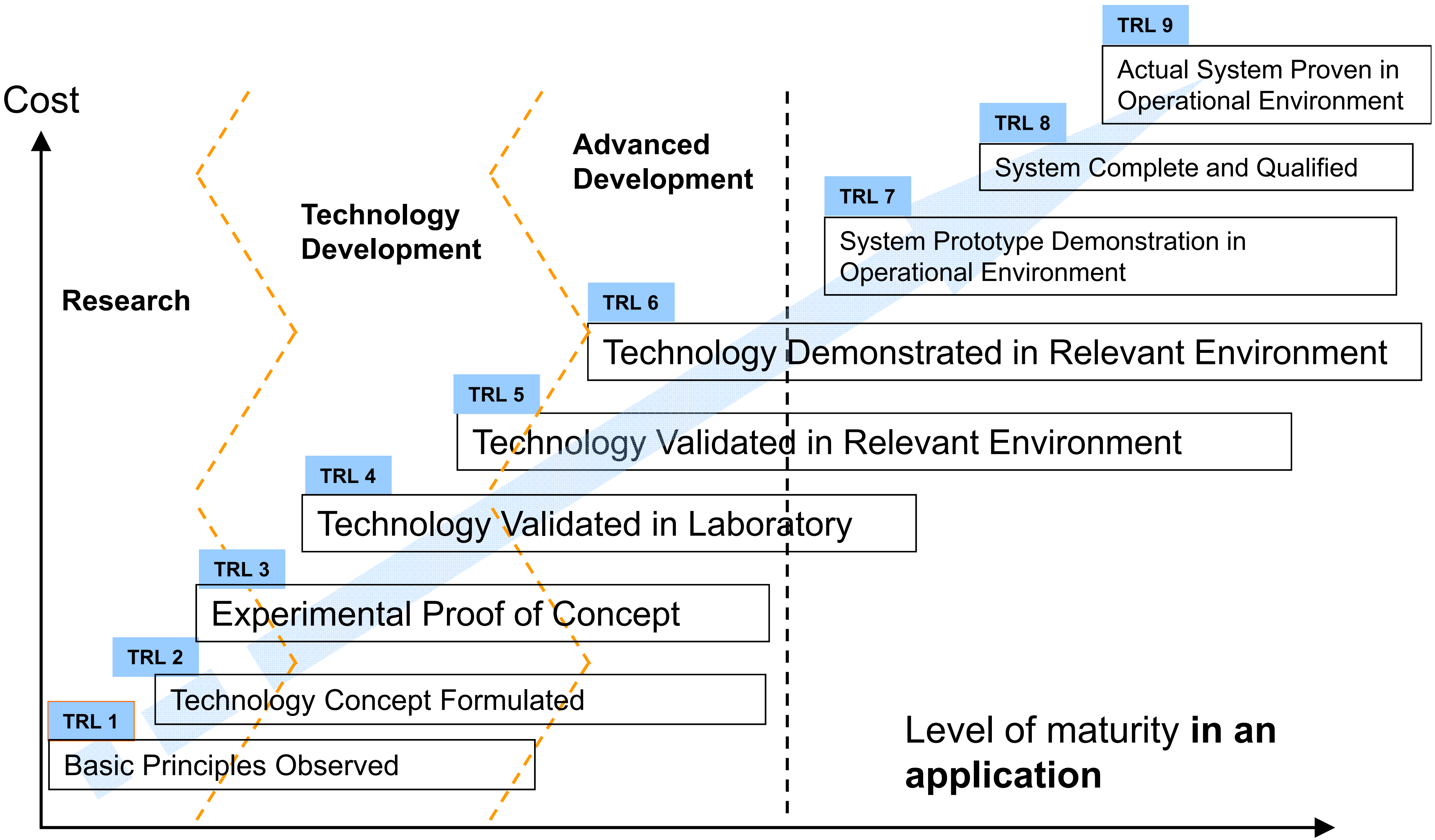


理想的产学研团队



End users
• Define user needs
• Provide real-world test environments
• Validate results
• Integrate solutions for real-world problems
• Generalize results
• Market outreach
• Supply SotA technology
• Conduct experiments
Validation
Research
Technology transfer
Robotics industry

H2020 general TRL scheme



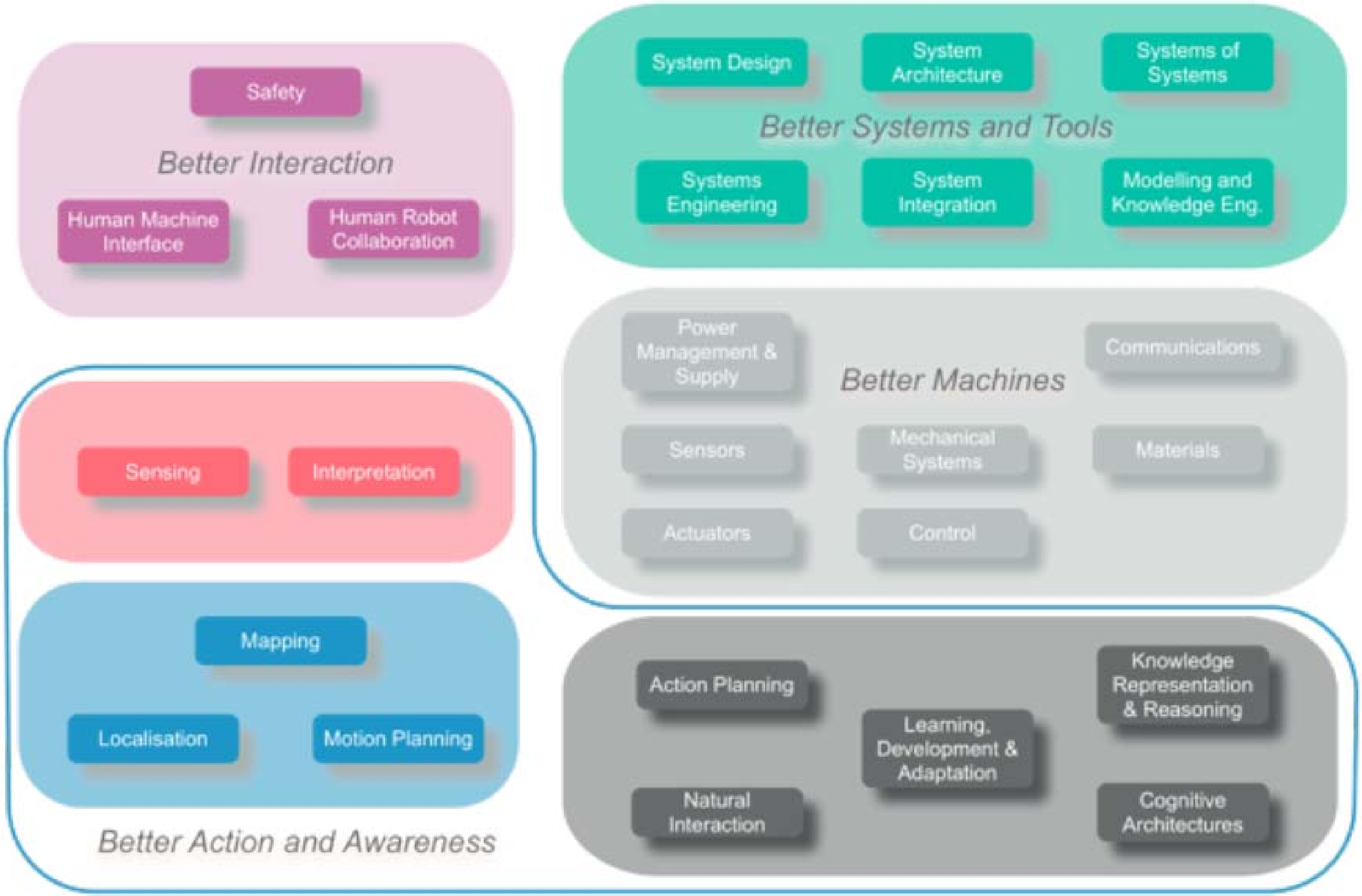
未来机器人需要什么样的性能 ？

当代机器人	未来机器人	性能
机器人可以行恶劣、危险的任务	与人协同合作	多功能：感知、执行、信息处理和通讯、能源供应、机构支持等
重复性的任务	自适应动态环境	↓
有限的自主性	智能快速感知	少部件、高鲁棒性、低计算负载、高能源效率、高适应性、高可靠性、低成本
基本的用户界面	高效灵巧操作	
已得到广泛认可	自然用户界面	

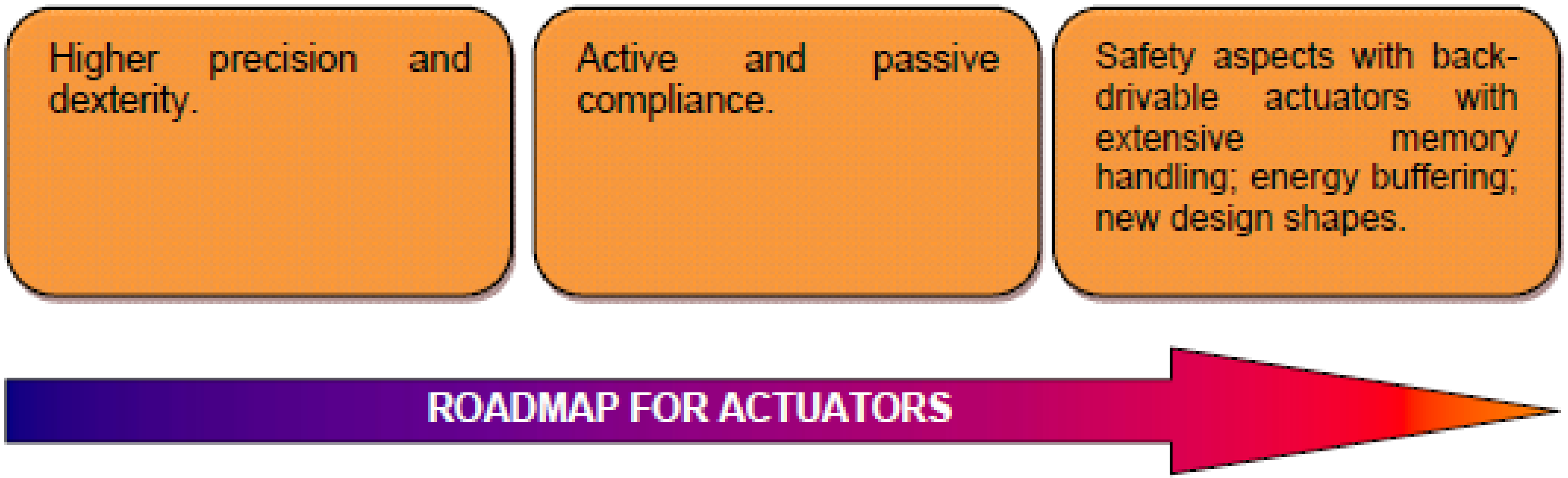
Technology Clusters

- To Improve Design Methods And Systems.
  Better Systems And Tools
- To Make Better Robot Machines.
  Better Robots
- To Improve Human Robot Interaction.
  Better Collaboration
- To Improve Robot Autonomy.
  Better Action And Awareness (SRA2020)

Technology Clusters



Improving Designs and Systems



System Design

- Design covers all aspects of a system from assessing the function to be performed.

Systems Engineering

- Consider a complex system as a system of interdependent modules.

Better Systems and Tools

System Architecture

- Understanding how the architecture of a robot system affects the overall function

Systems Integration

- The dependability and operational success of a robotic system

Modelling and Knowledge Engineering

- a key technology in all robotic systems

System of Systems

- approaches encompass design, systems engineering and analysis in an integrated manner

Better Action and Awareness: Perception

Formal standardization and characterization.

Risk analysis concerning safety issues.

Definition of functionality and the range of the operating conditions.

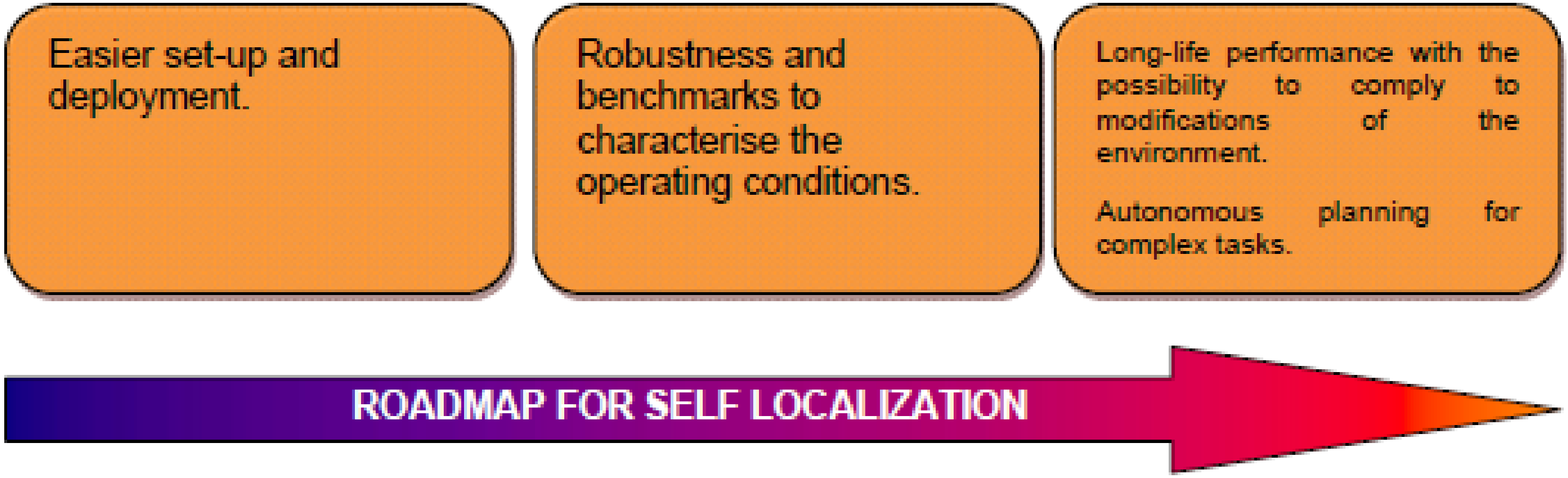
Standard benchmarks.

Multi sensor fusion capable of provide the required Safety Integrity Level (SIL).

ROADMAP FOR SENSORS

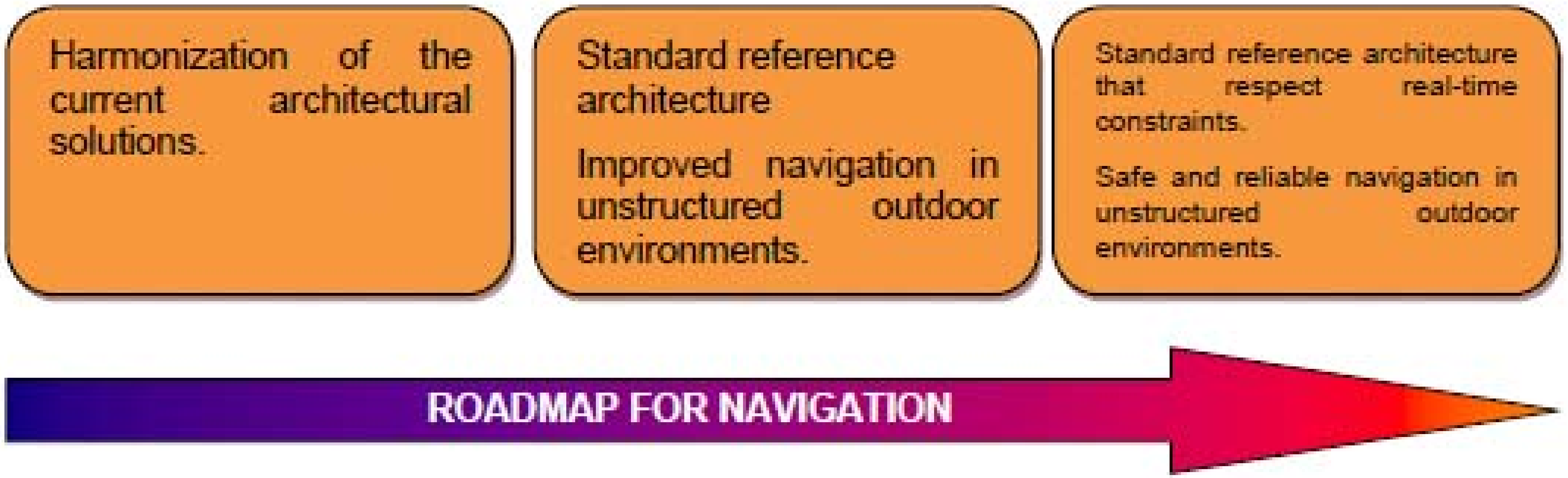
- increase the distribution of basic sensor processing
- enhance sensor fusion
- standardise sensor interfaces, utilises navigation technologies to assess location, build maps
- increase the distribution of basic sensor processing Interpretation
- reliably recognise a wide range of known objects
- reconstruct 3D object shapes from sensor data
- exploit the potential for facial expression recognition

Better Action and Awareness: Localisation



- increase the accuracy of localisation on maps constructed from sense data.
- perform opportunistic localisation by exploiting existing signals in the environment

Better Action and Awareness: Navigation



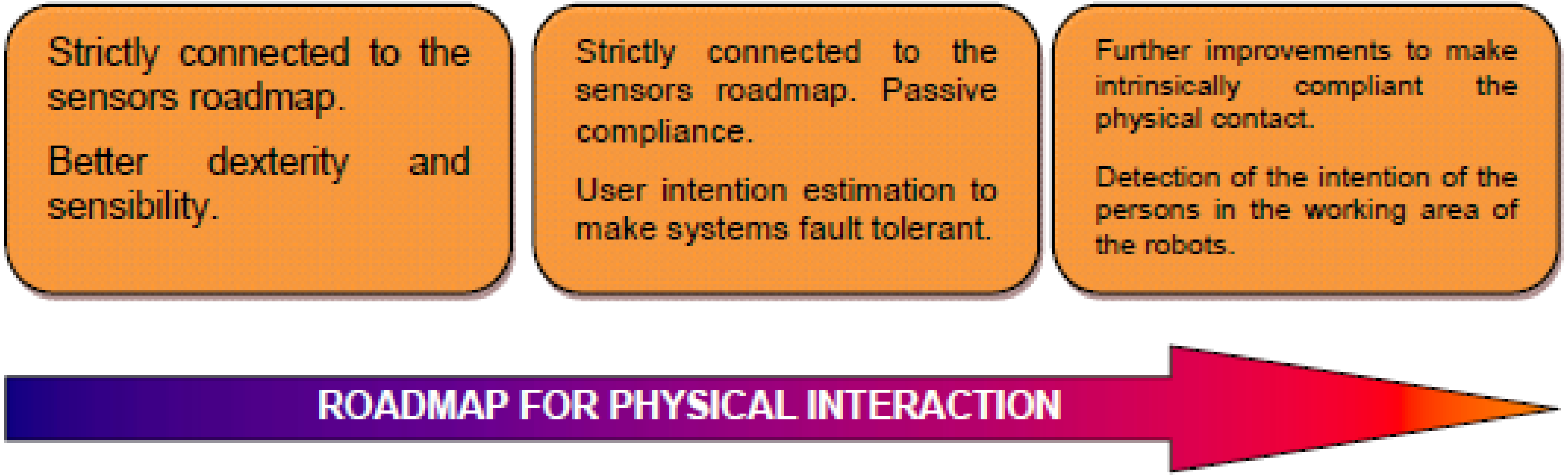
Mapping

- maintain maps of dynamic environments over longer periods of time
- segment and apply labels to maps identifying key environmental features
- add semantic information to maps

Motion Planning

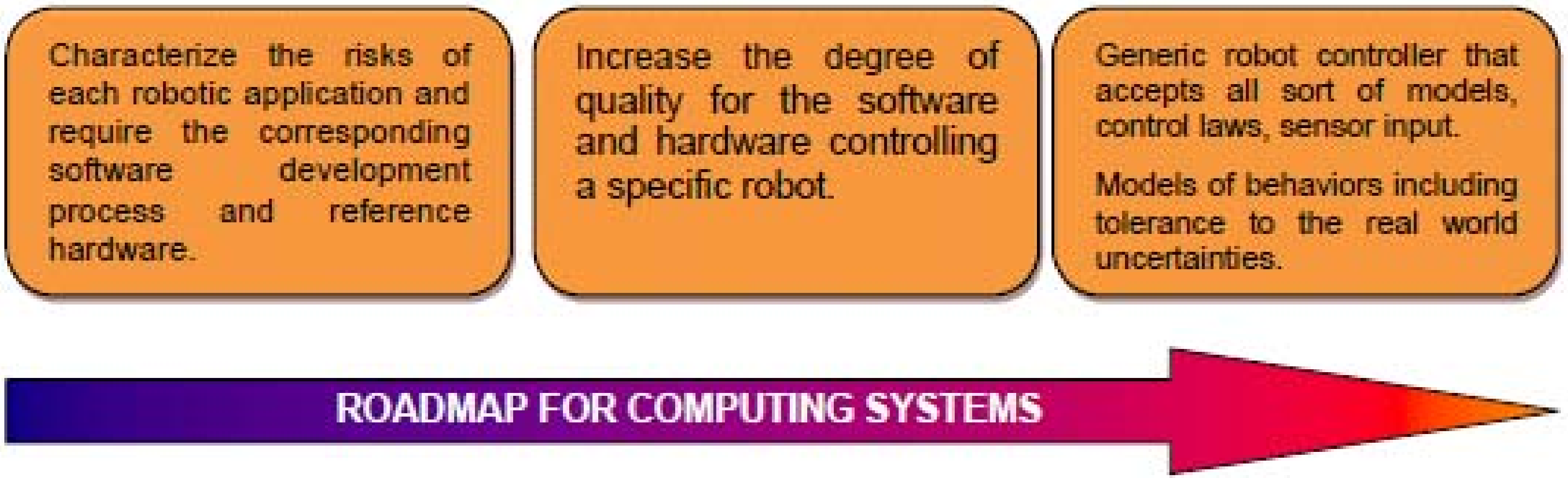
- devise large scale motion planning methods

Improved Human Robot Interaction



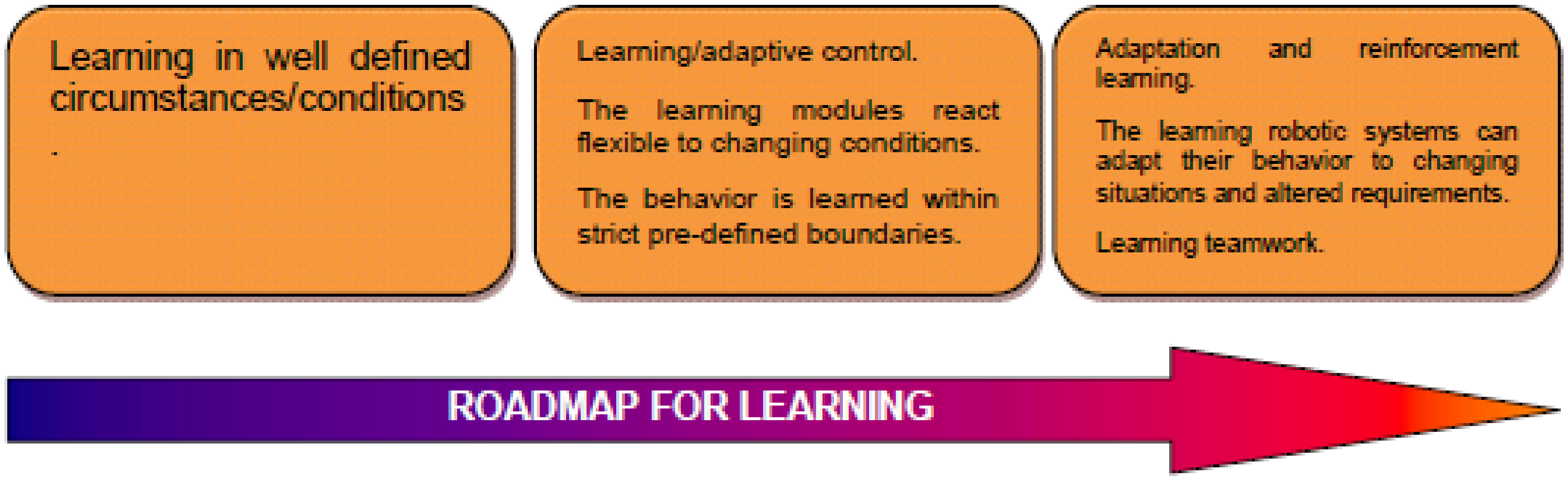
- Human Machine Interface
- Safety
- Human Robot Collaboration

Improving Robot Autonomy



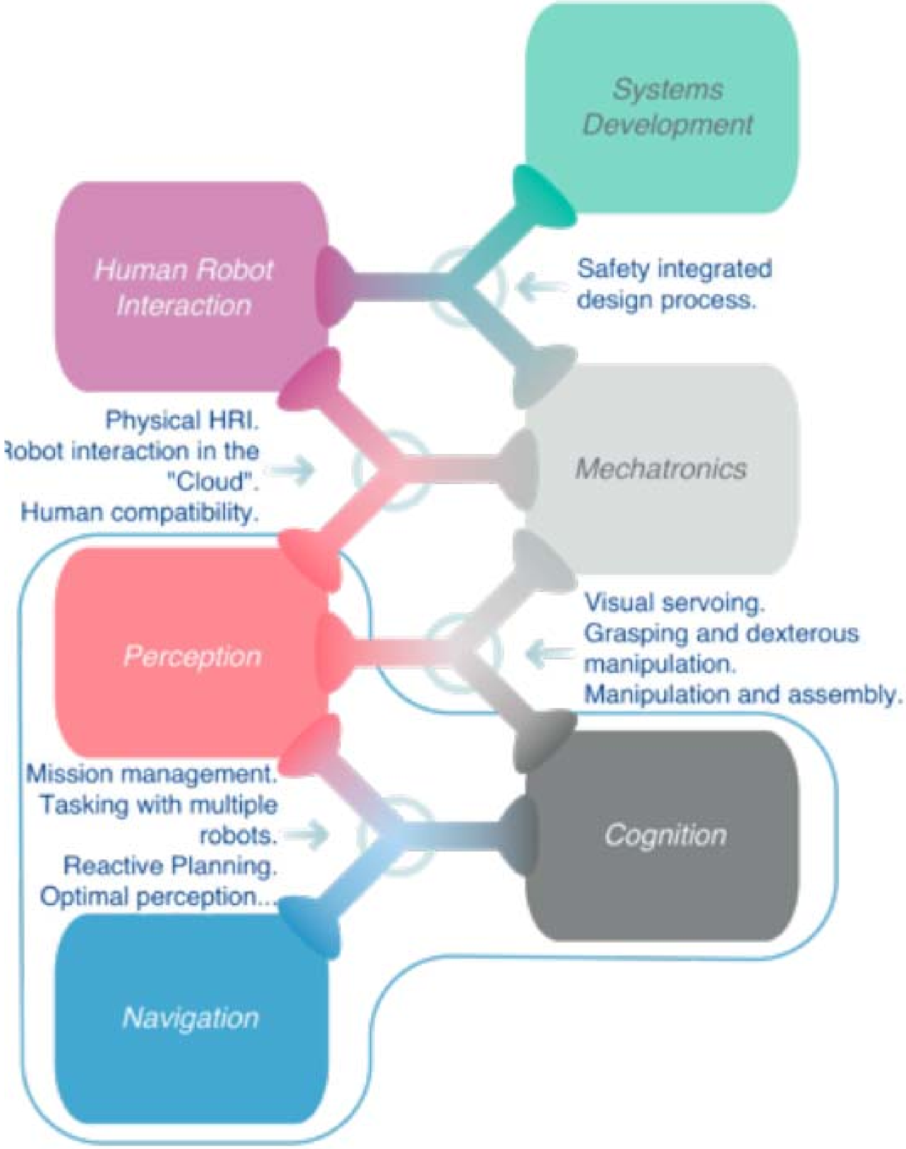
- interpret the surrounding environment and alter actions to achieve a goal
- utilises perception technology to extract useful information from sensors
- utilises navigation technologies to assess location, build maps
- uses cognition to weld this perception of location and environment

Better Action and Awareness: Cognition



- Cognitive Architectures
- Learning Development and Adaptation
- Knowledge Representation and Reasoning
- Action Planning
- Natural Interaction

Technology Combinations



Technology Combinations

- Perception, Mechatronic and Cognitive Technologies
- Perception, Mechatronic and Human Robot Interaction Technologies
- Mechatronic Technologies
- Cognition and Human Robot Interaction Technologies
- Perception, Navigation and Cognition Technologies
- Navigation Technologies
- Systems Development Technologies
- Systems Development, Mechatronics and Human Robot Interaction Technologies

IEEE/RSJ International Conference on Intelligent Robots and Systems

28 September – 3 October 2015, Hamburg, Germany

iROS Hamburg 2015

- Gateway to the Era of Robots -