Robots in society: Event 2
Service Robots

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Innovative Technology and Science Ltd

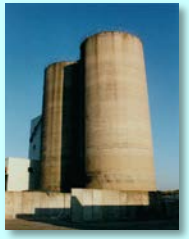
- **InnoTecUK set up in 2009 and it has grown to having ≈30 staff and a turnover of £2.3 million in 2016**
- **Progressive company with extensive networks and detailed expertise in Robotics, Automation, Sensors and Non-destructive testing (NDT)**
- **Focus was on developing new technology for NDT applications in hazardous environments via R&D projects in UK & EU**
- **Future expansion to product and service development and new robot applications (medical and non-medical sectors)**


Power Lines


Petrochemical

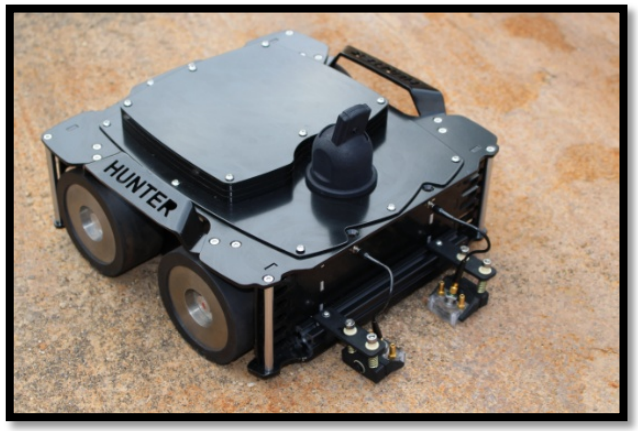

Buildings & Structures


Oil Tanks


Power Stations

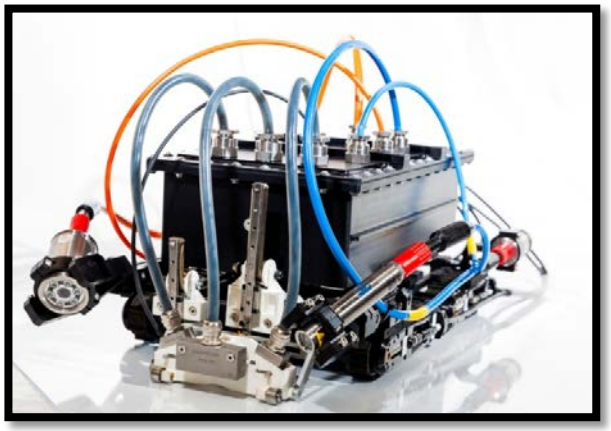

Ship Hulls

InnotecUK's main products



HUNTER: Ferrous surfaces

- Magnetic wheels
- Camera system
- Payload (≈8kg)
- Adaptive to deploy various NDT systems



MAJIC: Ferrous surfaces

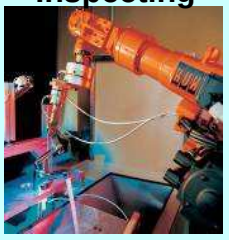
- High traction magnetic tracks
- Hi-res camera
- Laser system
- Inspection in air and underwater

VORTEX: Non-ferrous

- Negative vacuum pressure adhesion
- Camera
- High traction wheels
- Payload (≈4kg)

Emerging main robot sectors

- **Industrial robots: powerful, precise robots for manufacturing**

Spot welding 
Handling 
Assembling 
Machining 
Polishing 
Inspecting 
Palletizing 

- **Robots for hazardous environments: Hazardous environments**

Power lines 
Petrochemical 
High buildings 
Oil tanks 
Power stations 
De-mining 

- **Service robots: Useful tasks (close human-robot collaboration)**

Medical robots

Garbage 
Domestic 
Servant 

Assistance 
Person carrier 
Rehabilitation 
Surgery 

Some ISO robot definitions

- **robot:** programmed actuated mechanism with a degree of autonomy, moving within its environment, to perform intended tasks
- **service robot:** robot that performs useful tasks for humans or equipment excluding industrial automation applications
- **industrial robot:** automatically controlled, reprogrammable multipurpose manipulator, programmable in three or more axes, which can be either fixed in place or mobile for use in industrial automation applications

Industrial robots are dangerous: Impacts

New ways of using industrial robots

KUKA KR500 heavy duty arm

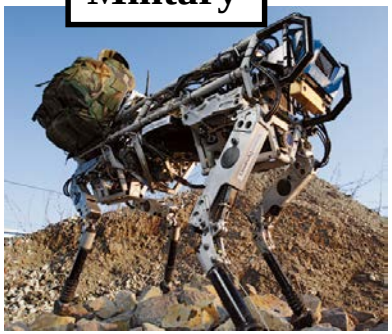
KUKA Robocoaster Robot

Expansion of robots to society

Manufacturing

Domestic

Military



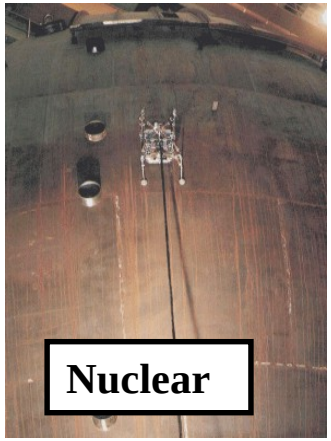
Medical

Collaborative

INDUSTRIAL - SERVICES

Mobile servant

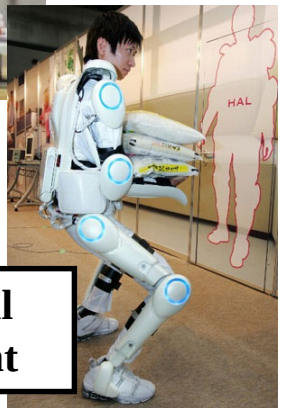
Surgery



Nuclear

Security

Person carrier



Physical assistant

Industrial / service robots: Distinctions and future requirements…. SAFETY issues

	Industrial Robots	Service Robots
Working environments	Controlled and defined environments	Information structured/ unstructured environments
Users	Training for specified tasks in defined environments	Training to cover wide range of tasks in info structured/ unstructured environments
Safety	Machine dependent (ISO 10218-1)	Dependent on the robot and the user (ISO 13482)
Working philosophy	To keep robots and humans separated (see ISO 10218-1, -2; ISO TS 15066)	Robots and humans must share workspace for providing/ receiving the services (see ISO 13482)
Machine design	Flexible on commissioning for defined task	Flexible on demand for generic tasks/ users

Need:

- **Flexibility**
- **Usability**
- **Safety**
- **Human-Robot Collaboration**
- **Effectiveness**
- **Reusable**

Future Needs: Manufacturing to Services

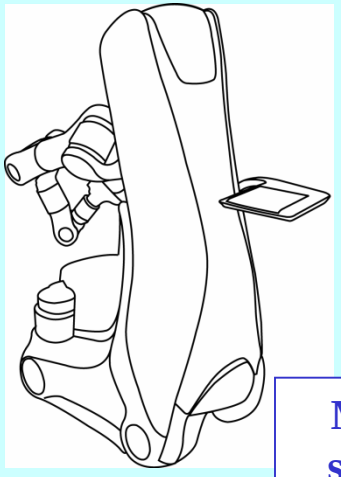
- **Robots to do tasks that must be done but can't be done any other way**
- **Robots need to move out of the factory to "everywhere"**
- **Robots need to do a WIDE variety of "service" tasks rather than only "manufacturing" operations**
- **Robotics has good potential because society is "ageing" and more dependent on technology**
  - **New tasks for robots emerging in everyday life**

WG1: Latest robot definitions

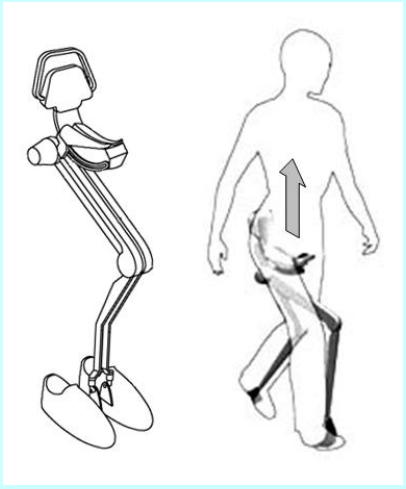
- **robot:** programmed actuated mechanism with a degree of autonomy, moving within its environment, to perform intended tasks
- **service robot:** robot that performs useful tasks for humans or equipment excluding industrial automation applications
- **industrial robot:** automatically controlled, reprogrammable multipurpose manipulator, programmable in three or more axes, which can be either fixed in place or mobile for use in industrial automation applications
- **autonomy:** ability to perform the intended tasks based on current state and sensing, without human intervention
- **personal care robot:** service robot that performs actions contributing directly towards improvement in the quality of life of humans, excluding medical applications
- **medical robot:** a robot intended to be used as medical electrical equipment (MEE) or as medical electrical systems (MES)

Personal care robots: ISO 13482

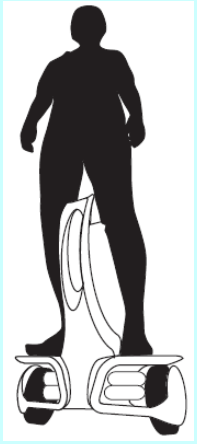
1. **Mobile servant robot:** personal care robot that is capable of travelling to perform serving tasks in interaction with humans, such as handling objects or exchanging information
2. **Physical assistant robot (PAR):** personal care robot that physically assists a user to perform required tasks by providing supplementation or augmentation of personal capabilities
   - restraint type PAR: PAR that is fastened to a human during use
   - restraint-free type PAR: PAR that is not fastened to a human during use
3. **Person carrier robot:** personal care robot with the purpose of transporting humans to an intended destination.

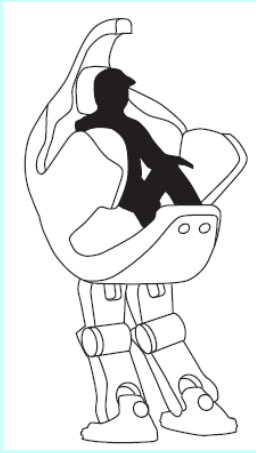


Mobile servant



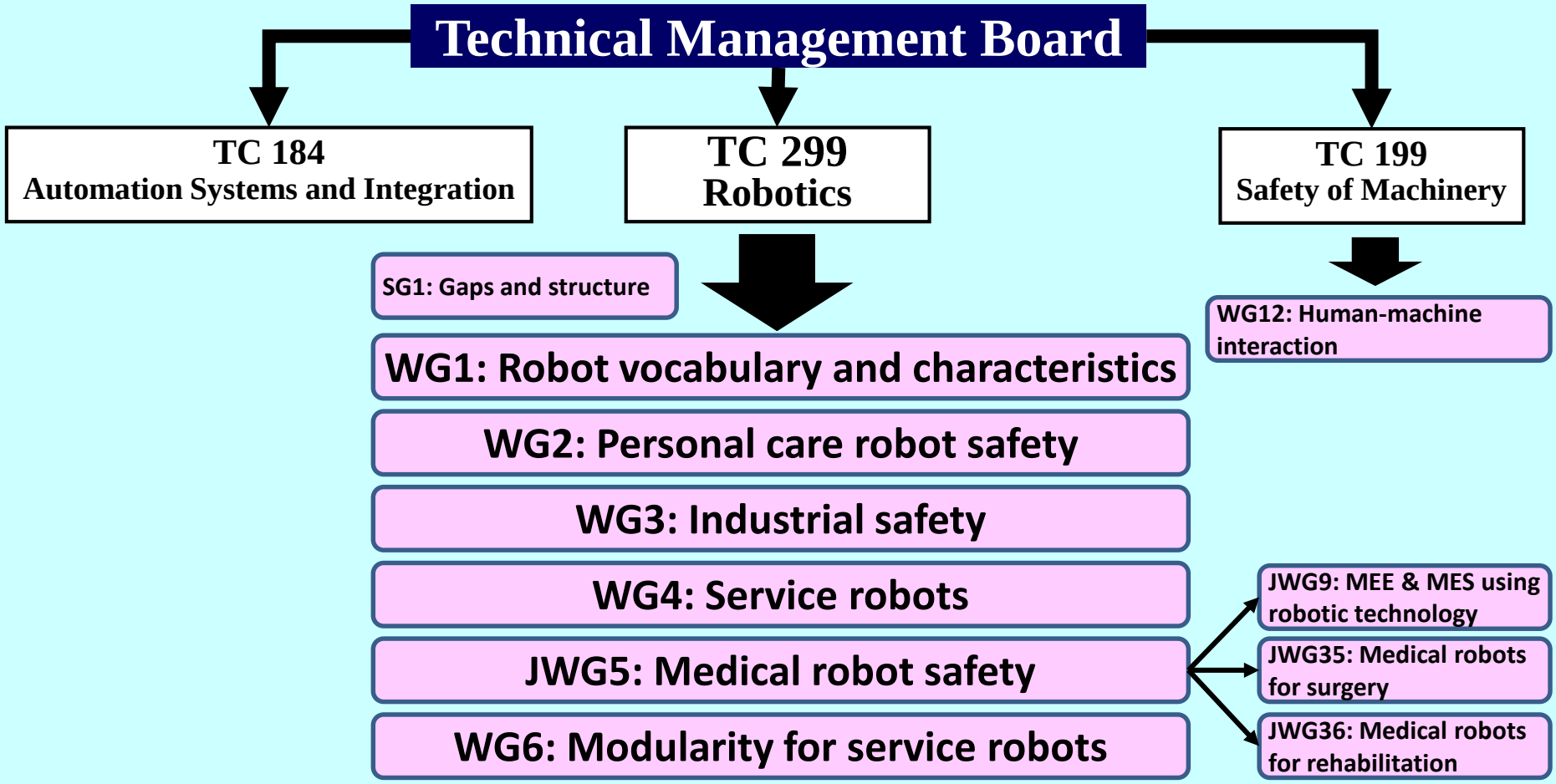
Physical assistant





Person carrier robots

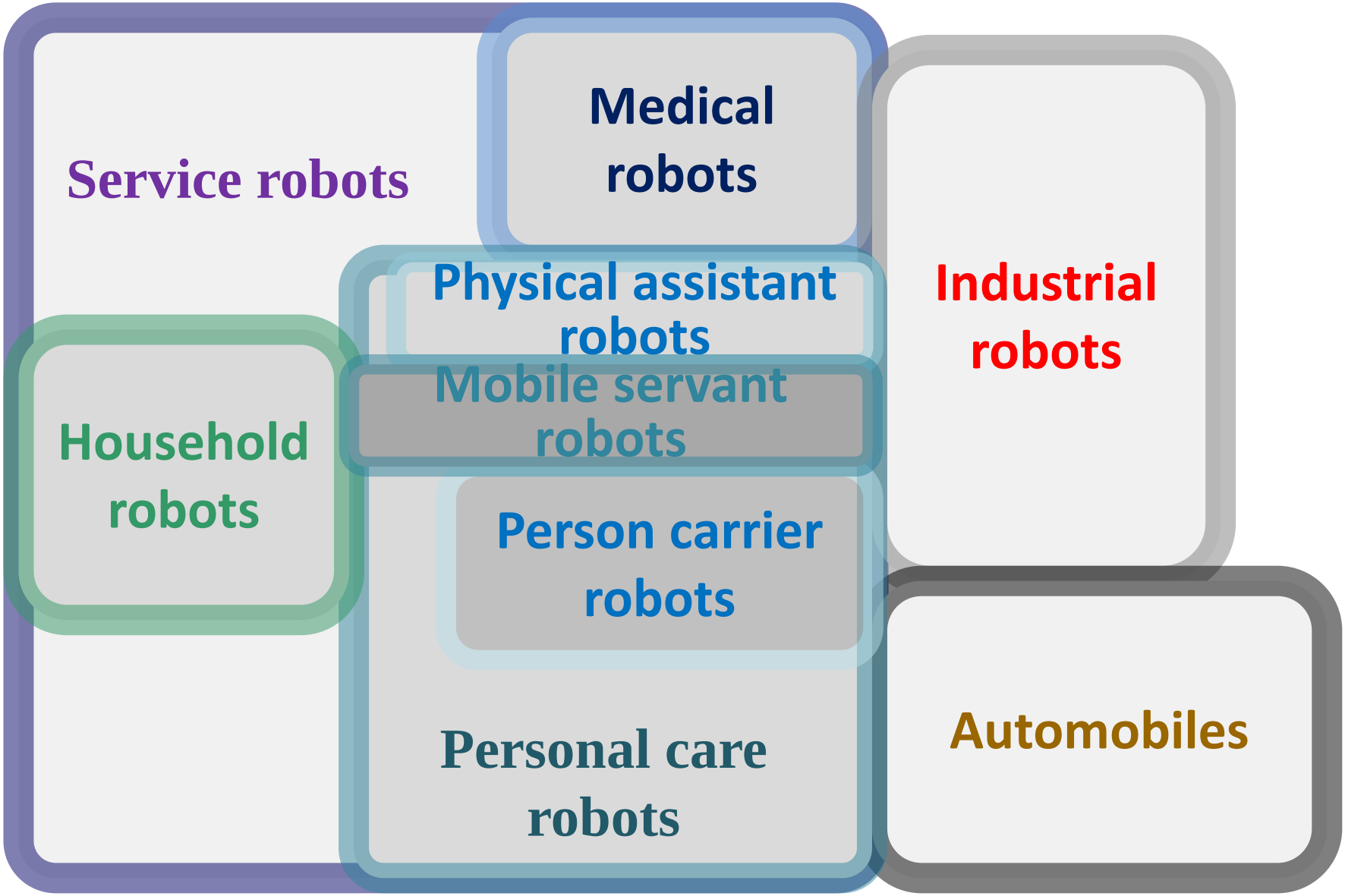
From Jan 2016: ISO TC 299 Robotics



- ISO 10218-1:2011, Safety requirements for industrial robots: Robot
- ISO 10218-2:2011, Robot systems and integration
- ISO TS 15066:2016, Collaborative (industrial) robots
- ISO 8373:2012, Vocabulary for robots
- ISO 13482:2014, Safety requirements for personal care robots

- WG1: ISO CD 19649, Vocabulary for mobile robots
- WG2: App guide to 13482, Safety-related test methods for 13482
- WG3: ISO TS 15066 balloting, collaborative IRs. NWPs on End of arm tooling, manual load stations
- WG4: ISO FDIS 18646-1, Performance test methods- Locomotion for wheeled robots, Part 2: CD on Navigation
- WG5: IEC TR 60601-4-1, MEE with DOA; IEC 80601-2-77, BS&EP Med robots for surgery; IEC 80601-2-78, BS&EP Med robots for rehab
- WG6: ISO 22166-1 Modularity for service robots: General requirements

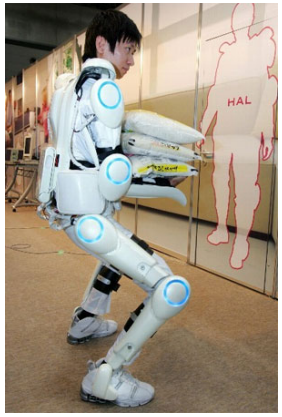
Service robots overlaps: Initial work in WG2



Wearable exoskeleton robots

Military | **Industrial** | **Service robots**

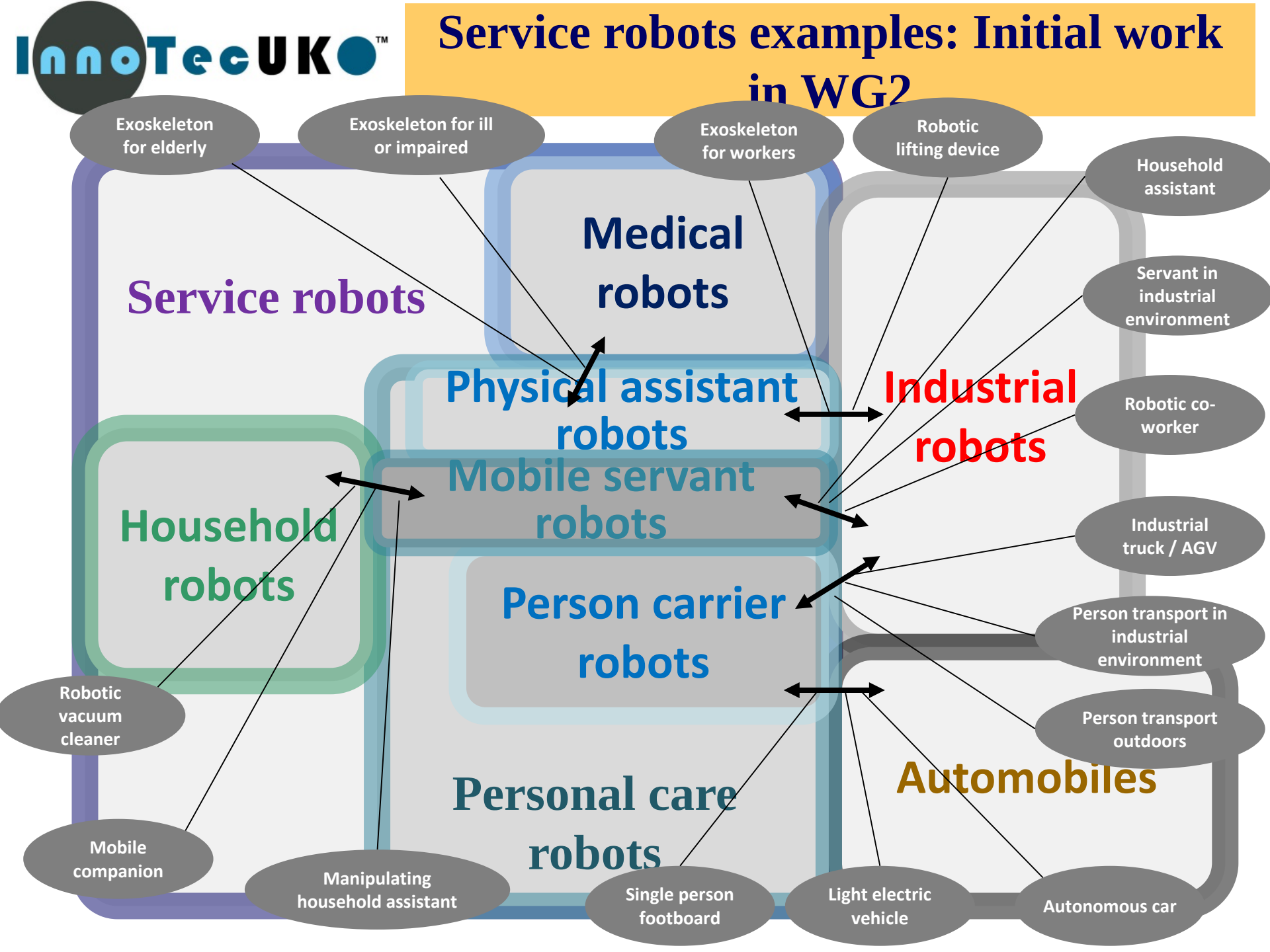







Military | **Industrial** | **Personal care** | **Medical**

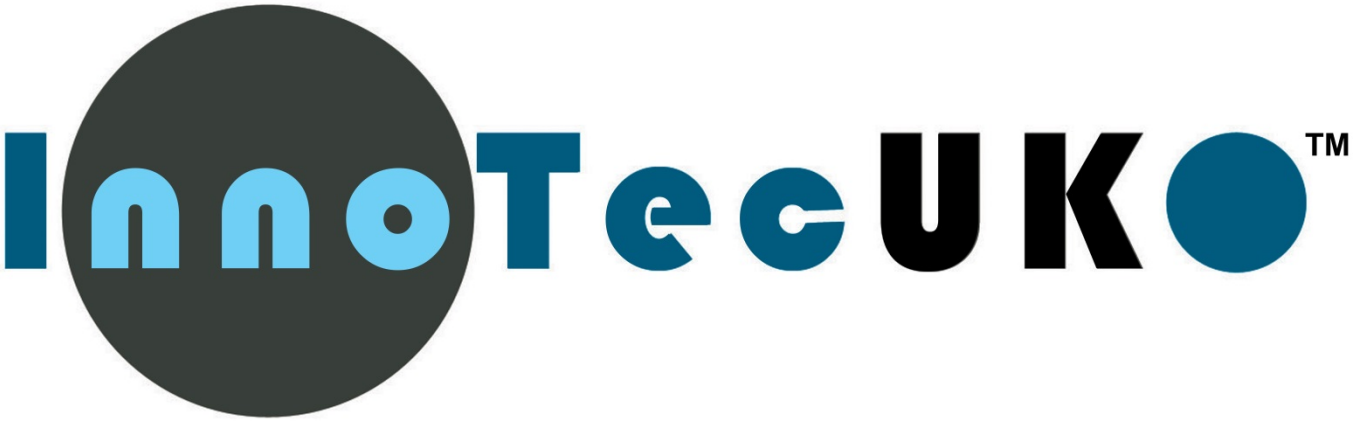
Service robots examples: Initial work in WG2



Conclusions

- **Robotics is evolving and expanding to new service application domains where close human-robot interaction is essential**
- **New wide ranging challenges emerging:**
  - **Service robots: Personal care robots (machines)**
  - **Service robots: Medical robots (MEE + MES)**
- **As robot domain grows need to address boundary issues with other market sectors to avoid confusion**
- **Involvement of all stakeholders is essential for rapid and successful development of robotics for public benefit**

THE END



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