NATIONAL ENGINEERING POLICY CENTRE

ROYAL ACADEMY OF ENGINEERING

ROYAL AERONAUTICAL SOCIETY

Institution of MECHANICAL ENGINEERS

IET The Institution of Engineering and Technology

Engineering Council

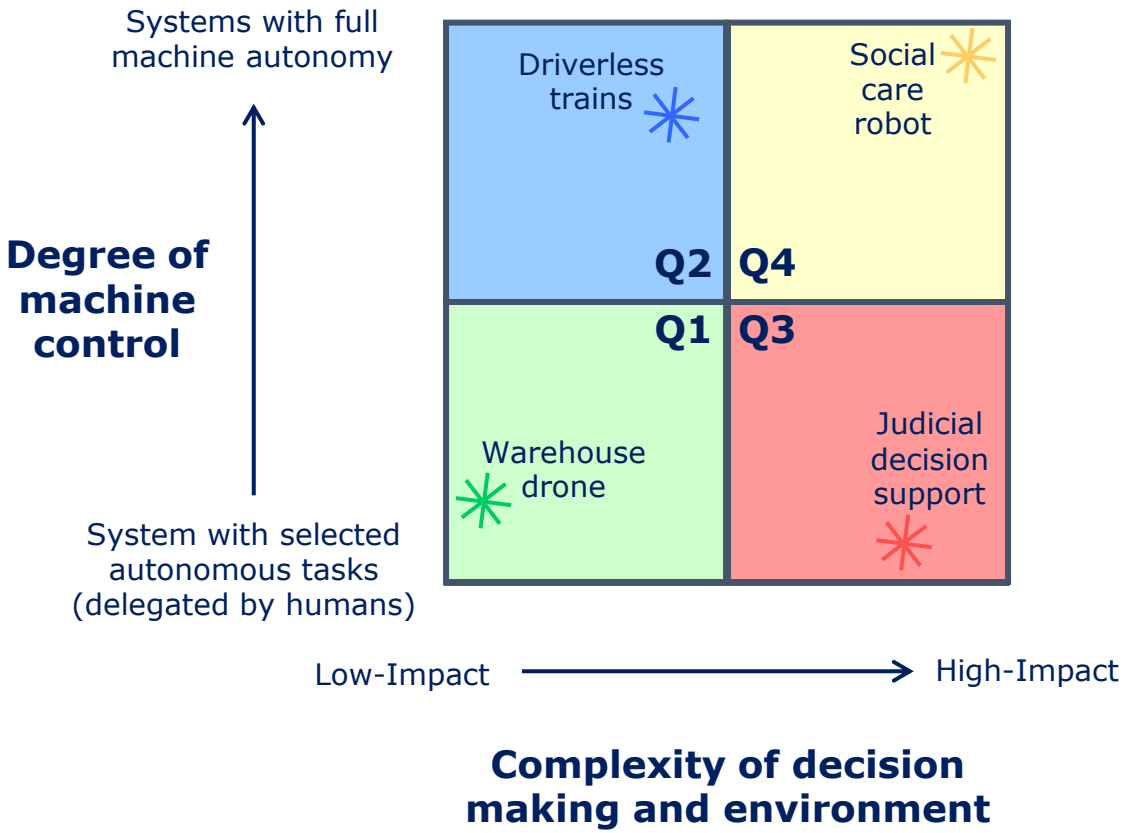
IAgrE

Institute of Marine Engineering, Science & Technology IMAREST

bcs The Chartered Institute for IT

Autonomous systems in shipping and beyond, the questions that need answers…

Autonomous systems



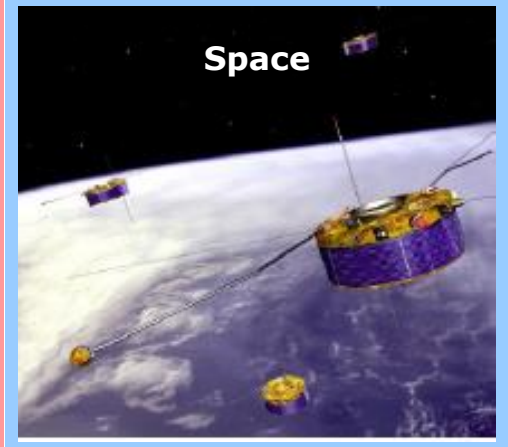
Autonomous systems **make informed decisions for themselves in complex environments**

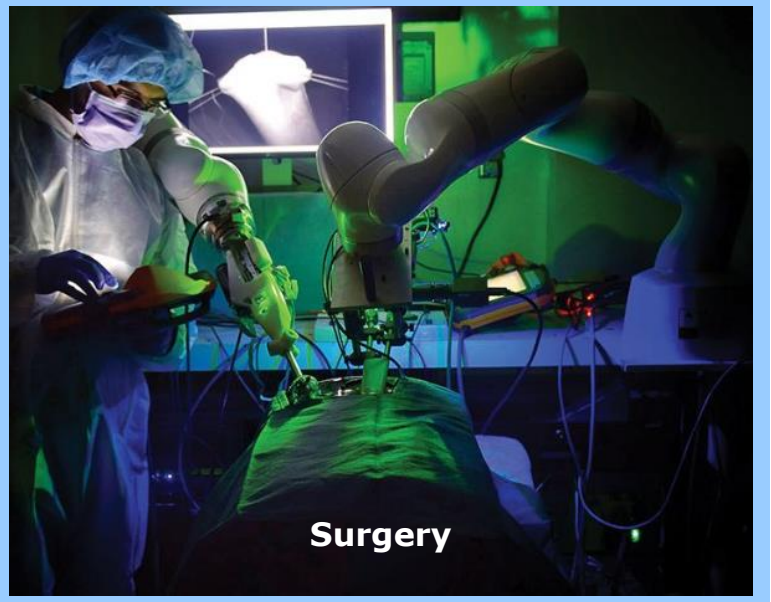
Autonomous systems

Already operational

Aspirational/

Not yet deployed





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Benefits and challenges

For autonomous systems benefits tend to be focussed on the removal of dull, dirty and dangerous tasks and the potential safety improvements.

Realising these benefits requires overcoming challenges and putting the right governance in place.

Across the next slides these are categorised as;

- Technical
- Ethical
- Oversight
- Regulation
- Profession responsibility
- Public Acceptability

Trade offs

There are a series of trade-off decisions to be made.

Safety is a critical factor for autonomous systems but must be considered along with cost and performance.

There are further ethical trade-offs between transparency, the protection of intellectual property and the accuracy of the system.

Much of these trade-offs are built into the way the system is designed. However, deciding where the appropriate balance point lies requires a conversation beyond engineers and regulators with mechanisms for the public to provide guidance.

Technical

One of the biggest challenges facing industry is the current gap in **safety assurance models**, the justified confidence or certainty in a system's capabilities.

Closing this gap will requires **validating the system safety and verifying it meets its requirements**. This requires a combination of real world data and trials, alongside the use of simulation.

- How safe and resilient do these new systems need to be?
- Can we be confident to deploy autonomous systems with current validation and verification techniques?
- Are new methods that allow operational verification of systems required?
- How transparent do these methodologies need to be?
- Can the surrounding infrastructure help overcome the technical challenges?

Ethics

There will be a risk of harm. While this is a problem with many systems, autonomous systems create an extra dimension to the problem due to the reduction in human oversight in complex, safety critical and operational domains.

This can come from both the system design and how it is deployed in practice.

- Who is morally responsible for the decisions made by an autonomous system?
- Do certain limits need to be built in to the software to avoid certain unethical behaviours? If so whose ethics?
- What degree of transparency is required for a system to be considered ethical?
- How can collaborative, collective, reflective decision-making with a diverse group be encouraged?

Oversight

For many systems, a system architect has proved beneficial, taking responsibility for the oversight of system design and risk management.

As autonomous systems are deployed in increasingly complex environments the scale of the system requiring oversight for autonomous systems is likely to be much broader than previous systems that have taken this approach creating challenges of liability and authority.

- Is there a role for an overall systems architect?
- What does the insurance model look like?
- Do current common law practices apply for autonomous systems?
- How can a culture of institutional humility be developed in order to learn from failures?

Regulation

The UK government aspire to take a leading role in regulation for fourth industrial revolution. Envisioned as a regulatory system that is outcome focussed, globally relevant, informed by stakeholders and supportive of innovators for testing and regulatory navigation.

This is visible in transport autonomy through initiatives from Centre for Connected and Autonomous Vehicles, Maritime and Coastal Agency and Civil Aviation Authority.

- Is there a role for a new regulator that looks across typical sectoral silos?
- How could it be resourced with the necessary expertise to understand the technology and ensure compliance?
- How can sharing of good practice across initiatives be enabled?
- Should there be a common regulatory view of how safe is safe enough for autonomous systems?

Professional responsibility

Current regulatory systems are supported by technical engineering standards that encourage the use of good practice and define the conditions that systems must be tested under.

Codes of Practice, or Conduct, are another support mechanism. These provide guidance for using autonomous systems and encourage responsible behaviours. These codes can build trust and change professional culture.

- How can the appropriate safety culture be created?
- Where does regulation and legislation need to step in to avoid risk for the system user?
- To what extent should industry be responsible for setting the bar for public trust?
- Should ethical governance be sought of the technological system or of the organisations that developed it?

Public acceptance

The acceptance of controversial technologies depends on societal and cultural structures. There is wide awareness that these will be transformative technologies, placing demands on the places in which they operate and changing the environment around them.

- How do peoples opinions vary depending on their role in the wider ecosystem?
- Can trust be established across the allied industries?
- How can cooperation be built up between individuals and the service providers?
- Can workers be taken on an inclusive journey?
- How can autonomy be used to bring both safety and environmental benefits?

If we find the right answers…

The future might be
- Safer
- More efficient
- Lower emissions
- More productive
- More accessible

But this requires
- Understanding
- Responsible innovation
- Collaboration
- Multi-disciplinary conversations
- Cross sector sharing