

SEAS DTC

Autonomous Technologies in the SEAS DTC and BAE Systems

BAE SYSTEMS



SEAS DTC

**Systems Engineering for
Autonomous Systems
Defence Technology Centre**

www.seasdtc.com



Defence Technology Centres (DTCs)

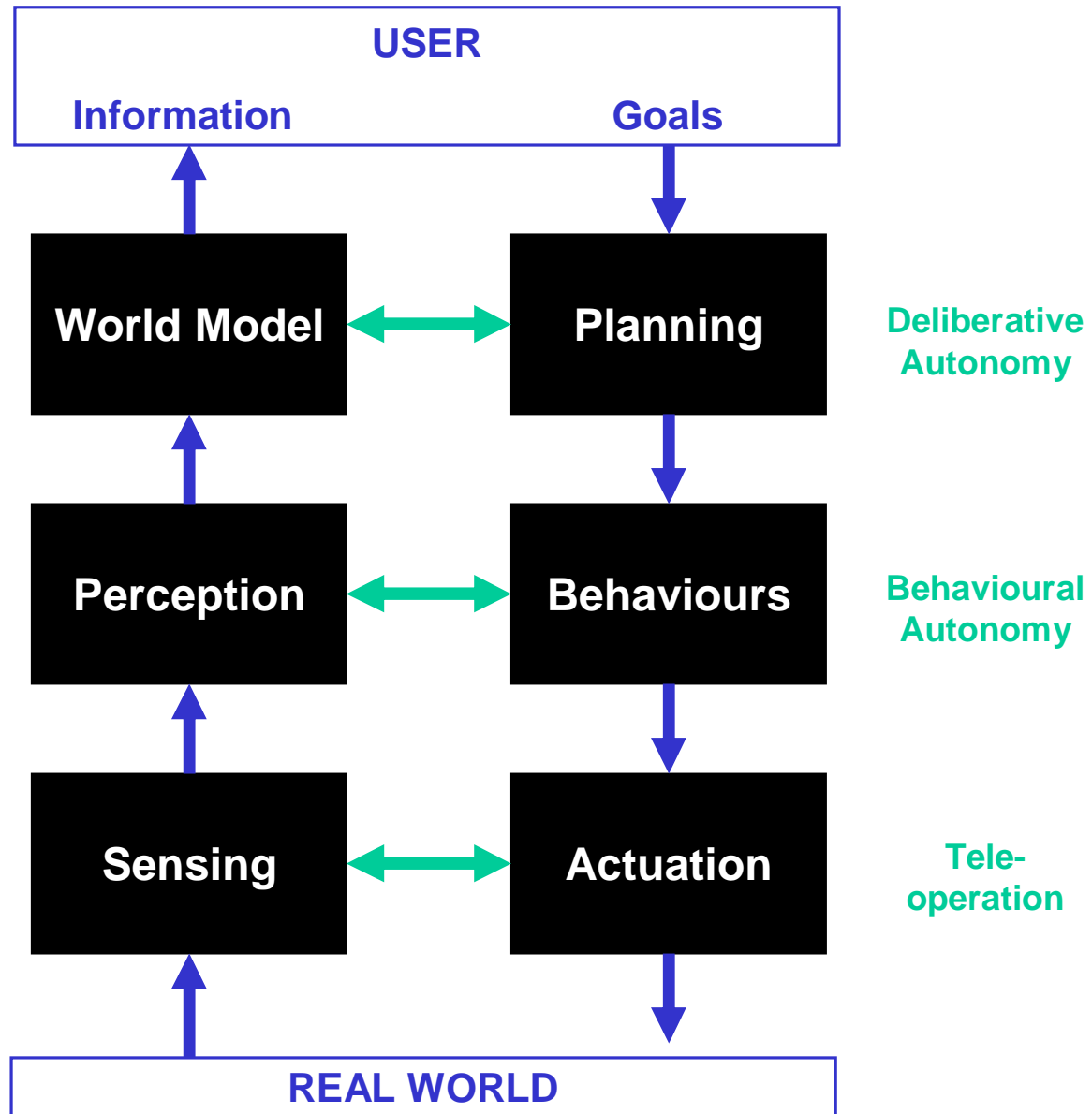


- **An initiative of the UK Ministry of Defence (MoD)**
- **Virtual centres of excellence, managed by industrial consortia**
- **Cover broad technology areas of significant importance to the delivery of UK defence capabilities**
- **Strategic aim to provide more rapid pull-through of low maturity research into the MoD's defence equipment programme**
- **Four DTCs currently operating :**
 - Data and Information Fusion (www.difdtc.com)
 - Electro-magnetic remote sensing (www.emrsdtc.com)
 - Human Factors Integration (www.hfidtc.com)
 - Systems Engineering for Autonomous Systems (www.seasdtc.com)
- **Seen an exemplar for research collaboration between Government, UK Defence industry and UK academia**

SEAS DTC Scope and Goals

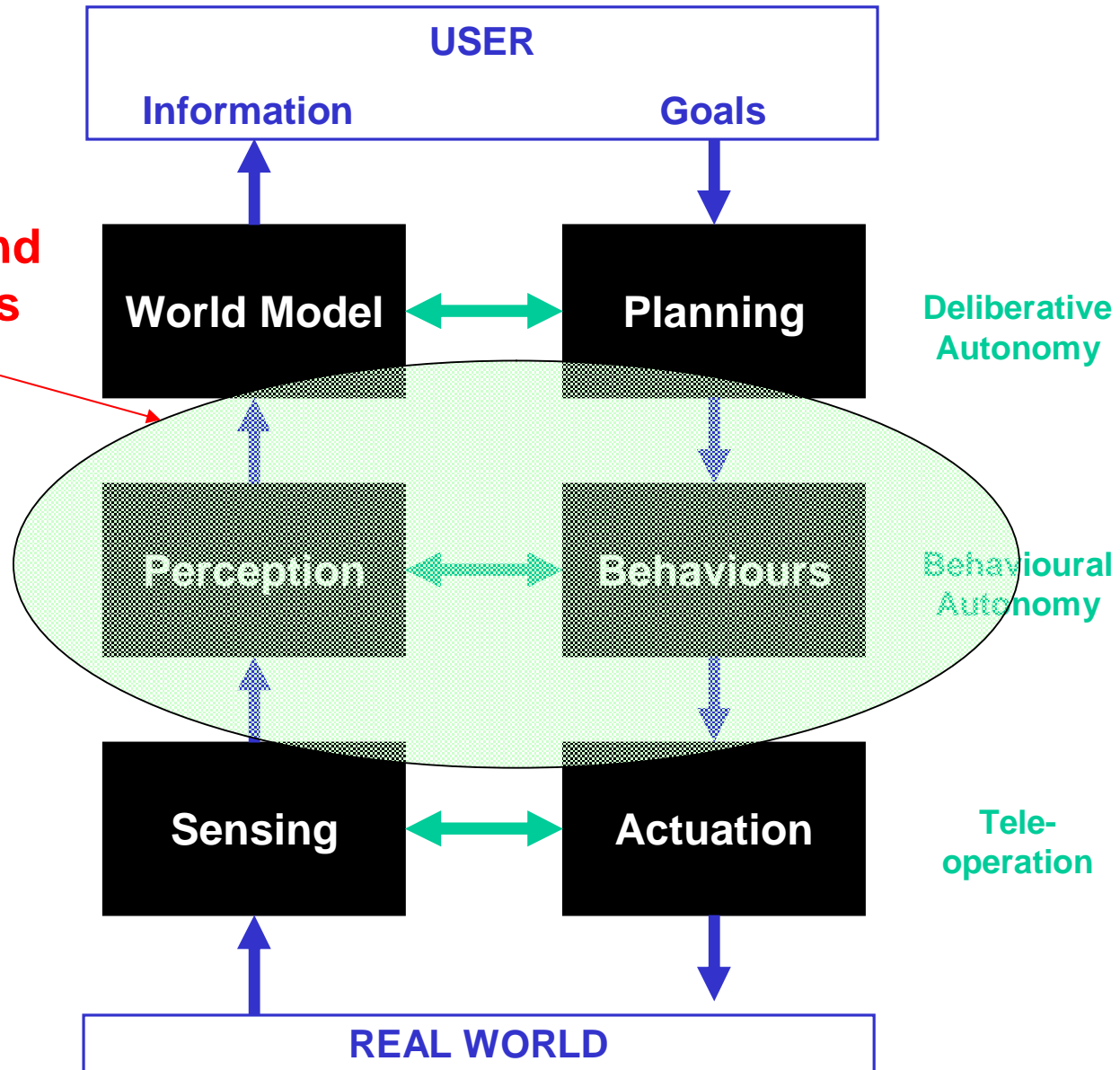
- **Cutting-edge research supporting development of the UK's next generation of uninhabited military systems and meeting the big challenges of autonomy :**
 - Increasing the ability of systems to act without human intervention in a wider range of situations
 - Reducing whole-life cost, support and logistics requirements for autonomous systems
 - Increasing survivability, speed and endurance of autonomous systems
 - Increasing the range of possible operating environments for autonomous systems
 - Increasing public and military acceptance of autonomous systems
- **Providing opportunity for UK industry and academia to co-operate with MoD in bringing forward innovative exploitable solutions**
- **Covering land, sea and air domains**
- **Dealing with whole system and major sub-system technologies**
- **Focusing strongly on Systems Engineering in order to :**
 - Understand the systems-level issues for autonomous systems
 - Facilitate pull-through of technology into military capabilities
 - Manage the DTC itself in a systems manner

Autonomy

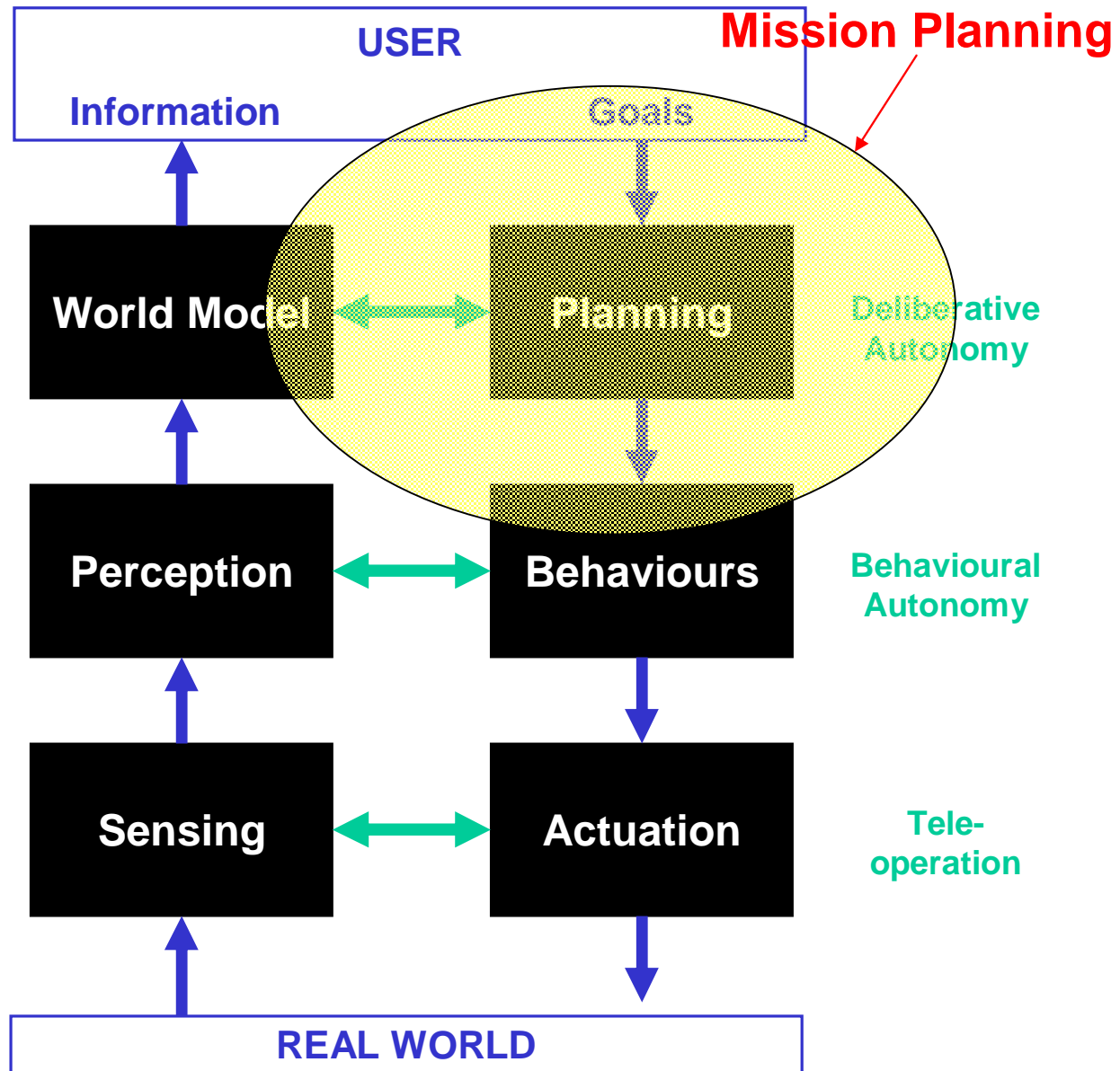


Autonomy

Algorithms and Architectures



Autonomy



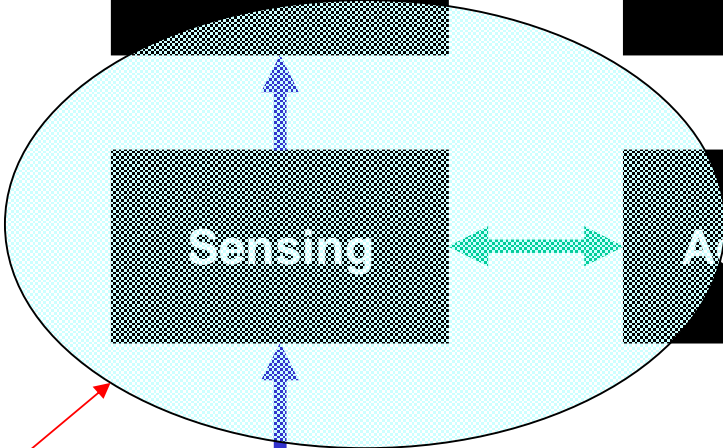
Autonomy



Deliberative
Autonomy



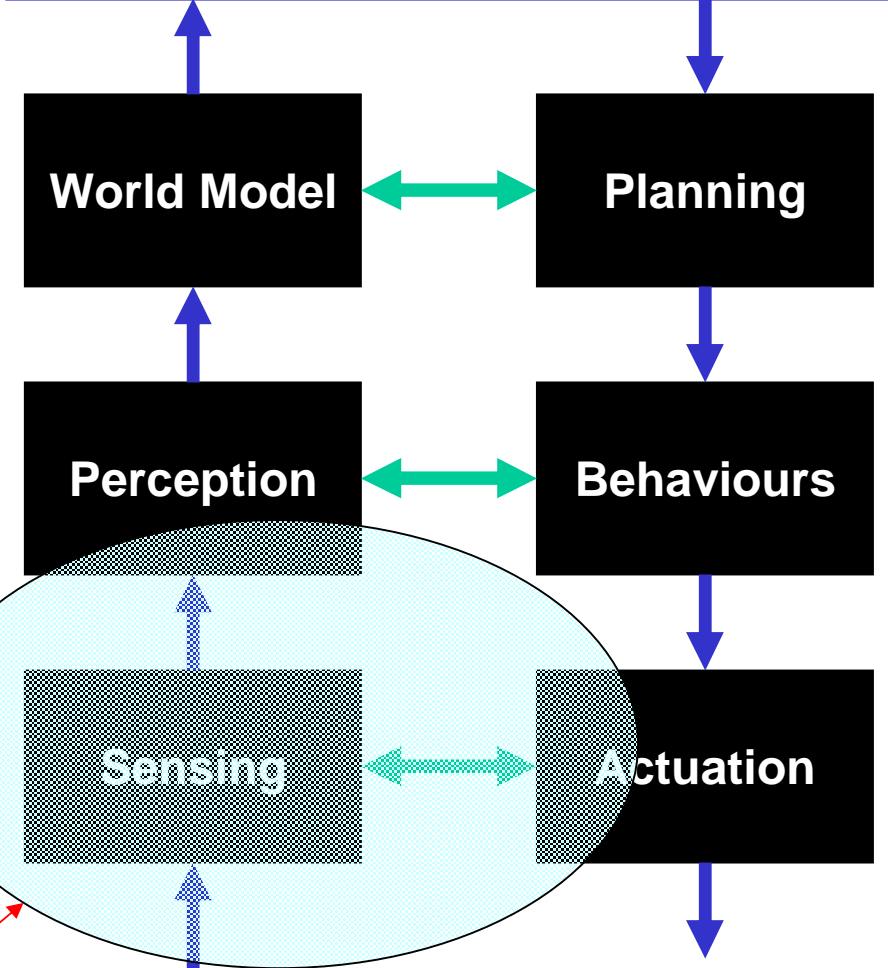
Behavioural
Autonomy



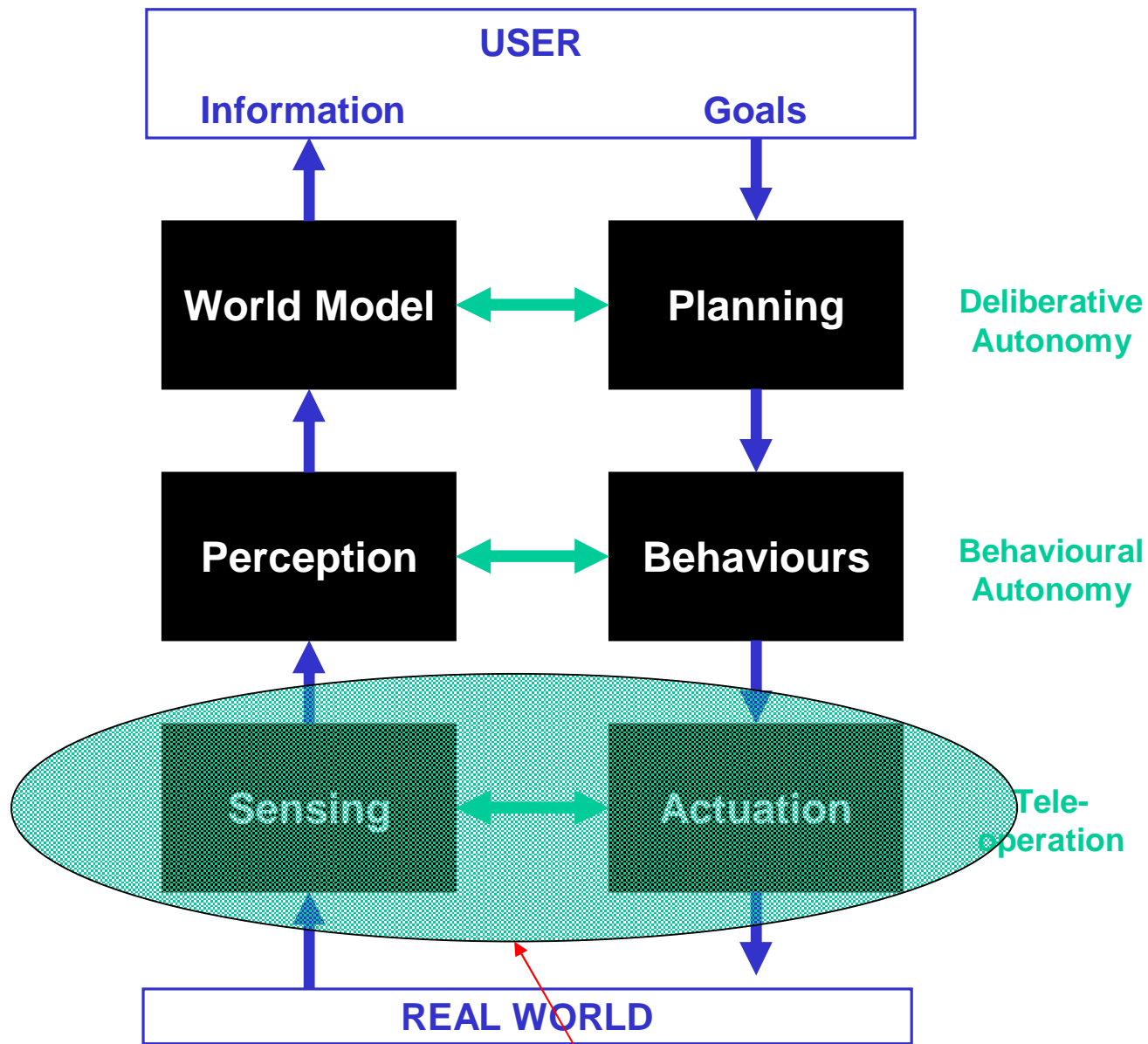
Tele-
operation



Sensor Exploitation

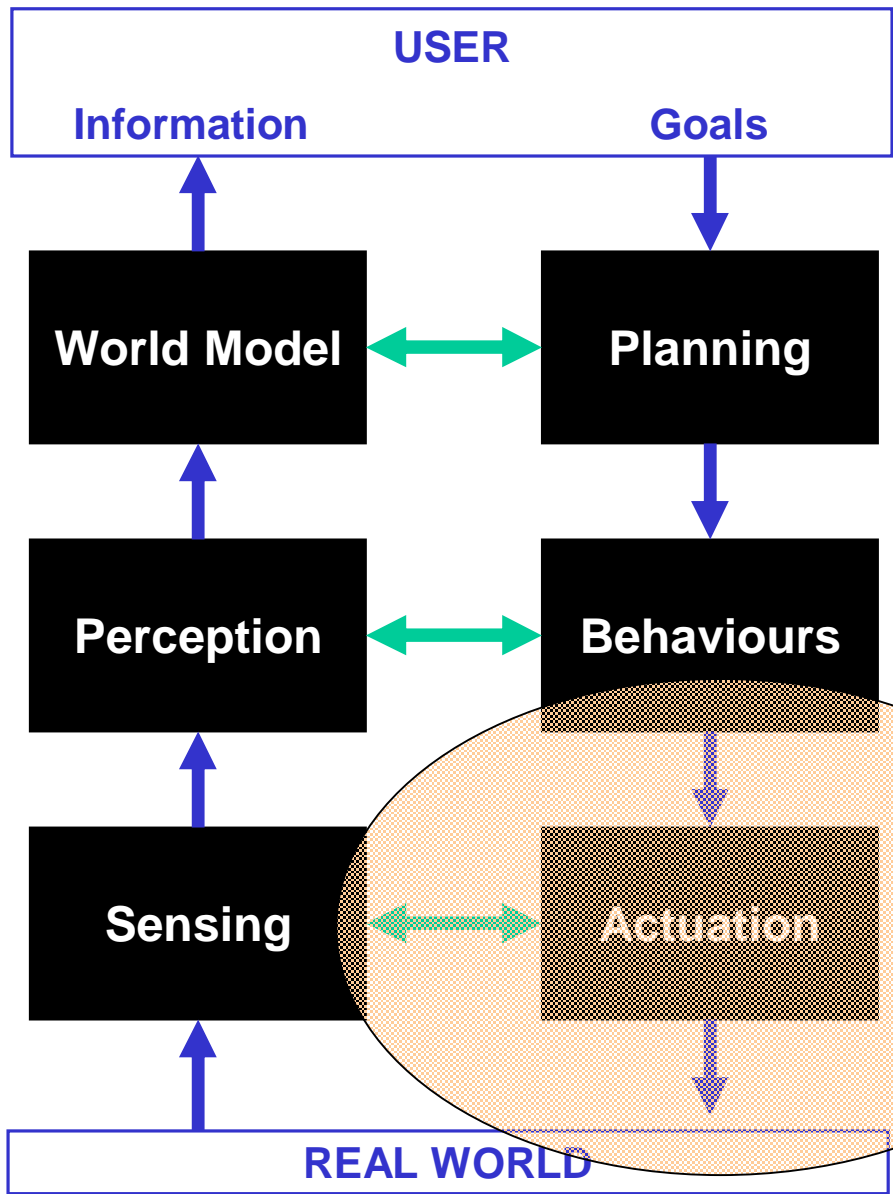


Autonomy



Communications and Control

Autonomy



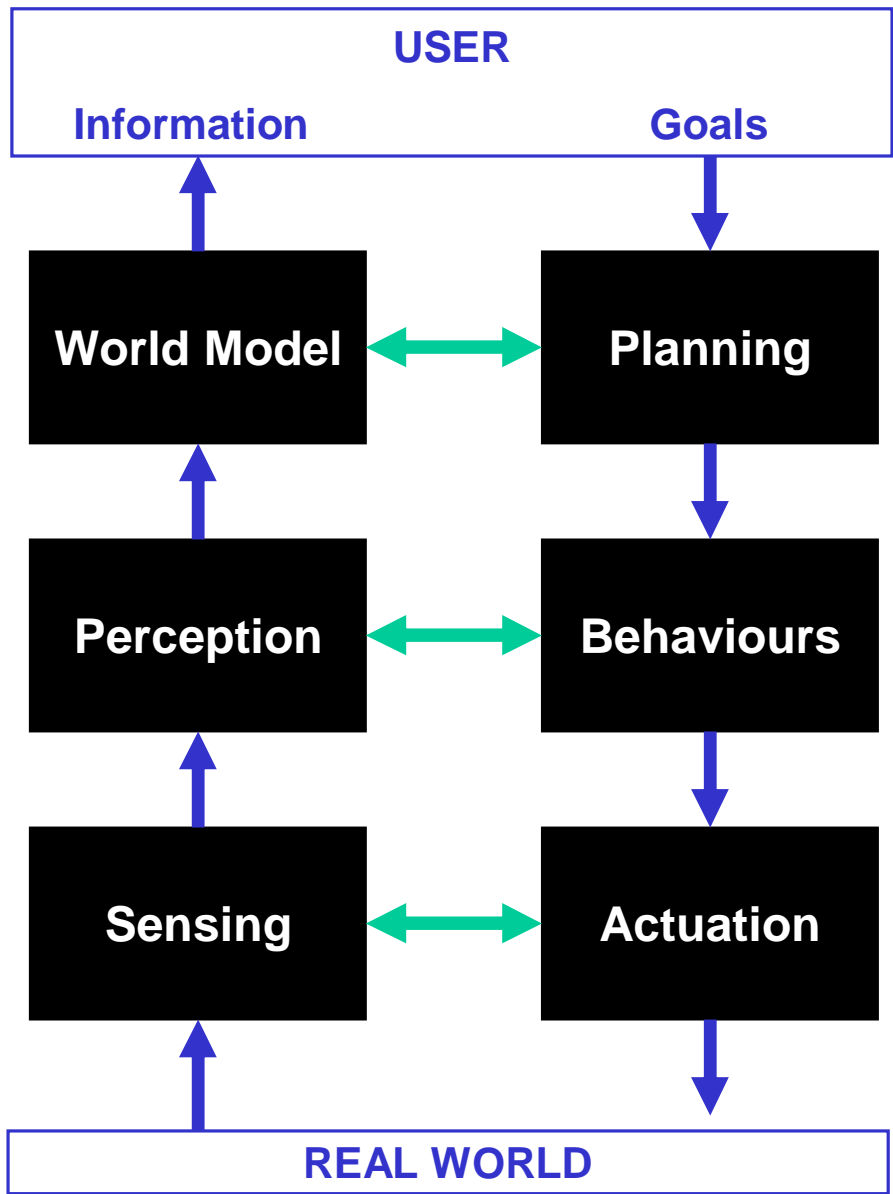
Deliberative
Autonomy

Behavioural
Autonomy

Tele-
operation

Propulsion, Power Gen, Energy Mgt

Autonomy



Deliberative
Autonomy

Behavioural
Autonomy

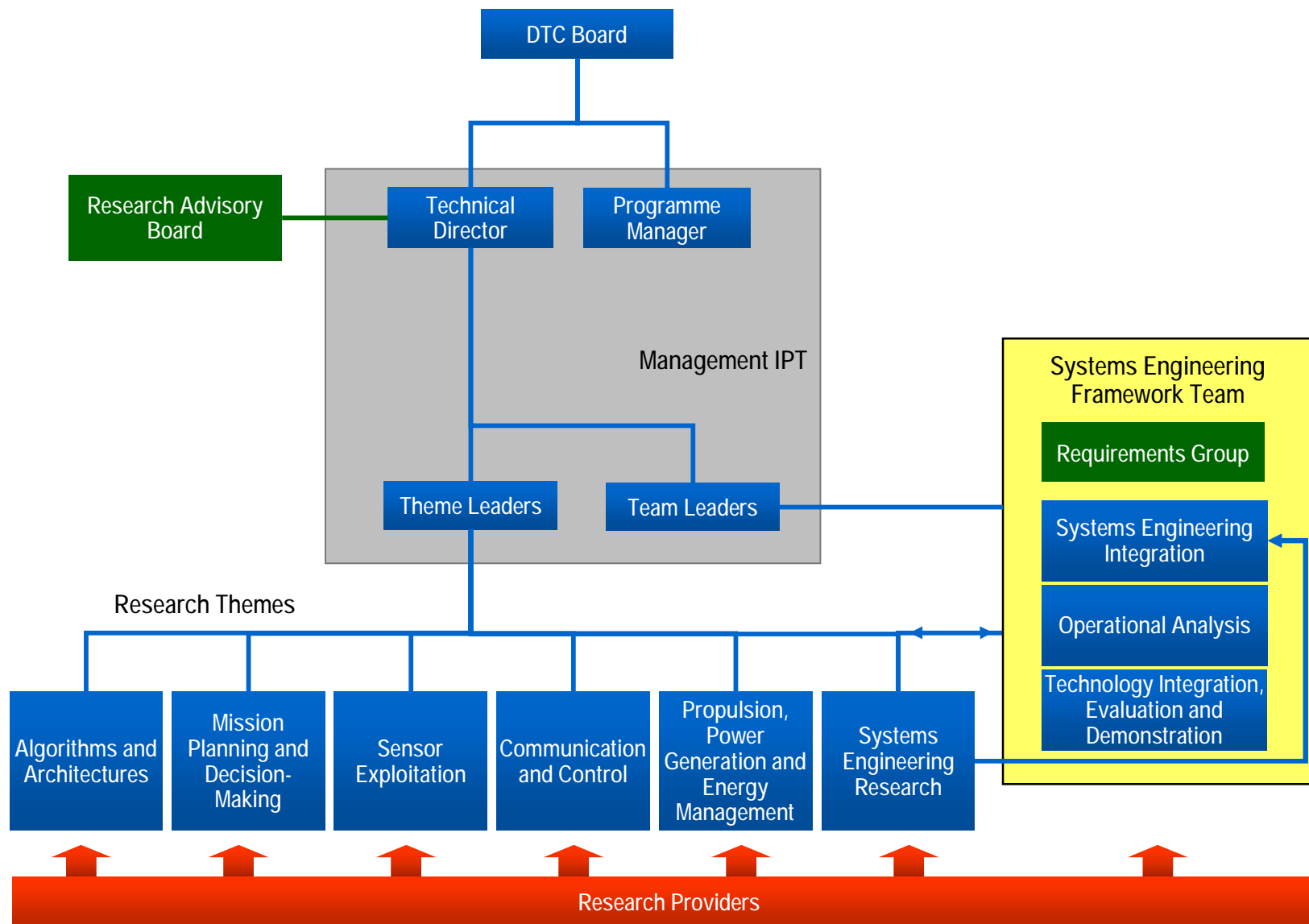
Tele-
operation

Systems Engineering Research pervasive

SEAS DTC Contractual Framework and Funding

- **The Prime Contract :**
 - has a 3 year duration with an extension option for a further 3 years
 - has a maximum value of £5M of MoD funds per annum
- **The DTC Consortium undertakes to provide relevant 'contribution-in-kind' to MoD to a matching value of £5M per annum**
- **Over 94% of MoD funding spent directly on research activities**
- **Sub-contracting of MoD funded tasks is undertaken by BAE Systems through a virtual DTC Office**
- **Intellectual property is owned by the organisation generating it, but MoD and other consortium members have user rights**
- **Open model of research proposals and selection**

SEAS DTC Organisation and Areas of Work



DTC Systems Engineering Framework

Overall Purpose : To provide a coherent integrated approach to the identification and management of the research programme and to the operation of the DTC

Operational Analysis (OA) :

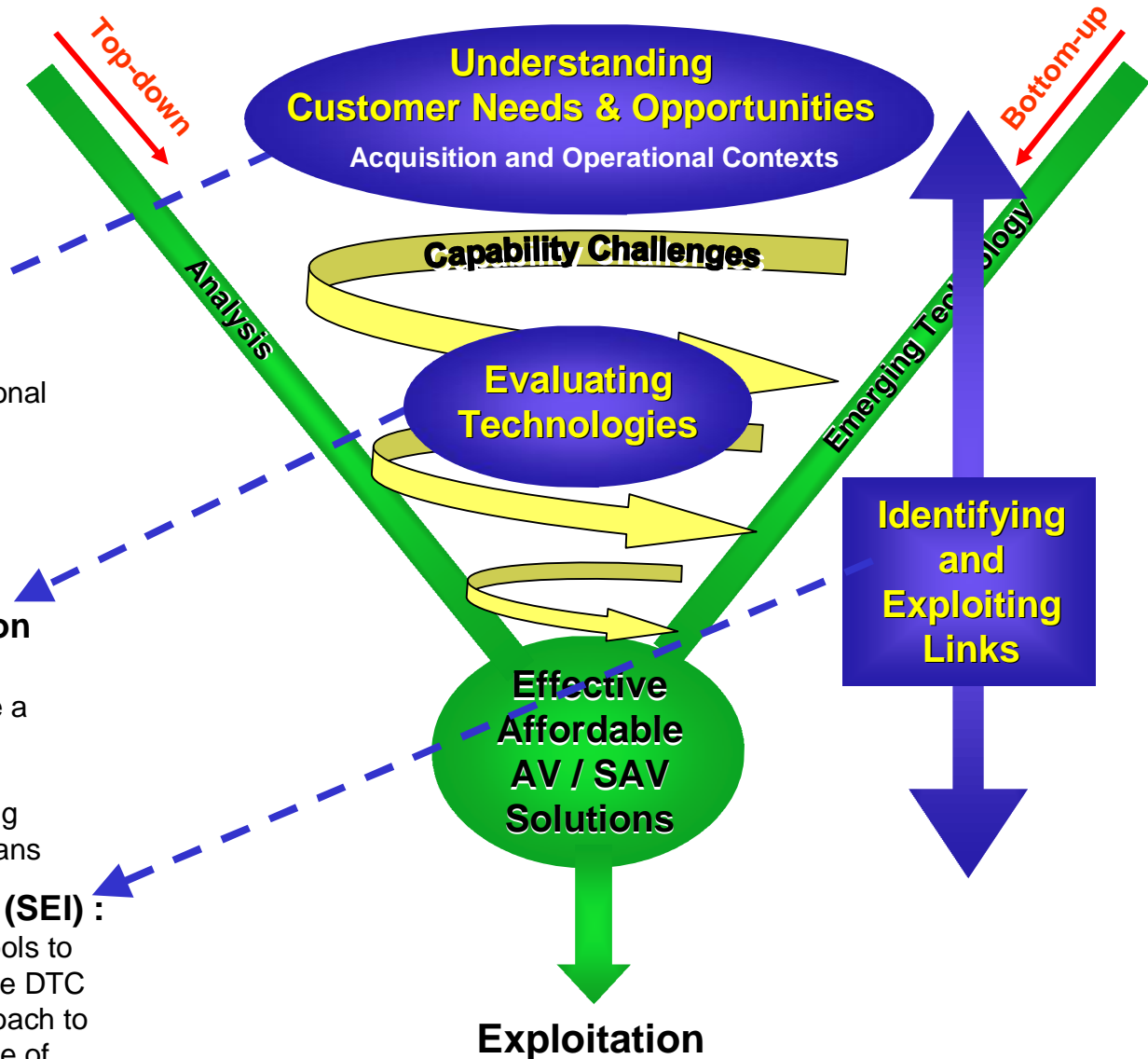
- Explore and understand the operational issues of Autonomous Systems
- Introduce assessment methods to provide effective evaluation of alternative systems and system architectures

Technology Integration, Evaluation and Demonstration (TIED) :

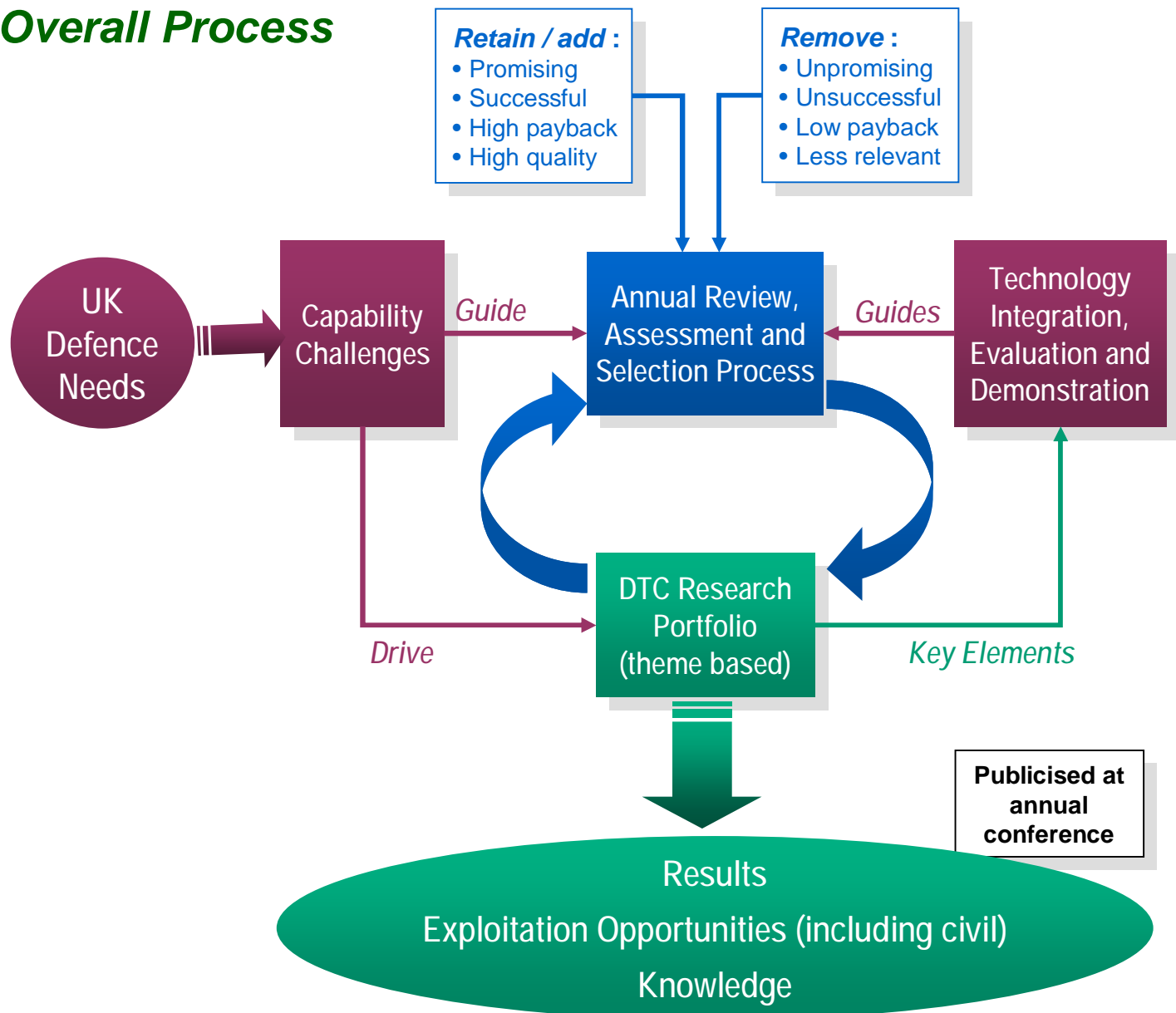
- Integrate developments and provide a cost-effective means to assess and evaluate potential solution concepts against a range of scenarios, utilising synthetic environments or other means

Systems Engineering Integration (SEI) :

- Apply best practice, methods and tools to ensure the operational efficacy of the DTC
- Utilise a Systems Engineering approach to the ongoing identification and linkage of relevant research topics



SEAS DTC Overall Process





EMRSDTC
Electro Magnetic Remote Sensing Defence Technology Centre

Joint Technical Conference & Exhibition

13th - 14th July 2006

SEAS DTC

Systems Engineering for Autonomous Systems
Defence Technology Centre

Location : Edinburgh International Conference Centre

Web : www.emrsdtc.com/conferences.htm



Book on-line:

www.emrsdtdc.com/conferences.htm

or Telephone BiP Solutions on :

0845 270 7095



BAE SYSTEMS

**Autonomous Technologies
in BAE Systems**

www.baesystems.com

“It’s about Autonomy not just UAVs”

- Important to develop complementary systems working in all domains
- Autonomy is just as applicable to manned applications
- Must serve a need, ‘simply because you can’ is not enough



UAV Demonstration

HERTI-1A



HERTI

HERTI-D

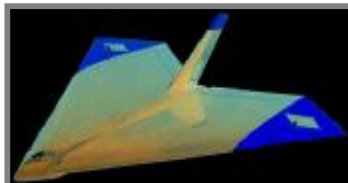


Stage 4 –
RAVEN



SUAV(E)

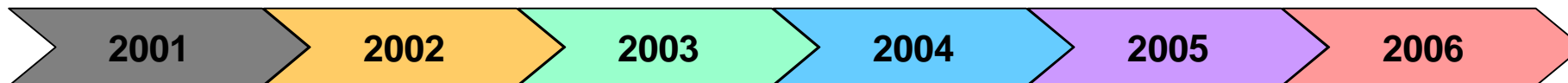
Stage 1 and 2



Stage 3 - KESTREL



Stage 4+ -
CORAX



UAV Demonstrator Programmes

Migrated the key technologies from these demonstrator programmes into a form that can be used in wider applications



Stage 3 Kestrel

- **Blended Wing-Body 5.5m Span, 140kg**
- **Experience in manufacture, integration and test of sub-scale aircraft**
- **Low cost, rapid development**
- **Activities in 2002**
- **Flight clearance process - the first jet powered UAV cleared by the CAA**



Raven

- **First Flight 17 December 2003**
- **Low cost, rapid development including low temp cured CFC**
- **Common sub-system**
- **Highly unstable, finless design, complex control laws**
- **9 month programme**



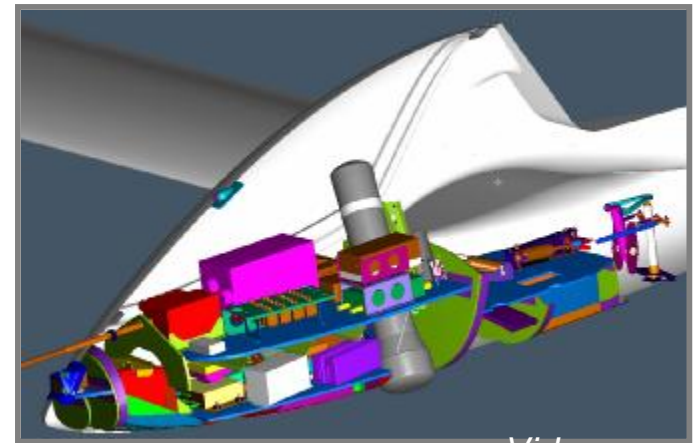
Corax

- **Multi role ISTAR system demonstrator**
- **Higher aspect ratio wing for endurance**
- **Composite centre fuselage, systems and engine**
- **10 month programme**
- **First flight 25 January 2005**
- **A fully autonomous flight from start of the take-off roll to full stop at the end of the landing**
- **Modular design, significant commonality**



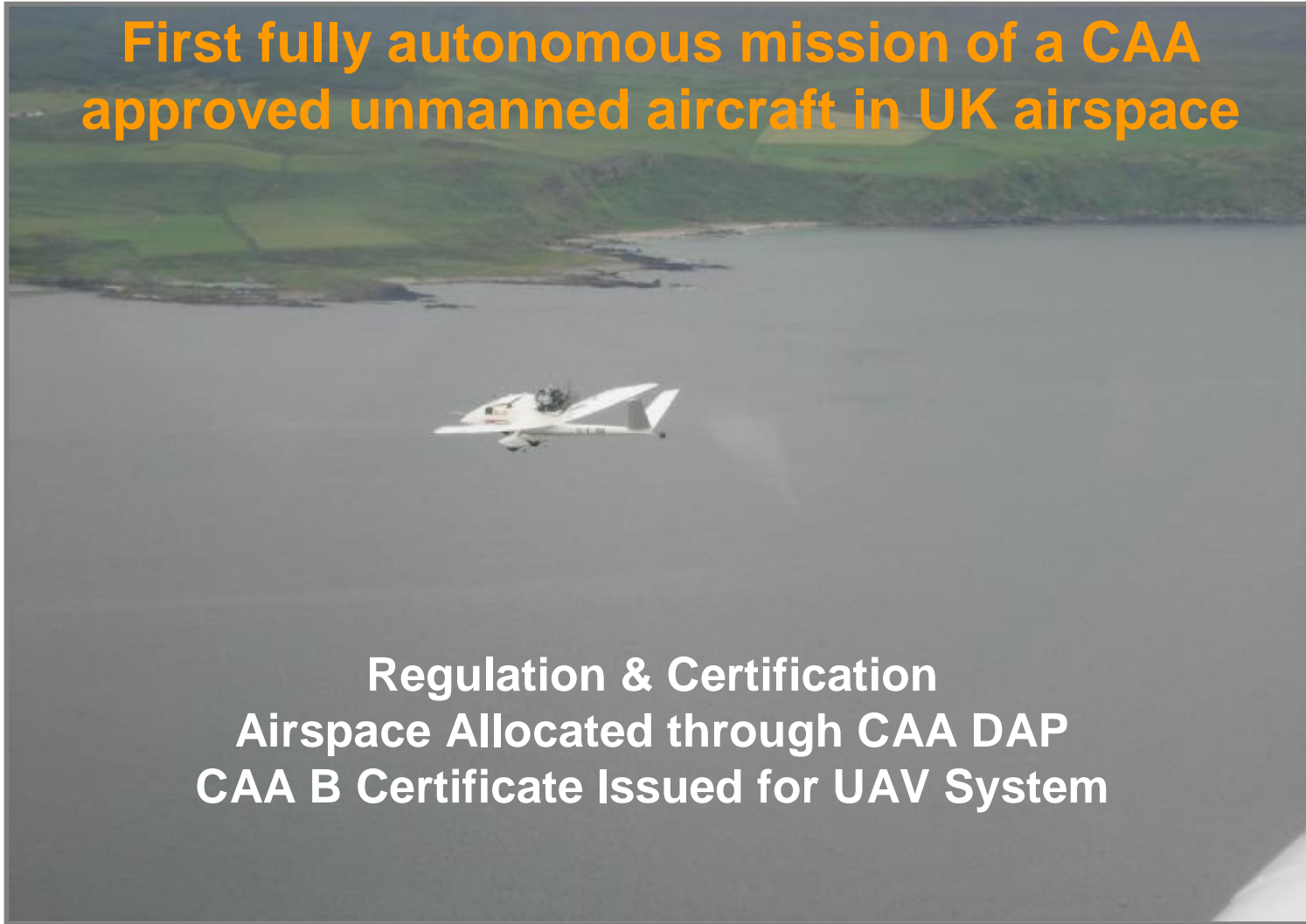
HERTI 1A

- **Advanced derivative of Herti-1D - larger, modified, composite airframe**
- **Performance of demonstrator in this configuration**
 - 450kg all up weight
 - 125kts with payload (ICE Equipment)
- **Primary Trials Objectives**
 - initial system & aerodynamic clearance configuration
 - initial operational demonstration in conjunction with ICE equipment
- **Flight clearance in conjunction with CAA under B Conditions for fully autonomous mission in UK airspace**



HERTI 1A – 18 August 2005

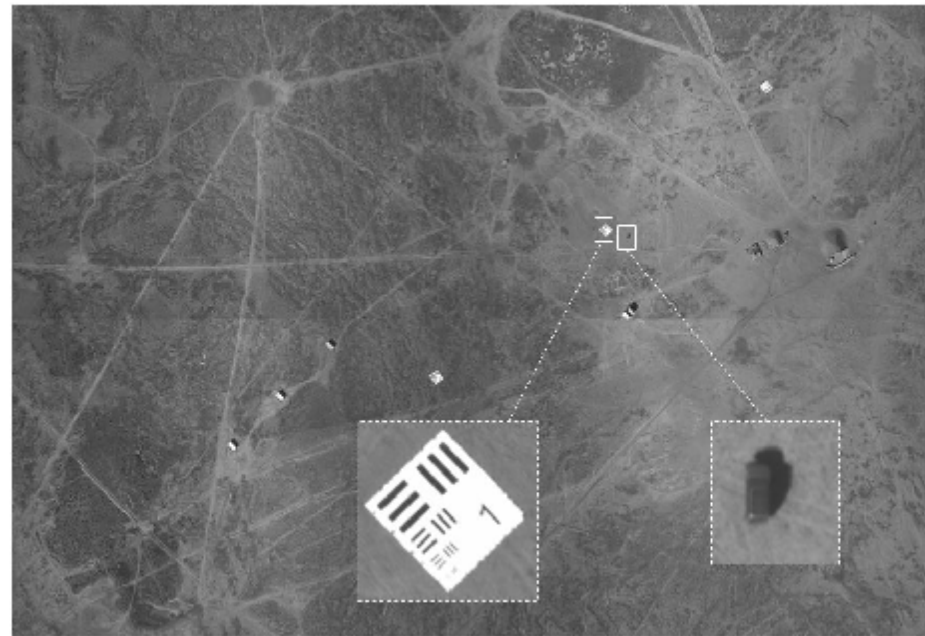
**First fully autonomous mission of a CAA
approved unmanned aircraft in UK airspace**



**Regulation & Certification
Airspace Allocated through CAA DAP
CAA B Certificate Issued for UAV System**

Image Capture and Exploitation (ICE)

Extensive 3 year research programme to develop novel, low bandwidth solutions in the real world



ASTRAEA

Benefits to
Cross Sector
Transport
Infrastructure



Improved
Technology
Capability
& Innovation



Increased
Regional
Development
& Wealth
Creation



High Value
Economy
& Skill Base



Autonomous Systems Technology Related Airborne Evaluation & Assessment

What is ASTRAEA ?

www.astraeaproject.com

Goal

To enable the routine use of UAVs in all classes of UK airspace **WITHOUT** the need for restrictive, specialised or non-routine conditions of operation

- **Part of the National Aerospace Technology Strategy (NATS)**
- **Part of the governmental / industry Aerospace Innovation and Growth Team (AeIGT)**
- **£32M initial programme**
- **Launched at ParcAberporth – 7 September 2005**
- **Grant offers received 30 March 2006**

Talisman UUV

- **Multi-role UUV concept demonstrator involving BAE Systems Underwater Systems and Submarines**
- **Draws up Air Systems and Insyte experiences**
- **Iridium Satcom & acoustic datalinks**
- **Internal payload for weapons & sensors**
- **MCM Role**
- **Reconnaissance**
- **Anti-ship / Submarine**



Unmanned Ground Vehicle Demonstrator

- **Autonomous Ground Vehicle based on a Wildcat 4x4**
- **Developed in collaboration with specialists Bowler Off Road**
- **Provides a rugged platform on which to develop a world leading Intelligent Autonomous System**
- **Plan to provide a basis for SEAS DTC demonstration capability**
- **Emphasis on intelligent autonomy, not the platform including all source navigation, collision avoidance, mission planning, integration with other assets including manned systems and UAVs, and cooperative autonomy**



Challenges for Autonomous Systems into the Future

Underwater

- *By 2015*: UUVs providing intelligence collection, area reconnaissance, communications and navigation relay, and submarine hunting capability
- *By 2025*: Multiple UUVs providing enhanced reconnaissance, intelligence collection, underwater communications networks, UUV hunting and Battle Damage Assessment

Sea Surface

- *By 2015*: Unmanned surface vehicles, and surface ships with enhanced smaller, faster, agile capabilities supported by autonomous systems to reduce crew workload and enable networked connectivity to other autonomous assets.

Air

- *By 2015*: The focus will be on the provision of enhanced ISTAR of air and sea, and further improvements to ISTAR of land to support effects at increased range
- *By 2025*: Deep, robust, agile and persistent ISTAR, and BDA, is envisaged to support long range force projection systems. Vision: 'Achieve 10 times the effect, with half the manpower, at half the cost and one tenth of the deployed logistics'

Land

- *By 2015*: Autonomous vehicles providing assistance in the form of surveillance, target detection and recognition, logistics support, situational awareness aids, mine detection and clearance
- *By 2025*: Autonomous units supporting / providing remote target detection systems, automated logistics convoys, automated indirect fire delivery, sentry systems, and autonomous load carriers

Company Approach

- To recognise autonomous systems as the next '**disruptive technology**' with the potential for offering solutions with more performance and greater value for money
- Invest in the **key technologies** required to exploit the market as it matures
- Continue to use **Proof of Concept** demonstration programmes to focus the R&T activity and visualise the concepts to the user
- **Target investment** in product development in order to position mature systems in the market place as it evolves
- Leadership of SEAS DTC and role in ASTRAEA bringing together military and civilian exploitation routes and regulatory frameworks



Thank you !

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