



Ministry
of Defence



The Defence AI Playbook

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Introduction



Cdre Rachel Singleton

As arguably the most transformative technology of our generation, new uses for artificial intelligence (AI) are emerging at an unprecedented pace and increasing scale. The Ministry of Defence (MOD) recognises that AI has enormous potential to enhance our capabilities, improve productivity and maximise our strategic advantage. Released in 2022, the Defence AI Strategy sets out a clear vision that, in terms of AI, the UK MOD will become the world's most effective, efficient, trusted and influential Defence organisation for its size.

Working with talented and engaged stakeholders across Defence, government, industry, academia and our allies, the Defence AI Centre (DAIC) is accelerating AI adoption and driving the transformation of Defence into an AI-ready organisation. The continued investment in the delivery of ambitious, safe and responsible AI-enabled capabilities to Defence users across the breadth of our business will underpin our strategic and operational advantage.

The DAIC is the catalyst to accelerate MOD's ability to harness the game-changing power of AI.

We are building an AI ecosystem to strengthen our relationship with industry, establish new links with non-traditional suppliers and small and medium enterprises, and break down the barriers to collaboration on current and future Defence challenges.

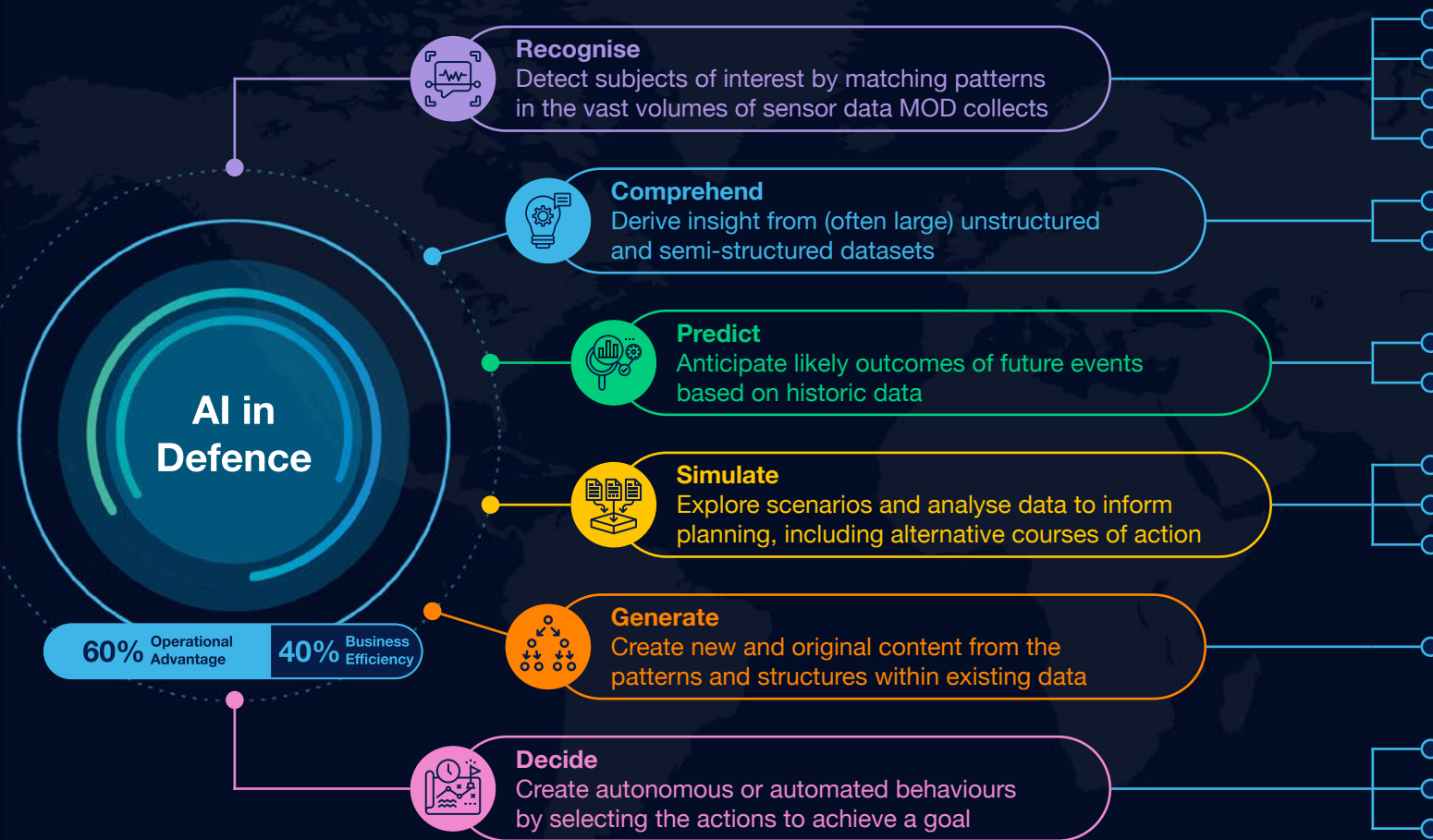
This Defence AI Playbook was developed to illustrate the breadth of AI opportunities across the organisation, from strategic advantage on operations to efficiency in our business processes. Each of the case studies included represents an area of AI under development or use within the organisation and exposes some of the common challenges Defence faces to realising the potential benefits of AI.

As we move from start-up to scale up, the DAIC will continue to develop the ways in which we collaborate with all of our stakeholders. It is through these partnerships that truly transformative solutions will be developed and adopted. Please take the time to review the Defence AI Playbook and join us on this exciting journey.

AI Landscape: Applications of AI



AI Landscape: AI Problem Spaces





CASE STUDY

Spare Parts Failure Prediction

- The British Army operates a wide range of in-service vehicles, some dating back to the 1980s.
- Vehicle availability is constrained by parts failures, and if spares are unavailable this can have a significant impact on operational and training capabilities.



Solution: predictive algorithms using Machine Learning and Natural Language Processing techniques



Predict



- AI can read from manual historical failure and usage records, using a decade of data to learn to better forecast parts failure in the future.
- Purchasing and access to spares can be optimised based on these forecasts, ensuring they're available at the time and place a failure occurs.
- Unnecessary replacements are avoided, if we understand that the true lifespan of a part is likely to be much longer than previously expected.
- A capability proven on a few parts in one class of vehicles can form the basis for a fleet-wide capability.



AI Challenges: Limited Data

Our legacy vehicles lack modern digital health and usage monitoring systems. We may therefore be dependent on manually recorded data and service records, with consequent data quality issues around accuracy and consistency. We also, by definition, lack data from future deployments – Defence is rarely predictable.



CASE STUDY

AI at the Edge

- Intelligence, Surveillance and Reconnaissance (ISR) platforms collect vast amounts of data through their sensors, but connectivity to deployed platforms is limited and often expensive, limiting the volume of data that can be brought back for analysis.
- Sometimes data is unusable, due to noise or obscuration for example – if we can detect poor quality data on-board the

platform, that would save valuable bandwidth.



Solution: Sensor quality assessment on-board ISR platforms



Recognise



- When starting projects like this, we undertake detailed assessment of user stories and technical feasibility, to inform the approach and scope.
- Leveraging open-source tools, a comprehensive pipeline has been created in MODCloud for model training, compression and testing. This pipeline enables us to evaluate the performance of different models when compressed, before deployment to the platform.



AI Challenges: Edge Processing

The computational power available on our platforms is limited, requiring compromise between accuracy and timeliness of our AI models, and a clear understanding of the trade-offs being made. This is particularly acute for some of our legacy platforms and those at the “extreme edge” (e.g. satellites).



CASE STUDY

Intelligent Search & Document Discovery

- Across many areas of Defence, from intelligence analysis to research & development, we have a huge volume and variety of documents that need to be understood.
- Finding related information across multiple documents is often a challenge without

prior knowledge of its contents, due to nuances in language and context.



Solution: Natural Language Processing-based Search and Visualisation Capability



Comprehend



- By combining the power of Natural Language Processing and graph visualisation, we can expose hidden relationships within documents.
- Using advanced algorithms, analysts and researchers are able to efficiently search and navigate through documents, uncovering valuable insights and identifying previously unseen connections.



AI Challenges: Public Perception

MOD is committed to our ambitious, safe and responsible principles in our use of AI, and we apply these across all of the work we do. We carefully consider a broad range of potential harms from AI in Defence, in order to maintain confidence of all stakeholders, including the public. With the speed of technology development outpacing legislation and standards, this remains under constant review.



CASE STUDY

Object Detection in Satellite Imagery

- Analysis of satellite imagery plays an important role in intelligence gathering.
- It relies on trained analysts who must view large numbers of images, looking for signs of activity that would be relevant to UK military planners or forces on the ground. This includes identifying objects of

interest, and also recognising what has changed.



Solution: Satellite Imagery Analysis Capability

- The Defence AI Centre is working with



Recognise



partners to develop an Imagery Analysis capability which uses Machine Learning for object detection.

- It offers a web interface to prioritise images for the analyst, automatically flagging images containing objects of interest, or significant changes in areas of interest. The analyst remains responsible for interpreting what is seen to deliver actionable insight to the frontline.
- The capability also enables the creation of training sets for continuous model improvement.



AI Challenges: Development Environments

When working on some classified or legacy systems AI teams will not always have easy access to modern, AI-ready tools in the same environment as the data or the end user. This might require development to take place on separate systems, perhaps without access to real data for training.



CASE STUDY

Analysis of Radio Frequency (RF) Signals

- The UK collects a huge volume of emissions data from across the electromagnetic spectrum, from a variety of military surveillance platforms.
- The capacity of human analysts to manually process this data is limited, and so there is a risk that we do not fully

exploit the information value of what is being collected.



Solution: AI-powered Signal Classification Capability



Recognise



- A new tool, inspired by popular music recognition apps, has been created using AI techniques to make sense of the RF signatures that have been collected.
- By identifying and isolating waveforms, and comparing them against a labelled data set, we can classify the likely source along with a measure of confidence.
- Working closely with end users, such tools need to be carefully designed and integrated into their workflow, to fully leverage the potential of the technology.



AI Challenges: Integrating with Operational Systems

Within Defence we operate on hundreds of different IT systems, which means each time we want to integrate AI into a new system there is a significant discovery activity to understand whether and how that can be achieved. It can sometimes require significant investment or time to complete that integration.



CASE STUDY

AI Assisted Operational Planning

- Military operational planning requires the analysis of data from a range of sources including mapping data, geospatial, force structures and much more.
- Analysing this data manually is time consuming, and can lead to patterns and correlations between data from different

sources being overlooked.



Solution: decision support tools to automate elements of operational planning

- Using Machine Learning, Natural Language



Simulate



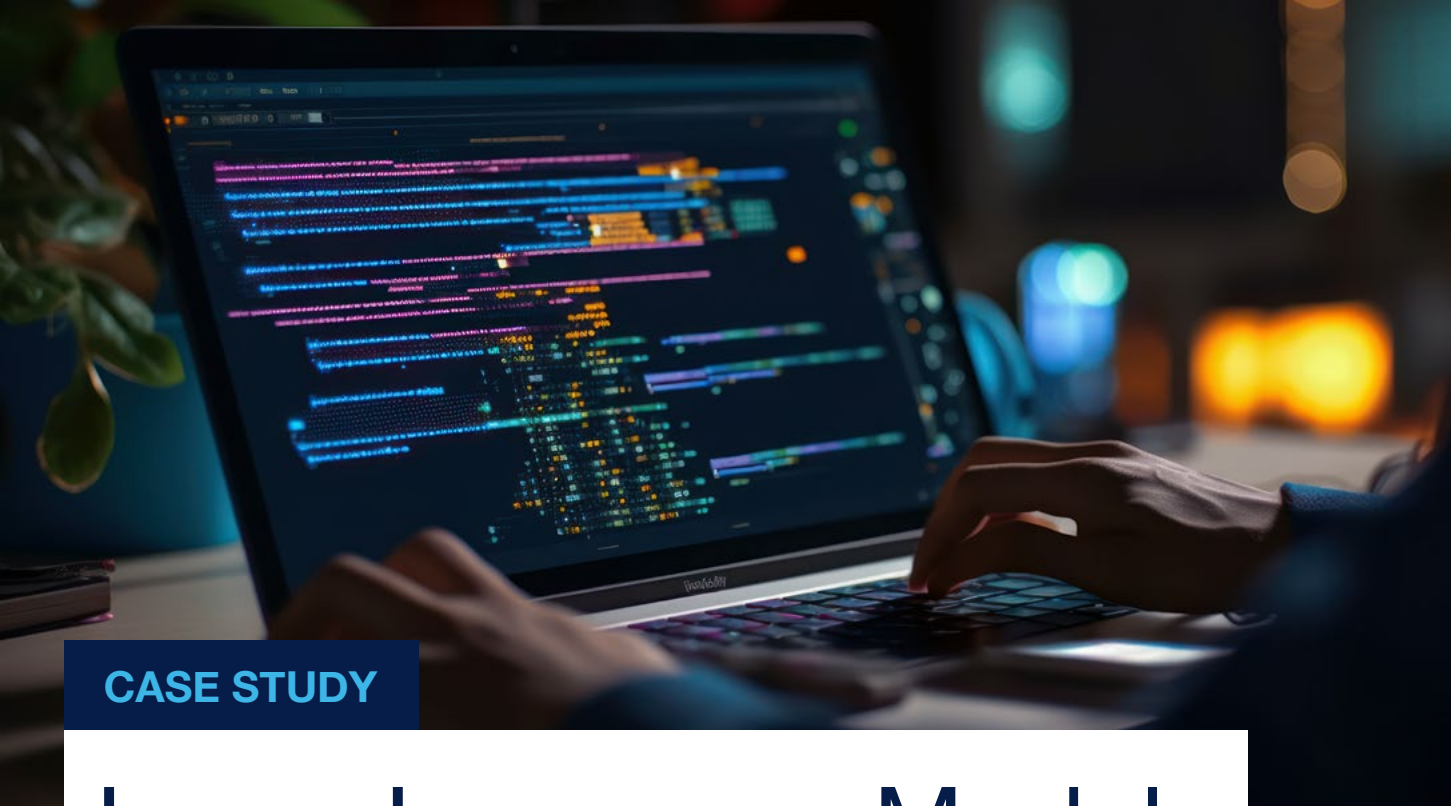
Processing and other data analytics techniques and tools we can automate elements of the planning processes, providing clear user-focused tools to support their work.

- Benefits include streamlining the planning process for staff officers through automation, such as automating the cross correlation of terrain and meteorological data against vehicle characteristics and route planning criteria.
- Common tools could be used across a variety of operational theatres and domains.



AI Challenges: Fusion of Data Sources

When bringing together data from such a wide variety of sources, both static and dynamic, there are challenges associated with fully correlating the data sets, understanding the relationships between them, and identifying whether for example two data points from different sources are actually referring to the same thing.



CASE STUDY

Large Language Models (LLMs) for Defence

- Large Language Models (LLMs) have developed rapidly in a short time, with enticing commercial offerings promising significant enhancements to the way we work across all areas of Defence.
- The appetite across Defence to experiment with and adopt these is significant, but

we need to ensure we can do so in a safe and responsible manner, cognisant of the potential risks from these new technologies.



Solution: enabling LLMs on core Defence systems



Generate

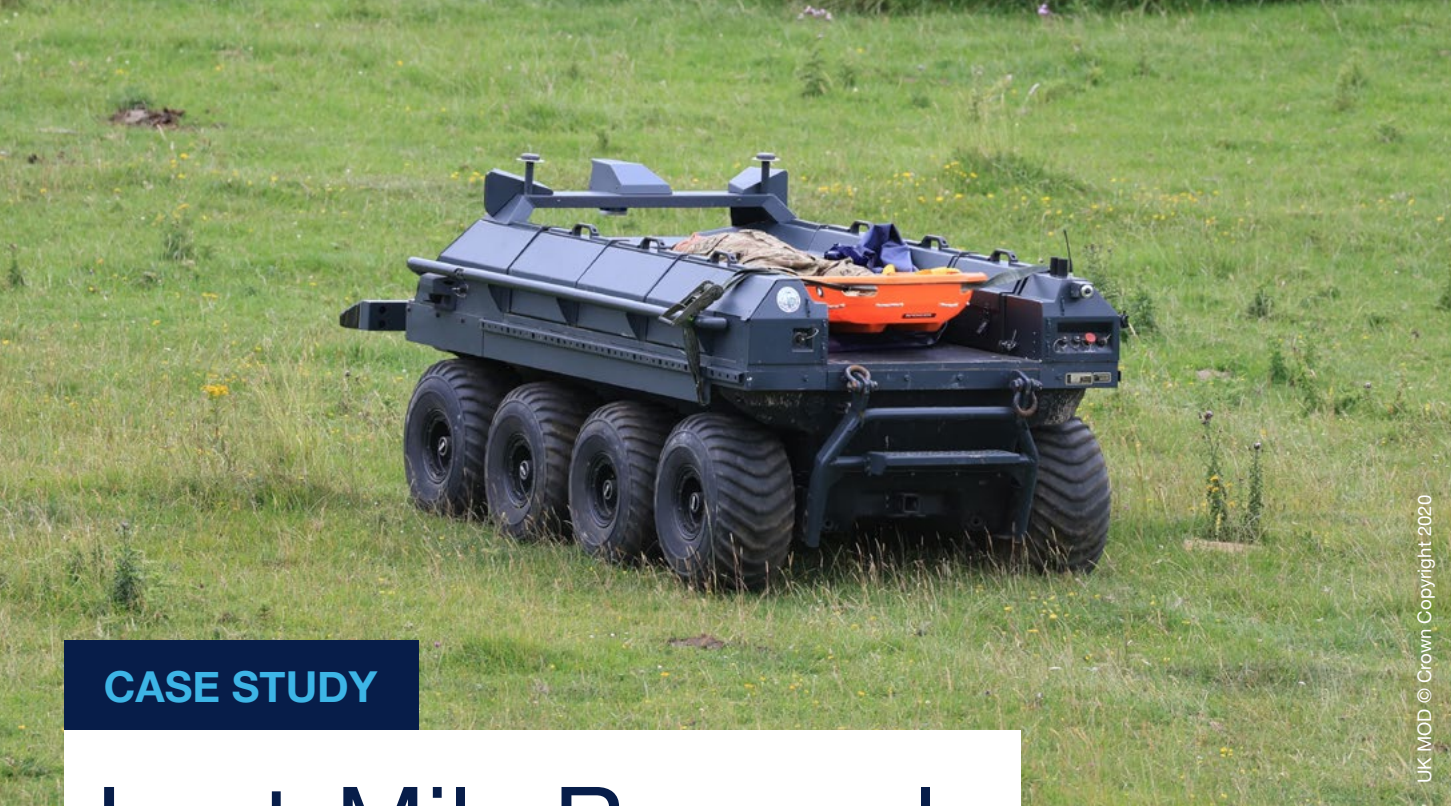


- As just one of a number of projects investigating LLMs for Defence, we are providing an assured interface to cloud-hosted LLMs, available as a pilot to users across Defence.
- This activity will allow full evaluation of the opportunity from LLMs, whilst keeping Defence data secure.
- The pilot project also aims to understand and share the policy, security and assurance guidelines for deploying and adopting LLMs securely on MOD systems.



AI Challenges: Unknown Risks

LLMs are a new technology, and the risks are not well understood. Our commitment to be ambitious, but also safe and responsible, means we must tread carefully. There for example are obvious information security risks in using cloud-hosted LLMs; potential intellectual property risks; and ethical or reputational risks of using LLMs for some applications.



CASE STUDY

Last-Mile Resupply

- The Army has tested cutting edge Robotic and Autonomous Systems (RAS) to assess their ability to operate as part of a RAS-enhanced light Brigade Combat Team in the near future. RAS would increase combat mass and tempo of resupply, whilst reducing risk to life for our people.
- Operating RAS safely in unknown terrain and contested environments requires a highly robust and resilient autonomous

navigation capability, able to recognise and avoid obstacles and threats, and continue to operate safely even if communication links are lost.



Solution: AI-based navigation for ground-based RAS

- Our partners in industry are building and integrating robust and resilient



Decide



autonomous navigation solutions, combining advanced AI-based perception with other techniques to visualise the environment and plot a safe route through, to reach the destination set by the operator.



AI Challenges: Assurance of Safety Critical Systems

Providing fully autonomous navigation for RAS poses significant challenges for Test, Evaluation, Verification and Validation (TEVV) and assurance. To deploy RAS safely and responsibly, we must be confident that they will behave as expected, even in hostile environments that might differ significantly from training and normal use.

Contested Environments

On deployed operations we often have limited size, weight and power; and sometimes limited access to communications.



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Find out more at [Defence Artificial Intelligence Centre - GOV.UK](https://www.gov.uk/defence-artificial-intelligence-centre)