Business applications of Artificial Intelligence

Transportation and storage sector briefing paper

BridgeAI

Acknowledgements

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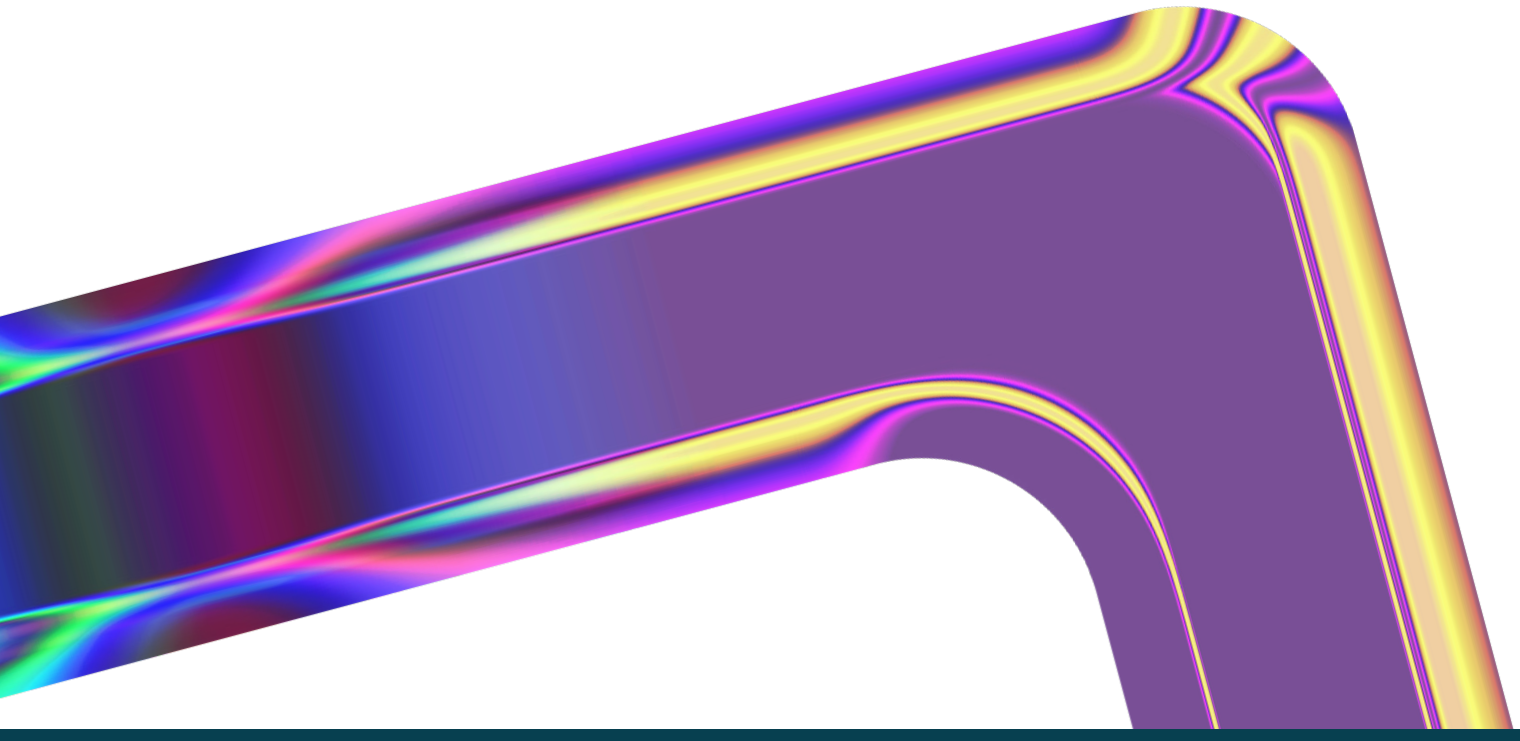
About the briefing paper series

A significant barrier to AI adoption in the business world is the scarcity of clear, accessible information on how to leverage AI to enhance organisational productivity. Understanding the practical applications of AI is a prerequisite for companies to identify relevant opportunities and develop a strategy to operationalise them. To address this need, the AI Governance and Regulatory Innovation team at The Alan Turing Institute is pursuing a research project to illuminate how businesses in the four BridgeAI priority sectors of agriculture, forestry and fishing, construction, creative industries, and transportation and storage can leverage AI to be more productive.

The first milestone of this project is the publication of a framework for categorising and analysing business applications of AI and a brief analysis of sector-specific AI use cases. Our findings are published as a **series of five documents**: four sector-specific briefings complemented by a paper presenting a framework to categorise and analyse AI use cases. The sector briefings offer a short analysis of the high-level economic features of each sector in the UK, the specific challenges to AI adoption faced by businesses in that sector, and five business applications of AI per sector. Each sector brief can be read as a standalone document. The paper on the classification framework presents the tool that we developed to categorise and analyse AI use cases in a business context. In addition to providing the hermeneutical structure underpinning our research, this tool provides a valuable resource for businesses trying to identify relevant AI opportunities. Companies can use this framework as a starting point to build on and develop their bespoke methodology to identify, select, and implement the right AI solutions.

The second milestone of this project will be to refine the framework based on feedback collected after the publication of this first exploratory version and expand its scope to include information about the risks connected to each AI use case and the mitigation strategies that can be adopted to address those risks in that specific context.



Desired impact

Our research aims to support businesses at the early stages of their AI adoption cycle. By providing a conceptual framework to systematically categorise business applications of AI and offering concrete examples of sector-specific AI applications, we hope to help businesses identify possible uses of AI in their area, understand the nature of relevant technological solutions, and develop a sound strategy to operationalise those solutions responsibly.

Intended audience

The audience for this briefing series is primarily businesses within the BridgeAI priority sectors looking to adopt AI to support their operations. It is worth noting that the accompanying framework was developed based on generalised principles which are applicable to any sector and should, therefore, provide value to a wider audience, including non-commercial organisations. In addition to benefiting companies, this briefing series provides valuable resources for government officials and regulators aiming to understand how businesses use AI, as well as for training officers and advisors seeking a systematic approach to developing AI strategies for business.

AI Governance and Regulatory Innovation team

This work has been completed by researchers from The Alan Turing Institute who are part of the AI Governance and Regulatory Innovation team based within the Public Policy programme. As part of our offering for the BridgeAI programme, we support UK businesses navigate the increasingly complex AI governance landscape. This is delivered through training and sector-specific research on some of the most pressing AI governance issues, as well as by engaging with regional AI policy stakeholders to help consolidate a nationwide community of actors invested in responsible AI governance.

Introduction

Artificial intelligence (AI) is rapidly transforming the global economy, yet many sectors of the business world are only beginning to explore the opportunities AI technologies offer. Despite AI adoption being on the rise globally, the technology's potential to support organisations by improving their productivity and competitiveness remains partially unexplored in many economic areas. For instance, only 20% of small companies in the UK say they use at least one AI tool as part of their operations, despite 55% stating that AI could provide benefits to their business.[1] To ensure AI will benefit a wide range of sectors and regions and support businesses in their AI adoption journey, the UK government launched several high-impact initiatives to "invest and plan for the long-term needs of the [country's] AI ecosystem".[2] These include, among others, the BridgeAI programme, which aims to foster the development and adoption of AI technologies in sectors with high potential for AI-driven economic transformation.[3]

Despite important steps forward, several barriers to widespread AI adoption still exist. These include the high cost of AI solutions, the uncertainty of their return on investment,[4] the scarcity of relevant technical and business skills in the labour market,[5] regulatory uncertainty related to the development and use of AI,[6] low rates of senior management buy-in, the difficulty of collecting or accessing high-quality data,[7] and scepticism for some AI applications caused by ethical concerns around issues such as bias and privacy. At a more fundamental level, many companies struggle to identify the right AI opportunities due to a general lack of awareness about the full range of practical business applications of these technologies. In other words, many companies are unsure about how exactly to leverage the potential of AI to support their business goals. For instance, a recent survey of 100 business leaders from different countries and sectors found that while "leaders are overwhelmingly looking at AI as an opportunity, the picture is not yet clear on how to harness this opportunity practically."[8]

One way to address this uncertainty is disseminating knowledge about existing AI use cases and best practices in the industry. Understanding how other companies use AI technologies, be it to support internal functions or to build better products and services, enables businesses that are considering embarking on the journey of AI adoption to think creatively about how AI can add value to their organisation.

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1 Russell, C. & E. Quist (2024). *Redefining intelligence: The growth of AI among small businesses.* Federation of Small Businesses. https://www.fsb.org.uk/resource-report/redefining-intelligence.html.

2 UK Government (2021). *National AI Strategy.* https://www.gov.uk/government/publications/national-ai-strategy/national-ai-strategy-html-version.

3 Innovate UK (2023). *BridgeAI.* https://iuk.ktn-uk.org/programme/bridgeai/.

4 CDEI (2021). *UK Business Innovation Survey*. https://assets.publishing.service.gov.uk/media/61bb2e77e90e07044462d8b7/Business_Innovation_Survey_2021.pdf.

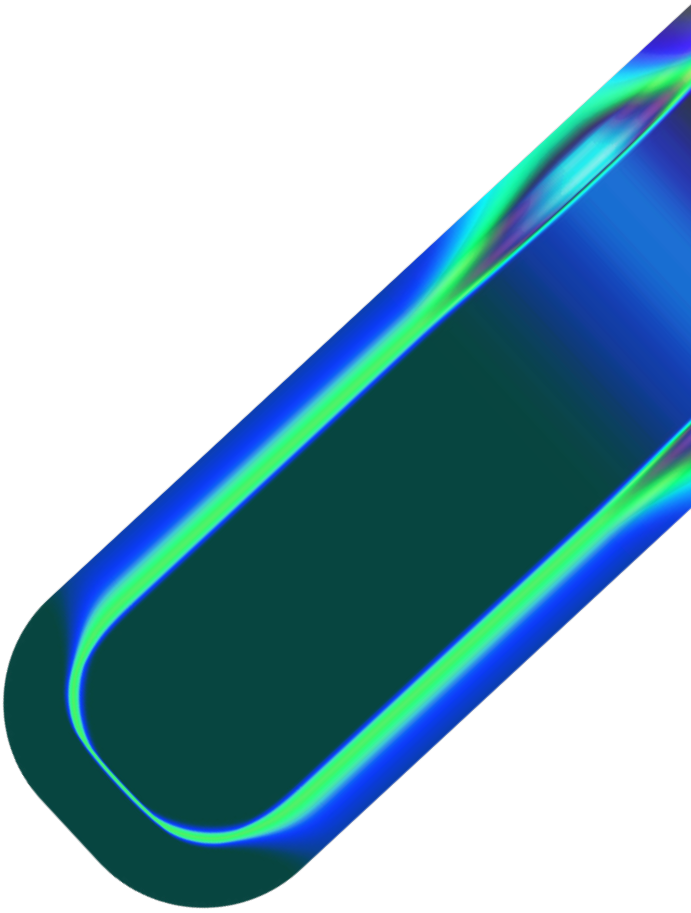
5 *AI ecosystem survey informing the National AI Strategy.* The Alan Turing Institute, https://www.turing.ac.uk/sites/default/files/2021-09/ai-strategy-survey_results_020921.pdf.

6 Gillespie, N., S. Lockey, C. Curtis, et al. (2023). *Trust in Artificial Intelligence: A global study.* The University of Queensland and KPMG Australia. https://policy-futures.centre.uq.edu.au/files/16650/Trust%20in%20AI%20Global%20Report_2023_UQ.pdf.

7 Mittal, N., Saif, I. & Ammanath, B. (2022). *Fueling the AI transformation: Four key actions powering widespread value from AI, right now.* Deloitte, https://www2.deloitte.com/content/dam/Deloitte/us/Documents/deloitte-analytics/us-ai-institute-state-of-ai-fifth-edition.pdf.

8 Bicakci, B. et al. (2024). *Leadership in the Age of AI.* EgonZehnder and Kearney. https://www.egonzehnder.com/leadership-in-the-age-of-ai.

Building on this premise, this briefing aims to contribute to demystifying how businesses in the transportation and storage sector can use AI to be more competitive, sustainable, and productive. The first part of the briefing offers an overview of the key economic features of the UK's transportation and storage sector, including a brief discussion of sector-specific challenges to AI adoption. In the second part, we leverage the **AI use case classification framework** to discuss five sectoral AI applications. Each AI use case is accompanied by a use case card, which provides a visual summary of the key information related to that application. These examples illustrate the wide-ranging and diverse potential applications of AI in the transportation and storage sector.



Sector overview and challenges to AI adoption

The transportation and storage sector provides products and services for the movement of people and goods. It encompasses various modes of transportation, including air, road, rail, sea, and inland waterways, as well as related services such as logistics, warehousing, and distribution.

The sector contributes significantly to the UK economy and is considered strategic to secure the UK's industrial growth.[9] In 2022, the sector employed 5.2% of the UK workforce and contributed £68.7 billion to the economy, equivalent to 3.39% of the country's GVA.[10] The sector also supports the growth of other industries by providing key infrastructure and services, and connects communities across the country. The productivity of the transportation and storage sector has declined over the past few years.[11] As a response, the UK Government is investing in target areas such as 'digital, connectivity, and autonomy'.[12] In this context, AI is viewed as a transformative technology with the potential to support the sector's sustainable growth.

While AI applications in the transportation and storage sector can produce substantial benefits, there are significant sector-specific challenges to AI adoption. Transportation and storage is a safety-critical sector. Addressing questions around accountability and explainability of AI systems is key to ensuring legal compliance, trust, and social acceptability. In some cases, the lack of transparency around the decision-making processes of more advanced AI systems can lead to questions over how liability is apportioned between developers, adopters, and end-users, casting doubts over the viability of certain AI applications. In addition to that, AI adoption in the sector is complicated by the still-emerging nature of relevant regulatory regimes, limited AI skills and knowledge amongst the workforce, and privacy concerns related to the collection, access, and retention of data.[13] Members of the BridgeAI Transport Expert Working Group also signalled the sector's fragmented and siloed approach to innovation as a relevant challenge. For instance, the lack of coordination between actors in different parts of the sector can lead to ineffective data-sharing practices and diverging operational procedures, slowing down or hampering the integration of AI across different systems.

9 HM Treasury (2021). *Build better. Our plan for growth.* https://www.gov.uk/government/publications/build-back-better-our-plan-for-growth/build-back-better-our-plan-for-growth-html.

10 Office for National Statistics (2024). *Regional gross value added (balanced) by industry: all ITL regions.* https://www.ons.gov.uk/economy/grossvalueaddedgva/datasets/nominalandrealregionalgrossvalueaddedbalancedbyindustry.

11 The PSC (2023). *18 AI ideas to change the world. Innovate UK BridgeAI AI/ML Innovation Catalogue.* https://iuk.ktn-uk.org/wp-content/uploads/2023/09/230911-Innovate-UK-AI-Use-Cases-Final-Report.pdf.

12 UK Research and Innovation. (2024). *Innovation in transport.* UKRI. https://www.ukri.org/what-we-do/browse-our-areas-of-investment-and-support/innovation-in-transport/.

13 Centre for Data Ethics and Innovation & Department for Science, Innovation & Technology. (2021). *AI Barometer Part 4 - Transport and logistics.* https://www.gov.uk/government/publications/ai-barometer-2021/ai-barometer-part-4-transport-and-logistics#barriers.

Sector structure

As already mentioned, the transportation and storage sector encompasses highly diverse activities. These range from vehicle manufacture and maintenance to transport planning, management, and logistics and distribution. These activities are often interconnected and interdependent, making it difficult to trace a clear sub-sector categorisation of the transportation and storage sector. For the purposes of this research, we rely on a sector breakdown derived from the UK Standard Industrial Classification:[14]

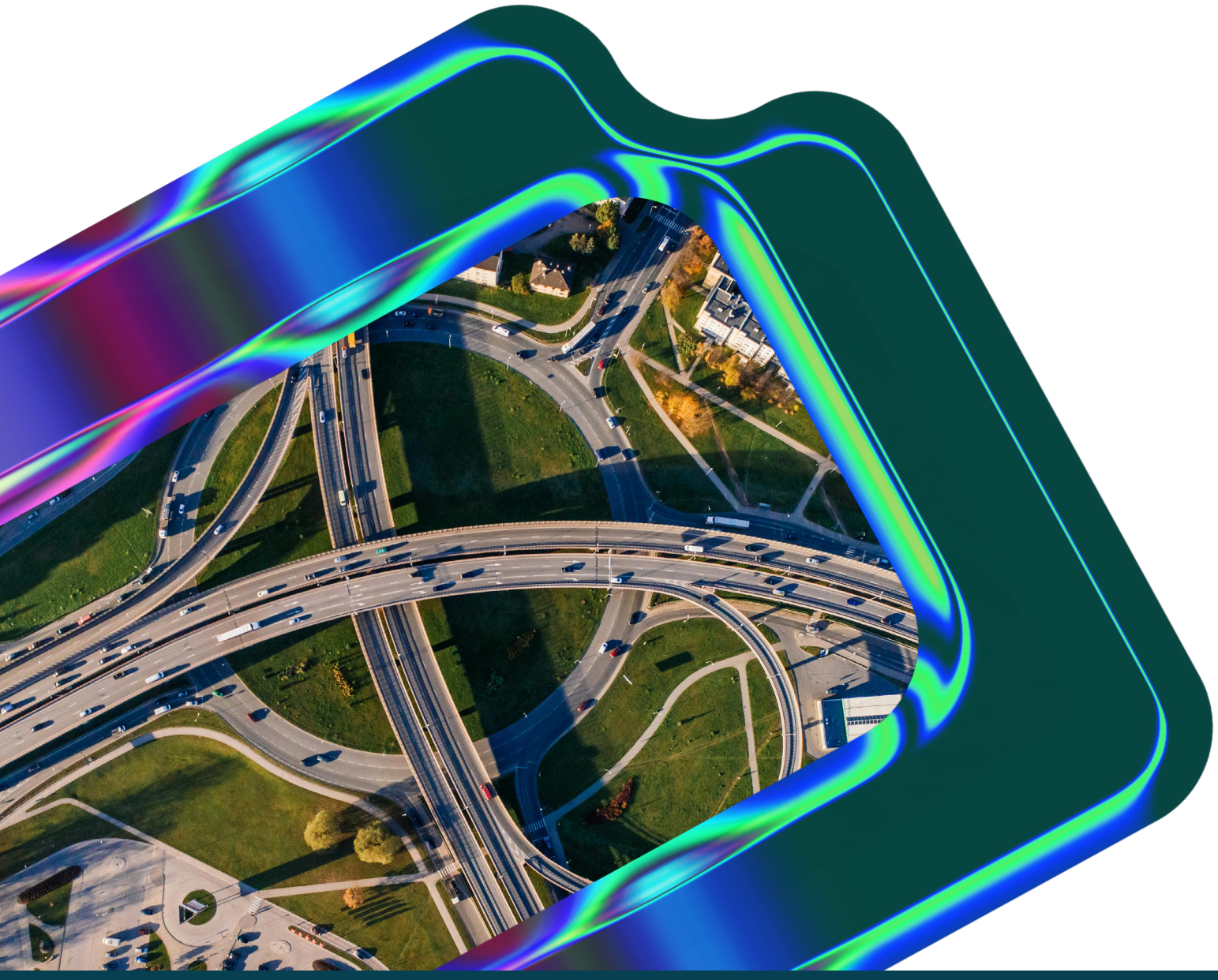
- Air
- Rail
- Road
- Space
- Water
- Warehousing and support activities

The transportation and storage sector includes companies focused on the transportation of people and freight as well as companies providing key services and operations supporting such activities. For example, the 'Air' sub-sector includes companies providing air freight and passenger transportation. The 'Rail' sub-sector includes companies providing goods and passenger rail transportation services. The 'Road' sub-sector includes companies providing freight and passenger road transportation services. The 'Space' sub-sector includes companies providing space tourism services. The 'Water' sub-sector includes companies transporting passengers and freight on waterways, including seas and rivers. Finally, the 'Warehousing and support activities' sub-sector includes companies operating warehousing and storage facilities for different modes of transportation, as well as companies providing support services like the operation of airport facilities, stations, and highways, companies managing traffic control, and cargo handling companies.

14 Office for National Statistics (2007). *UK SIC 2007*. https://www.ons.gov.uk/methodology/classificationsandstandards/ukstandardindustrialclassificationofeconomicactivities/uksic2007.

AI applications for the transportation and storage sector

Businesses in the transportation and storage sector are adopting AI technologies to improve the efficiency, productivity, and sustainability of their operations. Examples include route planning and traffic management, predictive maintenance, logistics optimisation, and autonomous driving. Below is a description of five AI use cases in the transportation and storage sector that we analysed using the framework presented in this **accompanying paper**.



In-vehicle interactive driving assistant

Enhancing in-vehicle services has become a strategic priority in the automotive industry. A key challenge lies in improving the quality of interactions between users and these services. AI technologies offer potential solutions to deliver more intuitive and efficient customer experiences. In this example, AI is used to provide interactive virtual assistant services for road vehicles. Users can activate the AI system through voice prompts and ask for routing and navigation assistance, including turn-by-turn directions. Although not specifically trained to provide emergency support, the system can distinguish phrases and words that suggest an emergency and call emergency-trained advisors. By delivering smarter and more responsive in-car systems, this AI solution contributes to improving both the experience of users and their safety. In addition to audio inputs, the system also analyses geospatial data to track the location of the vehicle. Provided voice recordings can lead, in almost all circumstances, to the inference of one's identity, deploying such an AI system requires appropriate personal data protection measures.

Business challenge:
Enhance user interaction in automotive applications.

Solution:
Drivers can activate an AI system through voice prompts to ask for routing and navigation assistance on the road, including turn-by-turn directions, and call emergency services.

Organisation

Type of use case	Business function
Product-centric	N/A

Data

Type of input data	Processing of personal data
Audio, Geospatial	Yes

AI system

AI system capabilities	Environment	Readiness level
Goal-directed action, Recognition and detection, Optimisation	Virtual	Operational

Economic sector

Sector	Sub-sector
Transport	Road

Automated snow clearing on train carriages

Railway companies operating on routes that may be exposed to snowfall must manage the clearing of snow accumulation on and under rail carriages to ensure safe and timely train rides. One of the key challenges in managing snow clearance is deciding how many staff members should be deployed on clearing tasks each day. Traditionally, railway companies made such decisions based on weather forecasts from the day before. Some companies, however, are now using AI to improve the efficiency of this maintenance task. For example, railway companies can use AI systems to analyse images from cameras placed on the trains and measure the extent of snow accumulation. Based on this data, the system can recommend an allocation of staff and resources for the required clearing work. AI can also be integrated within a larger cyber-physical system and used to operate automatic snow-clearing components based on the level of snow accumulation it detects on carriages. More precisely, the system can use data collected from cameras and sensors to decide whether to spray heated water onto target sections of train cars to remove clumps of accumulated snow.

Business challenge:
Reduce railway management costs.

Solution:
An AI system analyses camera and sensor data to assess how much snow has accumulated on train carriages and activates targeted heated water sprayers to remove snow clumps.

Organisation

Type of use case	Business function
Process-centric	Management of organisational assets

Data

Type of input data	Processing of personal data
Signal, Visual	No

AI system

AI system capabilities	Environment
Goal-directed action, Prediction and forecasting, Recognition and detection, Recommendation	Physical

Readiness level
Operational

Economic sector

Sector	Sub-sector
Transport	Rail

Optimal flight path planning support

Calculating optimal flight paths is key to ensuring the efficiency of air transport. However, it is not easy for pilots to keep track of all factors that can affect their trajectory while flying. AI can provide useful solutions to support them. For example, an AI system can be used to generate real-time recommendations for pilots on the shortest available flight path. As a result, pilots can have better situational awareness leading to faster response to travel plan changes as well as more accurate real-time tracking of flight performance and, possibly, discrepancy. Ultimately, optimal flight paths lead to cost savings, better customer experience, and lower environmental impact. This is made possible by the ability of the AI system to analyse aircraft-generated data and ground support data and provide pilots with recommendations to adjust flight operations in real-time. A combination of geospatial, textual, and numerical data covering variables such as alternative flight paths, weather forecasts, and onboard fuel conditions enables the system to calculate and constantly reassess the most convenient path to the destination.

Business challenge:
Optimise flight duration and fuel consumption in aviation.

Solution:
An AI system analyses geospatial, textual, and numerical data and covers variables such as weather and fuel conditions to constantly calculate the most convenient flight path.

Organisation

Type of use case	Business function
Process-centric	Production

Data

Type of input data	Processing of personal data
Geospatial, Numerical, Text	No

AI system

AI system capabilities	Environment	Readiness level
Optimisation, Recommendation	Virtual	Operational

Economic sector

Sector	Sub-sector
Transport	Air

Early warning system for vessel collision

Maritime traffic in busy, congested spaces can lead to hazardous situations demanding vigilance and adaptive strategies to prevent collisions and ensure safety at sea. Radar systems have traditionally provided solutions to avoid vessel collisions. Yet, they often present practical challenges for non-specialised users. AI could help make sophisticated situational awareness for vessels more accessible. For example, an AI system can support vessels to navigate waterways in dense urban environments more safely. By combining radar tracker data with real-time information collected from the Automatic Identification System (AIS) of nearby vessels, the AI system can detect them and analyse their behaviour. The system uses geospatial, numerical and textual data to provide insights into the name, location, and speed of nearby vessels. Radar data are also used to detect static objects that could pose a risk to the vessel. This enables the system to make predictions and provide recommendations to support the crew's navigational decisions, reducing the risk of collisions and ensuring safer journeys. The AI system can also learn from each trip and progressively improve its predictive capabilities.

Business challenge:
Reduce the risk of vessel collision and ensure safer maritime transport journeys.

Solution:
An AI system supports vessels to navigate waterways in dense urban environments more safely by using data from nearby vessels and radar data to warn of static objects.

Organisation

Type of use case	Business function
Process-centric	Production

Data

Type of input data	Processing of personal data
Geospatial, Numerical, Signal, Text	No

AI system

AI system capabilities	Environment
Prediction and forecasting, Recognition and detection, Recommendation	Virtual
	Readiness level
	Operational

Economic sector

Sector	Sub-sector
Transport	Water

Optimisation of system design specification for road vehicles

Creating system design specifications for road vehicles is a complex and resource-intensive task, often driven by time-consuming trial-and-error approaches. AI can support the process of selecting optimal design specifications, leading to reductions in total development time and design rework. For example, automotive companies can use an AI system to improve engine calibration efficiency. More specifically, the AI system can analyse numerical and textual data collected from several iterations of design simulations to predict how specific system parameters can be updated or modified to generate better designs. By automating the process of testing different combinations of parameters in virtual design simulations, the AI system can lead to significant time savings, cut data acquisition and processing costs, and reduce the use of prototype materials.

Business challenge:
Reduce development time and rework of system design specifications for road vehicles.

Solution:
Data from several design simulations is collected by an AI system, helping create predictions to allow for the generation of better design specifications for road vehicles.

Organisation

Type of use case	Business function
Process-centric	Research and development

Data

Type of input data	Processing of personal data
Numerical, Text	No

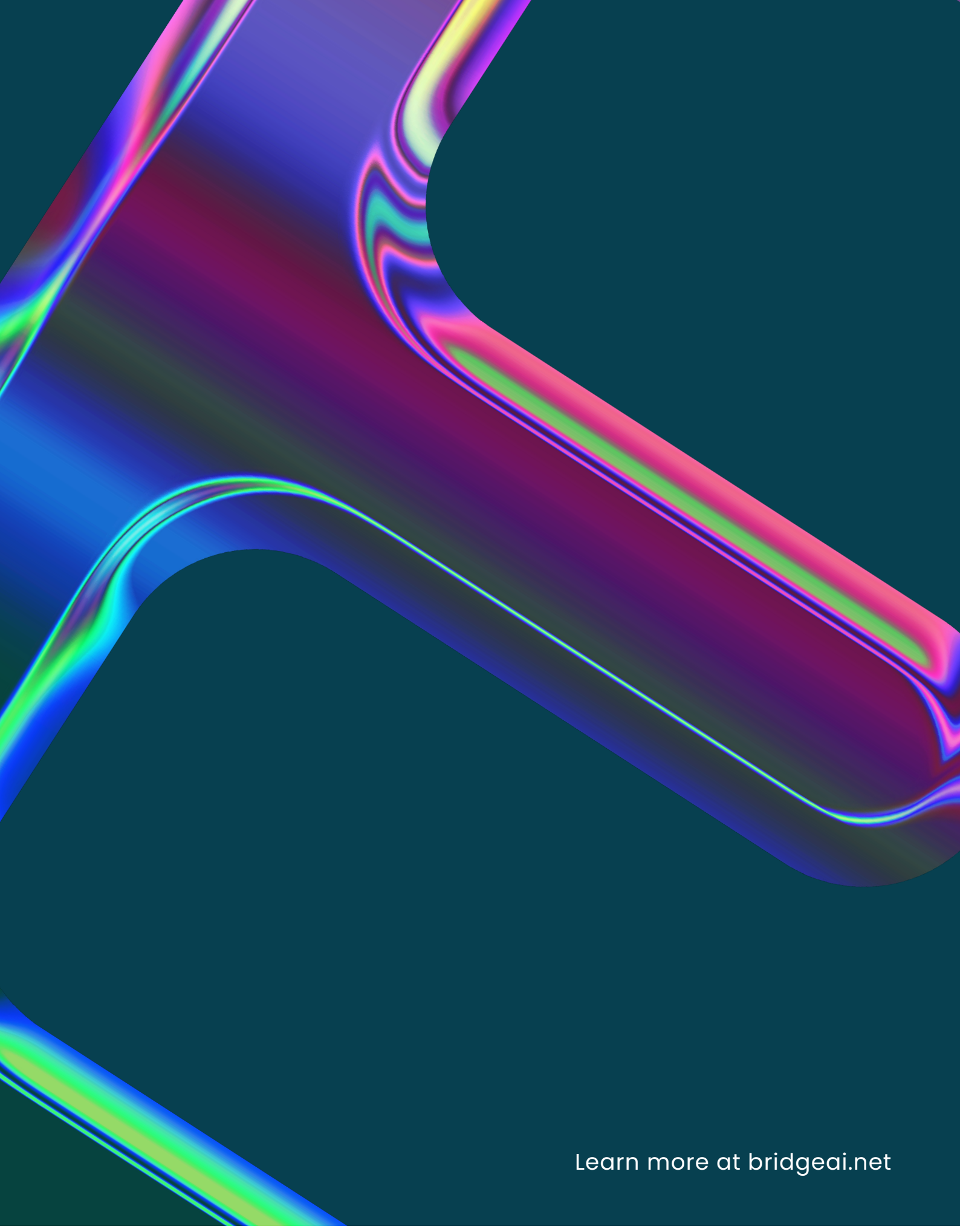
AI system

AI system capabilities	Environment
Optimisation, Simulation	Virtual

Readiness level
Operational

Economic sector

Sector	Sub-sector
Transport	Road



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