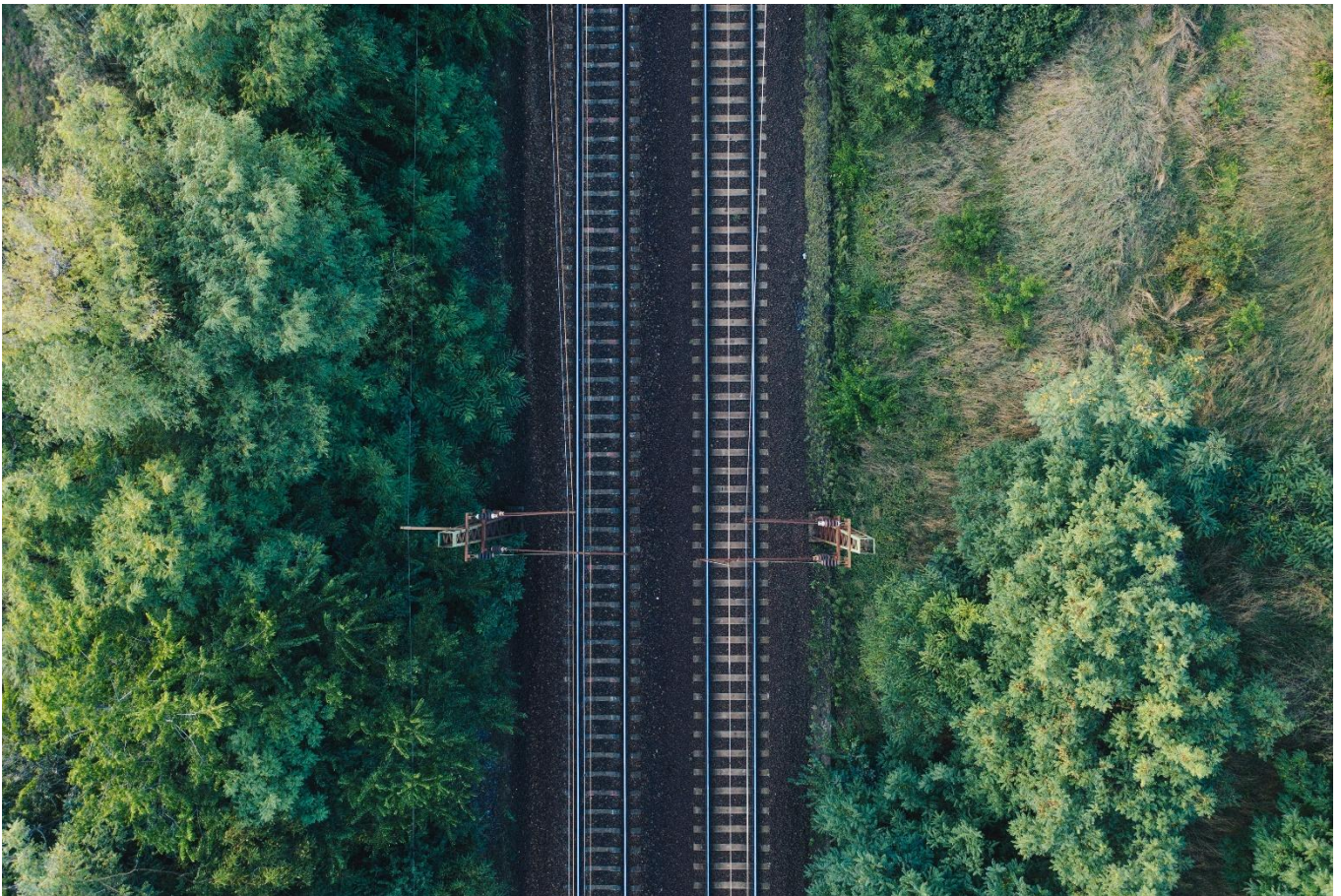


LMT monitoring report: progress and insights from the First of a Kind Programme



UK Research & Innovation
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LMT monitoring report: progress and insights from the First of a Kind Programme

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D Case study: Trains with Brain(s)

List of acronyms and abbreviations

Acronym	Meaning
AI	Artificial Intelligence
CCAM	Commercialising Connected and Autonomous Mobility
CFI	Contracts for Innovation
CP7	Control Period 7
DfT	Department for Transport
FOAK	First of a Kind
FOC	Freight Operating Companies
FTE	Full-Time Equivalent
GBR	Great British Railways
GCRE	Global Centre of Rail Excellence
IMS	Impact Management System
IP	Intellectual Property
IUK	Innovate UK
LMT	Land and Maritime Transport
MSPs	Monitoring Service Providers
NZP	Net Zero Propulsion
OLE	Overhead Line Equipment
PROLECT	Protection and Resilience for OLE using Computer Vision Techniques
QMS	Quarterly Monitoring Scores
R&D	Research & Development
ROSCOs	Rolling stock leasing companies
RSSB	Rail Safety Standards Board
SME	Small and Medium Enterprise
TDD	Transport Decarbonisation Demonstrator
TfL	Transport for London
TOC	Train Operating Companies
TRL	Technology Readiness Level
TVH	Tees Valley Hydrogen
UKRI	UK Research & Innovation
ZEHD	Zero Emission HGV and Infrastructure Demonstrator

Executive Summary

The First of a Kind (FOAK) programme, delivered by Innovate UK (IUK) in partnership with the Department for Transport (DfT), is part of the Land and Maritime Transport (LMT) portfolio. FOAK is designed to accelerate the adoption of innovation within the UK rail sector by funding high-maturity technology demonstrations, fostering collaboration across the industry, and supporting solutions that address critical challenges such as decarbonisation, digitalisation, and operational efficiency.

Overview of delivery

- FOAK22, FOAK23 and FOAK25 funded 70 projects with a total of £16 million in contracts for innovation (CFI) funding, averaging £230,000 per project.
- Projects covered decarbonisation, digital and data-driven solutions, passenger experience improvements, and maintenance automation and prevention measures.
- The average project duration was approximately 8 months, with individual projects ranging from 3 to 22 months.
- 86% of FOAK22 and FOAK23 (Wave 2) projects met their planned timetable and 92% of FOAK25 (Wave 3) projects are currently on schedule.
- 84% of FOAK22 and FOAK23 projects achieved all objectives by closure, with four exploring additional opportunities beyond their original scope. 88% of FOAK25 projects remain on course to deliver all planned objectives, with two exploring additional opportunities beyond their original scope.

Key findings

Technology development & commercialisation

- FOAK successfully advanced technology readiness, with most projects reporting increased Technology Readiness Levels (TRLs) through operational demonstrations and iterative development within compressed timescales.
- Wave 2 beneficiary survey evidence indicates that 14 projects (out of 26) have launched new products or services in the UK market (in contrast to none in the Wave 3 survey, which was expected given the earlier stage of the projects), and an additional four expecting to do so in the future (alongside 16 of 23 projects in the Wave 3 survey).
- Projects generated practical outputs including patents and technical reports, supporting knowledge transfer and the development of industry standards.
- Evidence indicates that commercialisation outcomes are mixed: some projects achieved market entry and improved market position, but structural barriers remain for others.
- Wider stakeholders reported that early FOAK rounds with broad themes produced outputs less aligned with industry demand; FOAK25's narrower challenge statements are expected to improve market relevance and commercial uptake.

Partnership and organisational development

- The programme significantly strengthened both new and existing partnerships, particularly with Train Operating Companies (TOCs) and supply chain partners.
- 19 (out of 26) Wave 3 survey respondents reported reinforced collaborations (alongside 19 of 23 Wave 3 respondents), and 21 (out of 24) rated partnership quality as “good” or “very good” (alongside 17 of 23 Wave 3 respondents).

- Participating organisations reported stronger technical, delivery, and commercial skills, with many embedding improved project management and reporting practices.
- Employment impacts were positive: 12 (out of 26) Wave 2 survey respondents reported job creation (echoed by 10 of 23 Wave 3 respondents), and 20 (out of 26) reported safeguarding existing roles (supported by 16 of 23 Wave 3 respondents).

Barriers and enablers

- Project delivery barriers included administrative challenges (portal functionality, inconsistent reporting templates and restrictive word allowance) and tight timelines, which sometimes placed pressure on SMEs.
- Commercialisation barriers included fragmented and opaque procurement processes, lack of institutional backing, limited investment appetite, occasional misalignment between competition themes and industry priorities and cultural resistance to change.
- Key enablers included CFI funding, operational demonstrations, evaluation requirements, networking events and early engagement with potential clients.
- Beneficiaries suggested that IUK increase the promotion of FOAK innovations, especially through mid-project showcases, and facilitate introduction to industry stakeholders to enhance visibility and market engagement

Early and potential long-term outcomes

- Early outcomes include commercial launches, new contracts, improved market position, and enhanced technical knowledge, enabling organisations to diversify services and respond to emerging industry challenges.
- Potential long-term benefits include reduced carbon emissions, improved safety, enhanced passenger experience, operational efficiency, financial savings, multi-modal deployment potential and overseas opportunities. Full measurement will depend on wider adoption and embedding of technologies.

Next steps for the programme

Based on the findings, several areas have been identified for consideration in future FOAK funding rounds. These include:

- Ensuring strong alignment with industry needs by defining focused challenge statements and competition themes that address genuine market priorities and are aligned with industry priorities, supporting clearer commercial pathways and maintaining ongoing evaluation to capture long-term impacts.
- Continuing to build on FOAKs technological and commercial successes in passenger-facing technologies, decarbonisation and data-driven innovation, including AI and automated decision-making.
- Strengthening commercial pathways and client engagement, particularly with public-sector clients, will help projects move beyond the prototype stage. Aligning procurement planning with technology development and offering follow-on funding for successful projects could further enhance impact and bridge gaps to commercialisation.

Recommendations for future evaluations

- Continued evaluation beyond immediate delivery is essential to capture medium- and long-term impacts as projects transition from demonstration to market adoption.

- Future evaluations should focus on commercialisation challenges, tracking the transition from demonstration to uptake, and identifying barriers limiting adoption.
- Economic impact assessments should explore SME growth, commercialisation outcomes, inward investment, exports, supply chain development and follow-on financing to measure FOAK's contribution to sector productivity.

Overall conclusions

The FOAK programme has delivered clear value to the UK rail innovation ecosystem. It has supported and facilitated the development and demonstration of new products, strengthened partnerships, and created and safeguarded jobs. To ensure lasting benefits for the rail sector and wider economy, continued strategic alignment, targeted support for commercialisation and robust evaluation will be critical.

1 Introduction & methodology

Introducing the LMT portfolio

- 1.1 The LMT portfolio comprises seven grant-funding programmes spanning a range of technologies, transport modes (including rail, road and maritime), and objectives. The seven programmes which make up the LMT portfolio are: the Zero Emission Heavy Goods Vehicle and Infrastructure Demonstrator (ZEHID); Maritime Decarbonisation programme; Commercialising Connected and Autonomous Mobility (CCAM) programme; the Tees Valley Hydrogen (TVH) Transport Hub programme; Rail First of a Kind (FOAK) programme; Net Zero Propulsion programme; and Transport Decarbonisation Demonstrator (TDD).
- 1.2 The seven programmes vary in objectives, size, complexity and duration. Constituent projects can range from single applicant six-month feasibility studies costing around £25k to deliver, to four-year multi-partner collaborative research and development (R&D) projects which can cost millions of pounds.

Purpose of this report

- 1.3 Steer-ED and Technopolis were commissioned by IUK, in partnership with the Department for Transport (DfT) to conduct a monitoring commission on behalf of the LMT portfolio and the constituent seven programmes. This report is one of seven LMT programme reports focusing on FOAK, presenting final findings, synthesised from across a range of evidence sources, described below.

Introducing the FOAK Programme

- 1.4 The rail (FOAK) programme is designed to accelerate the adoption of innovation across the UK rail sector. It does this by running targeted competitions that invite innovators to develop and demonstrate high-maturity solutions in collaboration with industry partners. These competitions provide structured funding through a contract, access to live railway environments and stakeholder engagement opportunities, supporting efficient integration of new technologies into the railway system and helping suppliers achieve market readiness.
- 1.5 FOAK is the only programme in the LMT portfolio that uses the Innovate UK (IUK) 'Contracts for Innovation' mechanism (formerly the Small Business Research Initiative). FOAK has been funded by Department for Transport (DfT) to address challenges such as: reducing emissions, advancing accessibility for disabled passengers, improving personal safety or enhancing train punctuality. The aim is that, if successful, the solution will be adopted more widely by the sponsoring department or agency.
- 1.6 This report focuses on three FOAK competitions:
 - FOAK22 (January to December 2023);

- FOAK23 (November 2023 to September 2024); and
- FOAK25 (September 2025 to March 2026).

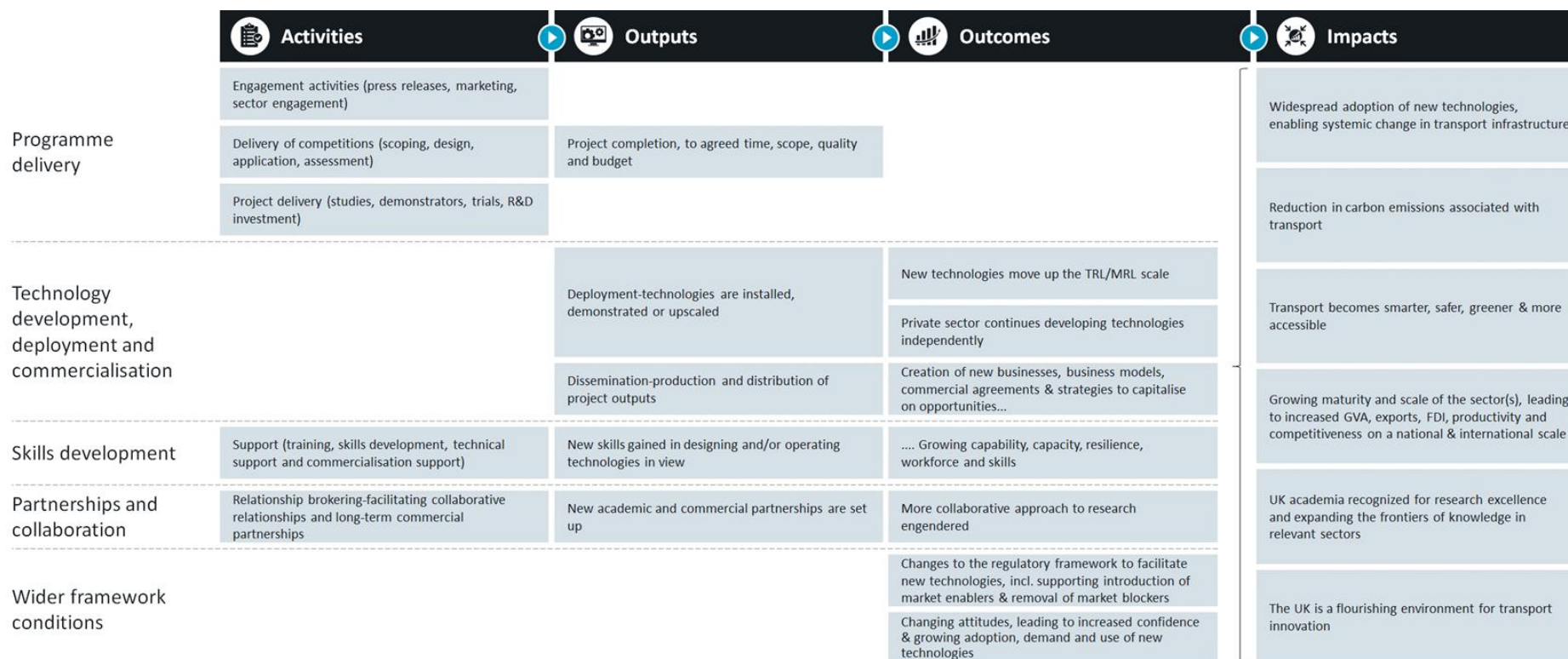
- 1.7 Several FOAK22 and FOAK23 stakeholders contributed to challenge statements and competition themes for FOAK25 and reflected on its design and the programme's strategic direction.

Monitoring approach adopted

The LMT portfolio monitoring framework and logic model

- 1.8 This programme level report (and the wider LMT monitoring framework) is structured around the portfolio logic model, presented in Figure 1-1. This shows the causal relationships between activities conducted and how those are expected to lead to long-term programme impacts, via outputs and outcomes. The logic model is divided into five themes, reflecting five key underlying mechanisms: programme delivery; technology development, deployment and commercialisation; skills development; partnerships and collaboration; and wider framework conditions. Each of the subsequent chapters of this report is titled after one of these five themes, providing a structured exploration of the causal mechanisms.

Figure 1-1: LMT portfolio high-level logic model

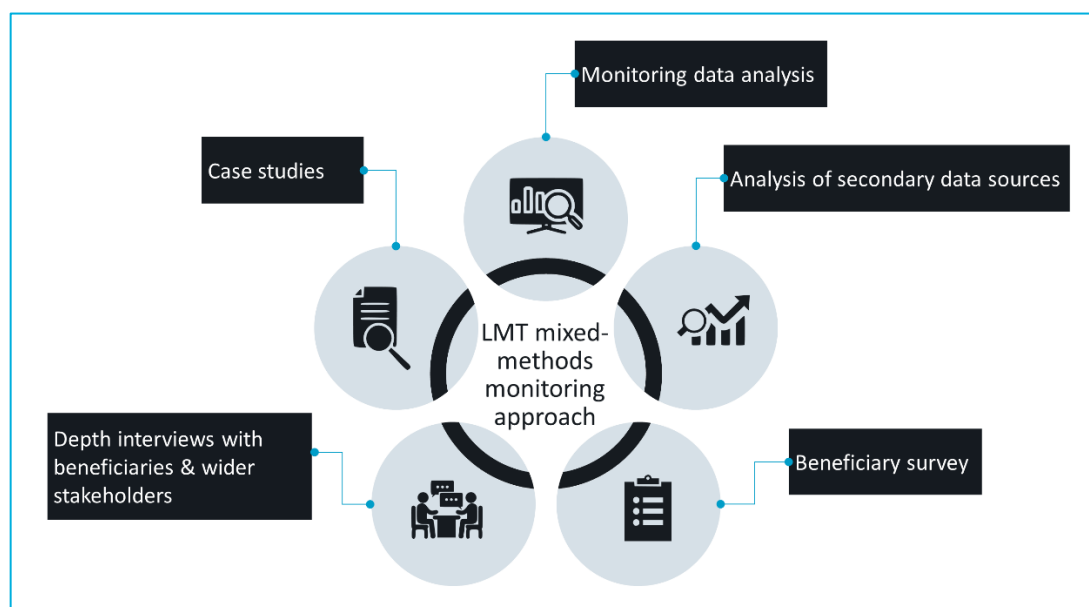


Source: Steer-ED and Technopolis, 2024

Sources of evidence utilised

- 1.9 Fieldwork was conducted over a three-year period and structured into three Waves of activity, referred to as Waves 1, 2 and 3, with the following timescales:
- **Wave 1:** Fieldwork took place between July and August 2024, focusing on FOAK22 and FOAK23.
 - **Wave 2:** Fieldwork took place between July and September 2025, focusing on FOAK22 and FOAK23.
 - **Wave 3:** Fieldwork took place between January and February, focusing on FOAK25.
- 1.10 This final FOAK programme report brings together evidence collected across all three research Waves (Waves 1, 2 and 3)¹, providing a consolidated account of findings to date. This final version builds on the Wave 2 FOAK programme report and incorporates newly available evidence from Wave 3.
- 1.11 Figure 1-2 below sets out the five types of evidence collection utilised for this monitoring commission. These evidence strands were selected in order to provide a broad and deep understanding of the portfolio, triangulating across a range of qualitative and quantitative research methods, and gathering inputs from a range of different perspectives.

Figure 1-2: Sources of evidence utilised within the monitoring approach



Source: Steer-ED, 2024

- 1.12 A detailed description of the scope and coverage of methods deployed across the portfolio is presented in Appendix A and is briefly summarised below for the FOAK programme.

¹ Wave 1 research helped form the foundation for the subsequent Waves. While it provided important context, the findings presented in this report are mainly derived from Waves 2 and 3.

- 1.13 Monitoring data analysis² – spanning three data sources: Applicant information data, Quarterly Monitoring Scores (QMS)³, monitoring reports and the Impact Management System (IMS).
- 1.14 Analysis of secondary data – including:
- Crunchbase to further explore whether businesses participating in LMT programmes are attracting external investment⁴;
 - Meltwater, a media monitoring platform to assess the public dissemination; and
 - Dimensions⁵, a research database that provides patent and publication data⁶.
- 1.15 **Beneficiary Survey** - An online survey for beneficiaries was developed (a range of multiple choice and free text questions) and distributed to project leads and partners, enabling multiple responses from each project, across all programmes within the scope of the research Waves. The response rates across all research Waves combined is presented within Appendix A. The response rates for Wave 2 and Wave 3 for FOAK are detailed below⁷:
- **Wave 2:** There was a 67% response rate, which covered 24 of the FOAK22 and FOAK23 projects. Of the survey respondents, 18 had responded during the Wave 1 survey, and 8 were answering the survey for the first time.
 - **Wave 3:** There was a 95.8% response rate, which covered 23 of the FOAK25 projects.
- 1.16 It is important to highlight that the survey respondents from the three Waves differed. As such, while the findings offer valuable insights, they represent a cross-sectional comparison rather than a longitudinal comparison across Waves.
- 1.17 **Depth interviews** – comprised one-hour depth interviews conducted with programme beneficiaries and a selection of wider stakeholders (knowledgeable industry stakeholders from both commercial and academic institutions). The number of interviews undertaken varied by programme, in accordance with the number of stakeholders involved. A total of 31 interviews were conducted across Waves 2 and 3 for FOAK (with a further breakdown provided in Appendix A).

²QMS, IMS and secondary datasets for FOAK22 and FOAK23 were provided in Wave 2 and FOAK25 data was supplied in Wave 3.

³ QMS scores are provided by Monitoring Service Providers as part of Quarterly Review Meetings (QRM) with each project.

⁴ Crunchbase data has been included in the Appendix A. Although it provided some useful insights, the number of organisations identified was limited, making it premature to draw conclusions about any link between funding achieved and LMT.

⁵ This data was based on metadata [as of 01/09/2025 for Wave 2] from Digital Science's Dimensions platform, available at <https://ukri.dimensions.ai/>. Access was granted under licence agreement with UKRI."

⁶ Dimensions data for FOAK22 and FOAK23 were supplied in Wave 2. FOAK25 awards were not available on Dimensions or Gateway to Research, likely because the rail award is more recent. As a result, no linked data on patents or publications for this competition have been included in this report.

⁷ Survey response totals vary across questions because some beneficiaries did not complete every item. Throughout the report, the base number of responses is shown for each question to aid interpretation.

- 1.18 **Case studies** – 3 case studies have been undertaken for this programme (a total of 21 across the portfolio). For the FOAK programme, the case studies selected were: Protection and resilience for overhead line equipment using computer vision technology; Cross freight; and Trains with brain(s). Findings are integrated across this report and are presented as vignettes with separate full write-ups presented within the appendices. All case studies have been reviewed by the programme’s independent panel of subject-matter experts, selected for their expertise in relation to the programme or technology in question.

Methodological considerations

- 1.19 The key methodological considerations are as follows, which should be considered against the findings within this report:
- **Many technologies are still at the early stages of development**, meaning long-term impacts have not yet occurred. Many impacts are unlikely to emerge until several years after projects have completed. This is particularly the case for innovation funding, where numerous steps occur between initial project funding and measurable market outcomes. The findings gathered at this early stage (even if project have closed) should therefore be considered indicative of a longer-term trajectory rather than conclusive.
 - **Dependency on self-reporting**: although multiple sources of evidence have been examined, including consultation with wider stakeholders and industry experts, there is nonetheless an emphasis on understanding impacts via discussion with – or reporting by – project beneficiaries. Beneficiaries may sometimes emphasise positive outcomes or focus less on challenges, thus resulting in findings which could over-state the true impact of the portfolio. Wherever possible, the views of wider stakeholders and industry experts have been considered alongside beneficiary viewpoints to mitigate this risk.
 - **Heterogeneity of the portfolio**: The programmes within the portfolio vary significantly in terms of scale, technology, and commercial readiness. Applying a consistent methodology across the seven programmes is therefore challenging. To address this, Steer-ED and Technopolis sought to achieve a balance between providing consistent research tools across the portfolio, while also allowing for some tailoring to reflect the differences between programmes.
 - **Survey fatigue among respondents**: Repeated surveys of beneficiaries can lead to fatigue, causing lower response rates or incomplete responses and reduced data quality. This risk has been managed via briefing sessions with beneficiaries and proactive management of communications to ensure stakeholders understand the purpose of the research and benefits of participating. Across the portfolio, the beneficiary survey achieved overall project response rates of 51% in Wave 1, 66% in Wave 2 and 58% in Wave 3 which is still considered good representation (programme specific breakdowns are outlined in Appendix A).

Structure of this report

- 1.20 The remainder of this report is structured as follows:
- **Section 2: Overview of FOAK delivery** outlines the current status of FOAK and presents the progress made.

- **Section 3: Building and strengthening partnerships through programme delivery** focuses on how FOAK has fostered partnerships across industry, academia, and government.
- **Section 4: Development, commercialisation and deployment of new technologies** explores the progress made by FOAK in developing new technologies and progressing on the pathway to commercialisation.
- **Section 5: Growing skills and organisational maturity through programme delivery** assesses the impact of FOAK on enhancing skills and growing businesses and organisational capacity and capability.
- **Section 6: Impacts on wider framework conditions and long-term outcomes** discusses the potential long-term impacts of FOAK on broader industry and regulation.
- **Section 7: Conclusions & next steps** conclude the report.

2 Overview of FOAK delivery

Key Messages

- FOAK funded 70 projects across FOAK22, FOAK23 and FOAK25, awarding £16 million to beneficiaries, with an average award of £230,000 per project.
- Delivery activities spanned decarbonisation, digital and data solutions, passenger experience and maintenance and automation, reflecting the programme's broad thematic coverage.
- Most projects met planned objectives and delivered live demonstrations; 37 Wave 2 projects achieved all objectives by closure and 23 Wave 3 projects remain on course to deliver planned objectives. Moreover, four Wave 3 and two Wave 3 projects explored/ are exploring additional opportunities beyond their initial proposals.
- Generally, beneficiaries found the application process clear and proportionate, with briefing events and prior experience helping participants navigate the requirements.
- Beneficiaries valued clear objectives, responsive monitoring and market engagement opportunities, but highlighted administrative challenges including portal issues, inconsistent reporting and tight timescales.
- Key lessons for IUK, identified through the interviews with beneficiaries, include standardising reporting templates, creating more opportunities for market engagement, including promoting technologies mid-project and ensuring regular portal maintenance and updates.

Introduction

- 2.1 This chapter provides a detailed overview of the FOAK portfolio, outlining the objectives, timelines and key features of the programme, drawing on an analysis of monitoring data plus insights from the beneficiary survey. It goes on to characterise the delivery progress across the projects and offer insights from project delivery drawn from beneficiary interviews.

Introducing the programme

- 2.2 The FOAK programme is designed to accelerate the adoption of innovation across the UK rail sector. Its competitions encourage collaboration with industry and deliver high-maturity demonstrations, supporting efficient integration of new solutions into the railway system. The competition aims to support innovative suppliers for market readiness.
- 2.3 Each FOAK competition has themes, which aim to guide the development of innovation solutions.
- 2.4 The following themes were chosen for FOAK22:

- Low emissions and a greener railway.
- Rail freight.
- Cost efficiency and performance priorities for a reliable railway.

2.5 The following themes were chosen for FOAK23:

- Customer Experience Rail demonstrations.
- Reliable and maintainable assets rail demonstrations.
- Optimised train operations rail demonstrations.
- High speed rail systems installation demonstrations.

2.6 The following themes were chosen for FOAK25:

- Platform train interfaces.
- Personal safety.
- Bridge strikes.
- AI for complex processes.

2.7 FOAK has traditionally delivered a larger number of smaller projects, using public procurement to drive innovation. FOAK22, FOAK23 and FOAK25 supported 70 beneficiaries across 70 projects, with a total value of £16 million. The average award provided by IUK funding was approximately £230,000 per project, with individual project values ranging from £60,000 to £740,000.

2.8 The following provides an overview of the FOAK22, FOAK23 and FOAK25 competition timescales:

- **FOAK22:** The competition ran from April to June 2022, with projects starting from October 2022 and concluding by September 2023. Two projects received extensions – one until November 2024 and the other until January 2025.
- **FOAK23:** This competition ran from June 2023 to August 2023, with projects starting from October 2023 and concluding by September 2024.
- All FOAK22 and FOAK23 projects were officially closed as of January 2025.
- **FOAK25:** The competition ran from April to May 2025, with projects starting from September 2025 and due to close by March 2026.

2.9 Analysis of QMS data shows that 38 of the 44 projects across FOAK22 and FOAK23 (representing 86%) met their planned timetable and 24 out of 26 FOAK25 projects are meeting their planned timetable (representing 92%). Insights from project delivery

Project activities

2.10 FOAK projects spanned a wide variety of activities, aimed at delivering a higher-performing and more efficient rail system:

- **Decarbonisation and emissions reduction:** developing technologies to cut carbon output, improve air quality in trains, depots, and stations, and trial alternative fuels including batteries and hydrogen.
- **Digital and data innovation:** building integrated data platforms, advancing software tools, and improving timetabling and maintenance scheduling to support more flexible travel patterns. This also included using AI, drones and CCTV to improve access and workflow intelligence to improve planning and support assurance.
- **Passenger experience:** enhancing the accessibility and inclusivity of rail travel, improving reliability, safety and punctuality and introducing new or improved features.

This included real-time announcement transcriptions, sustainable seating, simplified ticketing, staff safety training and step free access.

- **Maintenance and automation:** increasing the reliability and availability of rolling stock and passenger-facing assets through better capacity management, climate resilience measures, and the use of robotics and AI for inspection, automating decision-making and improving recovery and public safety.
- **Prevention measures:** designing and implementing data-driven technologies to minimise congestion-causing risks, such as integrated Bluetooth and multi-sensor bridge-strike detection and prevention solutions.

2.11 The projects ranged in length between 91 days (approximately three months) to 671 days (approximately 22 months), with an average project length of 260 days (approximately 8 months). The longer project lengths reflected scale and complexity.

2.12 Case study projects illustrate the delivery of tangible outputs, for example:

- PROLECT (Appendix B), developed balance weights model using frame-by-frame analysis to capture greater detail in high-speed environments, which can reduce service disruptions due to temperature-induced wire expansion
- Cross Freight (Appendix C) delivered a digital platform to manage freight access rights and uncover new service opportunities. This has since been commercialised with Network Rail and deployed nationally.
- Trains with Brain(s) (Appendix D), launched a suite of infrastructure monitoring technologies, that analyse and cross-reference large datasets across asset types to enable faster identification of maintenance causes and effects, improving efficiency in rail operations.

2.13 Interviews with beneficiaries and wider stakeholders indicate that the majority of projects achieved their objectives, with many focusing on prototypes and live demonstrations of the technology. This is supported by QMS reporting, which shows that 37 Wave 2 projects (84%) met all planned objectives by their closure. A further four projects identified additional opportunities beyond those specified in their proposals and explored them within the project. Meanwhile, 23 Wave 3 projects (88%) remain on course to deliver all planned objectives and a further two plan to explore opportunities beyond those originally specified.

Beneficiaries' experience of delivery

2.14 Beneficiaries generally reported positive experiences with FOAK22, FOAK23 and FOAK25. They found the application process was clear and proportionate, and IUK support was widely valued, particularly because IUK's reputation and credibility helped projects gain legitimacy and engage stakeholders more effectively. At the same time, challenges arose around exploitation planning, reporting inconsistencies, portal issues, and tight delivery timescales. While clear milestones motivated some, others struggled with delays outside their control. Case study insights reinforce these patterns, as summarised below:

- PROLECT (Appendix B), faced long delays in securing specialist camera technology; however, the project successfully met key timing milestones, including installation and testing dates.
- Cross Freight (Appendix C), struggled with poor-quality and inconsistent industry data, which required significantly more cleaning and standardising than anticipated,

and also had to overcome cultural resistance from stakeholders accustomed to legacy processes.

- Trains with Brain(s) (Appendix D), built momentum by securing stakeholder support for evaluations, which enabled the collection of meaningful KPIs, demonstrated project benefits, strengthened the business case, and supported commercialisation.

2.15 One Wave 2 beneficiary also highlighted the value of the briefing event held prior to the funding allocations, where IUK and DfT clearly explained the competition requirements and project expectations. This briefing gave them a better understanding of how to select their proposal and identify appropriate project partners. Beneficiaries with previous experience working with IUK also found this beneficial, as they were already familiar with IUK processes and requirements.

2.16 Experiences of working with IUK were largely positive. In particular, beneficiaries described Monitoring Service Providers (MSPs) as fair, informed and helpful. Expectations and timescales were generally set out clearly, with contact levels tailored to participants' prior familiarity with IUK processes. Beneficiaries reported that monitoring service providers were enthusiastic and pragmatic in helping teams stay on track. Some beneficiaries also reported that their MSP made introductions to industry stakeholders, which was considered highly beneficial.

"MSPs were usually very well informed and knew what they were doing. They were enthusiastic and there to help you" – Wave 2 FOAK beneficiary

"Everything has been seamless and helps [... we have] background working with IUK and our monitoring officer has been extremely kind, [...] making sure we are meeting the required industry standard." - Wave 3 FOAK beneficiary

2.17 Whilst overall feedback was positive, some challenges persisted. One Wave 2 beneficiary noted that developing an exploitation plan at the outset was particularly difficult, as detailed information on commercialisation was not available before engaging with market stakeholders. The beneficiary did recognise the value of having an initial vision for exploitation but recommended a lighter-touch requirement may be more realistic at bid stage.

2.18 Some administrative challenges and areas for improvement were highlighted:

- **Standardisation of reporting requirements and proportionality:** A few beneficiaries reported that different MSPs preferred different reporting formats, which caused some frustration. To mitigate this, it was standardised reporting templates were suggested which could be uploaded to the portal. Some beneficiaries also found the reporting requirements to be *"onerous"* and suggested that certain documents could be streamlined or scaled according to the level of funding to make the process more proportionate.
- **Portal issues:** Challenges included incorrect word counts that prevented submission, rounding errors in finance tables and difficulties in transferring user access rights. Beneficiaries said these glitches made the process unnecessarily stressful, with one describing them as *"a huge problem that [IUK] still haven't addressed."* One beneficiary also noted that additional guidance on which

information is most important at the bid stage would be helpful, as they were unclear on which aspects carried the most weight.

- **Submission format and word count:** Some beneficiaries noted that word limits can be restrictive and suggested permitting larger word counts, as well as the inclusion of images and PDFs in applications and reporting. Some Wave 3 beneficiaries suggested improvements to the assessment stage, with one noting that incorporating interviews during the bid process could help ensure higher-quality applications. Another beneficiary felt that assessment panels should include industry experts who understand the operational context and technological landscape, arguing that without this expertise, assessors may struggle to determine how innovative or impactful a proposal truly is.

- 2.19 Delivery timescales were another area of mixed experience. Some beneficiaries suggested that more flexibility would have helped absorb unanticipated delays including site access or ordering bespoke components. In contrast, others noted that clear milestones and deadlines acted as a motivator, forcing engineers to focus and deliver an operational product within a live environment.

“I found the process very, very clear because the objectives were set [but] the timescales were challenging” – Wave 2 FOAK beneficiary

“[timescales] were always going to be tough but that’s actually where the structure [...] and reporting [...] has been] very useful because you hold yourself to account, [...] and can] have honest conversations [...] with monitoring officer about where we’re at on the timeline.” – Wave 3 FOAK beneficiary

- 2.20 Beneficiaries also reported financial challenges, including cash-flow pressures caused by long waits for first payments and unclear invoicing options for smaller companies. One beneficiary requested *“an option for smaller companies to do an invoice after month one which relates to the mobilisation and procurement costs”*. Difficulties in navigating the finance portal were also reported to be challenging, where misaligned forecasting and claim-timing issues led to incorrect overspend warnings.
- 2.21 Finally, some beneficiaries suggested that IUK and DfT could play a stronger role in promoting FOAK technologies to the rail industry. The FOAK showcase in February 2025 was cited as a strong example of how IUK can generate visibility and momentum; several beneficiaries said that holding similar events mid-project would allow teams to maximise benefits before project closure. Meanwhile, several FOAK25 beneficiaries noted that a showcase was not included in their competition and felt this would be valuable as they would have been a *“good networking opportunity, even an online showcase would be quite nice.”* They also highlighted the potential value of a multi-sector technology showcase to further support multi-sector collaboration and visibility.

Conclusion

- 2.22 The FOAK programme has successfully supported the development and demonstration of a range of innovative technologies across the UK rail sector, establishing a foundation for wider adoption. The majority of projects met their original objectives within anticipated

timescales and delivered operational demonstrations. The application process was generally seen as clear and proportionate, with briefing events and prior experience helping participants navigate the requirements.

- 2.23 Beneficiaries consistently valued clear guidance and structured support from MSPs, as well as opportunities to engage with industry stakeholders. However, administrative challenges, including portal functionality, inconsistent reporting expectations and restrictive word counts, caused some frustration.
- 2.24 Some difficulties were reported in preparing exploitation plans at the outset and while the programme's tight timescales were motivating, at times, they placed pressure on SMEs. Project delays were typically linked to practical constraints, including access to sites or third-party assets, rather than the technical feasibility of the projects.

3 Building and strengthening partnerships through programme delivery

Key Messages

- FOAK has successfully strengthened both existing and new partnerships: the beneficiary survey data shows that most beneficiaries developed additional or stronger relationships, and nearly all rated the quality of their partnerships as “good” or “very good.”
- Relationships with TOCs were especially valuable, providing real-world testing opportunities and insight into customer needs.
- Partnerships with technical experts and subcontractors enhanced project delivery by filling skills and capacity gaps, while supplier links supported future commercialisation.
- Beneficiaries reported significant benefits from the strengthened partnerships, including new commercial opportunities, greater confidence in collaboration and improved credibility with clients.

Introduction

- 3.1 A key objective of the LMT portfolio is to encourage a more collaborative approach to research through fostering new academic and commercial partnerships. Although FOAK programme applicants were not required to deliver their project in partnership with other organisations, partnership development was evident. Participating organisations included businesses and academic institutions.
- 3.2 This chapter sets out the role that project delivery has played in building and strengthening partnerships between industry, academia and regulators. It explores the mechanisms through which new partnerships were formed, and the FOAK programme’s contribution to strengthening these relationships. It goes on to describe beneficiaries’ accounts of the types of partnerships formed and their anticipated (or realised) benefits.

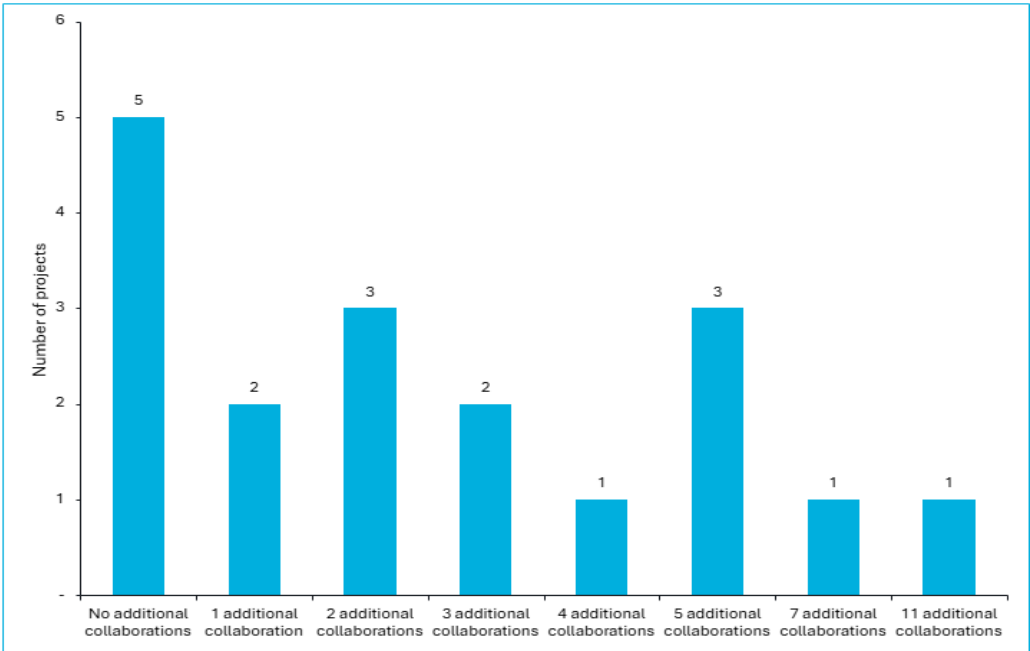
Exploring the role of programmes in partnership development

- 3.3 All beneficiary interviewees reported that their projects had strengthened relationships with a variety of partners. This is supported by the beneficiary survey findings, which showed that 19 of the 26 Wave 2 respondents felt FOAK partnerships had reinforced existing collaborations, while 12 reported that FOAK had led to the creation of new

partnerships. Wave 3 findings further support these finding as 14 out of 23 respondents reported FOAK partnerships strengthened existing partnerships and 17 reported that FOAK25 resulted in new partnerships.

3.4 Analysis of Wave 2 IMS data (Figure 3-1) confirms that most beneficiaries had formed new collaborations over the past year (13 out of 18⁸). This suggests that FOAK has sustained existing networks as well as stimulated new connections, broadening the reach and impact of innovation activity

Figure 3-1: Number of new collaborations of beneficiaries in the past 12 months, as a result of the FOAK project (n=18)



Source: Wave 2 IMS data (IUK), Steer-ED analysis (August 2025), Question: As a result of this Innovate UK support, how many new collaborations have you made with external organisations in the last 12 months?

Types of partnerships formed, and how they have been used

3.5 Beneficiaries described several types of partnerships formed or strengthened through project delivery, including:

- **Partnerships with TOCs and potential clients:** Many beneficiaries highlighted strong relationships with TOCs, which enabled real-world technology trials. Operators were often also prospective clients, allowing beneficiaries to gain insight into customer challenges and requirements; consequently, building confidence in their innovation solutions. For instance, the Trains with Brain(s) project (Appendix D) integrated multiple train-borne monitoring technologies onto passenger services through a partnership with West Midlands Trains. This partnership enabled live demonstrations, iterative refinement of algorithms and direct access to operational data, which strengthened both commercial and technical outcomes.

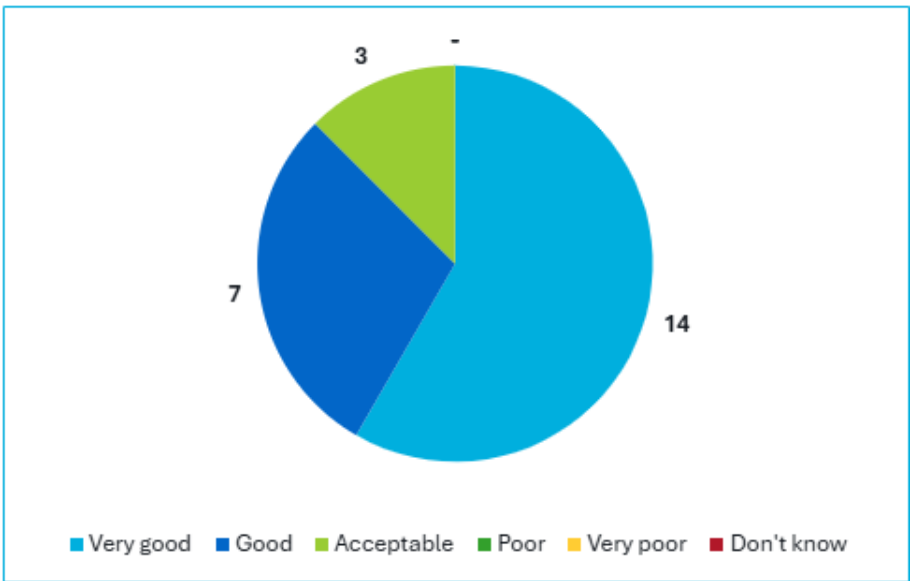
⁸ Note that no IMS data on collaborations was available to FOAK25 projects.

“We can actually spend a lot more time with the stakeholders to codesign [...which means we can] continue with the commercialisation of what’s been built” – Wave 3 FOAK beneficiary.

- **Partnerships to provide technical support or additional capacity:** Some beneficiaries formed relationships with businesses or subcontractors to provide specialist expertise or additional capacity, filling gaps in skills or experience necessary for technology development. Several beneficiaries reported that these technical relationships supported internal capacity and skill development through generating learning opportunities.
- **Partnerships with potential suppliers:** Some beneficiaries reported relationships with manufacturing or supply chain component organisations. In the PROLECT project (Appendix B), collaboration with OFIL Systems (camera manufacturer) allowed the installation and calibration of Corona monitoring cameras.

3.6 In regard to partnerships with central government, there was limited activity reported by beneficiaries. When asked about new or strengthened relationships since the previous year, 15 of the 26 Wave 2 survey respondents reported having developed additional or stronger partnerships (echoed by 19 of 23 Wave 3 respondents). Additionally, 21 of the 24 Wave 2 respondents (Figure 3-2) rated the quality of their project partnerships as “very good” or “good” (supported by 17 of the 23 Wave 3 respondents).

Figure 3-2: Reported quality of relationships between project partners (n=24)



Source: Wave 2 LMT beneficiary survey, Steer-ED analysis (September 2025), Question: How would you rate the quality of relationships between project partners? (Answer options: Very good, Good, Acceptable, Poor, Very poor, Don’t know, N/A)

Beneficiary perspectives on the benefits of partnerships

3.7 Several benefits were identified by beneficiaries (or were expected to arise in the future) from partnerships formed or strengthened through FOAK, including:

- **Commercial opportunities:** Several stakeholders reported that partnerships, with other SMEs and TOCs, has increased confidence in communicating to partners and has subsequently led to additional projects and collaboration opportunities. Partnerships with potential customers have also resulted in securing further commercial opportunities, including follow-on contracts.

“We’ve developed much closer working relationships [with partners] so feel a lot more confident speaking to them [...] on other opportunities” – Wave 2 FOAK beneficiary

“[Project partner] see a huge value in incorporating such products in their product pipeline and I think that is the confidence we take away in order to identify new operations where we can commercially exploit the solution” - Wave 3 FOAK beneficiary

- **Collective knowledge and skills:** Partnerships provided access to expertise and capabilities which did not previously exist internally, including specialist technical skills, industry insight, and complementary knowledge enhancing the overall value of projects. In the PROLECT project (Appendix B), collaboration with engineers, rolling stock providers, and camera manufacturers supported the development of machine learning algorithms and computer vision systems that improved maintenance safety, efficiency and climate resilience. Beneficiaries also highlighted that partners, including TOCs and Network Rail provided them with new insights including sector specific challenges, needs and useful literature.

“Network Rail sent me a very interesting paper [...] so that’s allowed us to add and plan a lot of features into our software [which we] may not have done before.” - Wave 3 FOAK beneficiary

- **Access for testing:** Collaborations with TOCs enabled beneficiaries to trial technologies in operational environments, which helped identify areas for improvement and refine solutions. Trains with Brain(s) (Appendix D) and PROLECT (Appendix B) both highlights how access to live rail networks was essential for validating solutions and refining functionality based on real-world conditions.

“[Partnership and access to control room] not just allowed us to do this project but also allowed us to understand the underlying kind of challenges they are facing at the moment, which [...] allows us to demonstrate the scalability.” – Wave 3 FOAK beneficiary

Case study vignette showcasing partnership development and the benefits to the project/organisation

The PROLECT project (Appendix B) developed machine learning algorithms to monitor overhead line equipment (OLE) on electrified railways, addressing issues such as drooping wires in high temperatures and risks from corona discharge. The project also

installed Corona monitoring cameras on in-service trains, using UV light to detect electrical discharges on damaged or dirty OLE components.

Strong partnerships were central to the project's success. Network Rail engineers from the Northwest and Central regions provided operational expertise and access to track for live testing. Angel Trains facilitated integration onto rolling stock, while OFIL Systems supported camera manufacturing. Collaboration with these industry experts ensured iterative technology development and demonstrations that reflected real-world railway conditions.

These partnerships also strengthened commercial relationships, enabling access to additional R&D funding for both the balance weight system, which analyses train-borne video imagery, and the Corona monitoring camera. This support accelerated commercialisation and enhanced the company's market position. As of Autumn 2024, the balance weight solution, supported by Network Rail R&D, has been deployed across hundreds of miles of track. The Corona camera is receiving further funding from Network Rail's OLE Engineering team, with installation on in-service trains expected in Spring 2025 and full commercialisation anticipated in 2025.

Conclusion

- 3.8 FOAK has played a significant role in fostering stronger partnerships across the rail innovation market. While partnership working was not a requirement of the programme, all beneficiaries reported that their projects had either strengthened existing collaborations or generated new ones. These relationships have brought together industry, academia and supply chain partners in ways that have enhanced the credibility of innovations, created new commercial opportunities and expanded beneficiaries' access to knowledge, expertise and testing infrastructure. The Wave 2 and Wave 3 beneficiary surveys reinforces this finding, with the majority of beneficiaries reporting improved or new partnerships and rating the quality of these relationships as "very good" or "good".
- 3.9 These strengthened partnerships are expected to have long-term benefits for the sector. By enabling beneficiaries to test technologies in live environments, secure follow-on contracts and fill capability gaps with technical support, FOAK has arguably created pathways for innovation to scale and embed more effectively.

4 Development, commercialisation and deployment of new technologies

Key Messages

- FOAK has successfully advanced technologies, with most projects reporting an increase in TRLs through operational trials and iterative testing.
- Projects have generated intellectual property (IP) and technical outputs, contributing to knowledge creation and organisational capability.
- A subset of projects has achieved commercial outcomes, including new products and services in the UK and overseas markets, and improved beneficiaries' market position.
- Structural barriers, regulatory complexity, slow procurement, unclear client pathways and cultural risk aversion limit commercialisation for many FOAK-supported solutions.
- Early competition rounds with broad themes produced some outputs that were less aligned with industry demand; however, narrower challenge statements (including some in FOAK25) are expected to improve market relevance and commercial uptake.
- Enablers of commercial progress include direct client involvement, targeted themes, Network Rail engagement, and potential follow-on funding to bridge the gap from demonstration to adoption.
- The impacts realised through FOAK, could be further enhanced by integrating procurement planning and providing market-aligned support alongside technology development.

Introduction

- 4.1 This chapter explores the extent to which FOAK projects have been successful in developing and deploying technologies, as well as progressing towards commercialisation.

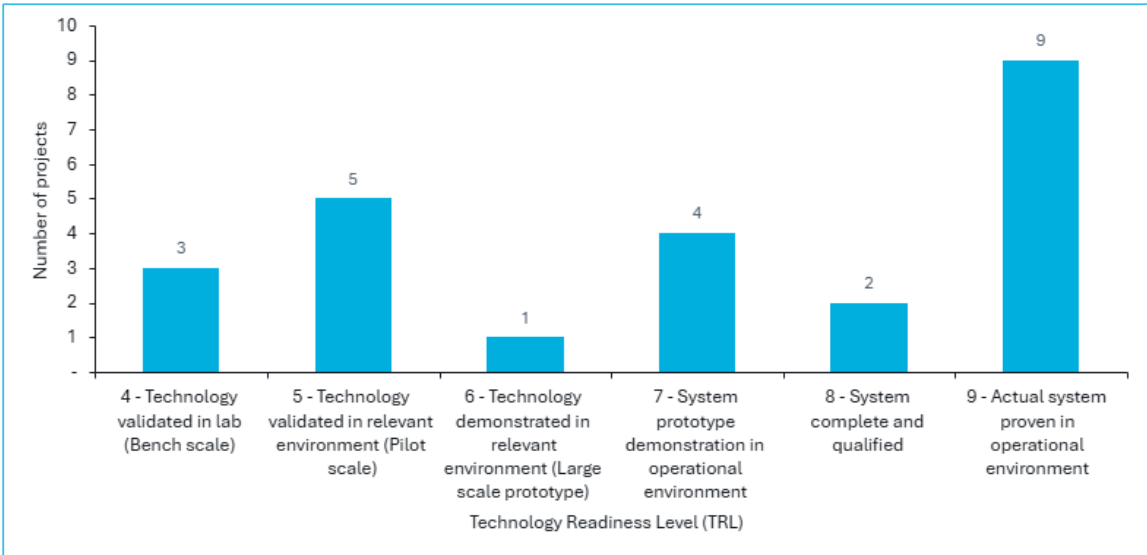
Reported TRL progression across projects, and mechanisms driving this

4.2 The main achievement realised through FOAK is the advancement of technologies through the TRL scale. Interviewees consistently reported that project activities, particularly live demonstrations and trials in operational settings, enabled their technologies to progress to higher maturity levels. Projects were diverse, spanning different stages of the TRL scale, and beneficiaries emphasised that trials allowed iterative improvements, often customised to operator needs, which built confidence in both the technology and its potential applications.

4.3 Wave 2 and Wave 3 beneficiary survey findings support this view:

- Of the seven Wave 2 beneficiaries who reported TRL data before (ranging from TRL 2 to TRL 7) and after the FOAK project, five indicated that their innovation had progressed (Figure 4-1). For Wave 3, 23 beneficiaries reported TRL data at application stage (ranging from TRL 2 to TRL 9) and 17 indicated their TRL had progressed during the project.
- One Wave 2 project increased by five TRL stages (from TRL 4 to TRL 9) and two Wave 3 projects increased by four TRL stages (from TRL 5 to TRL 9 and TRL 3 to TRL 7) during the funding period.
- It is also worth noting that there were some exceptions. For example, within FOAK25, one project began at TRL 9 and remained at this level, while two beneficiaries reported a decline in TRL level (one from TRL 6 to TRL 4 and another from TRL 5 to TRL 3). While not all projects experienced significant progression, beneficiaries and wider stakeholders reported that FOAK has consistently supported movement from concept to demonstration, often within relatively compressed timescales.

Figure 4-1: Self-reported TRL of their technology (n=24)



Source: Wave 2 LMT beneficiary survey, Steer-ED analysis (September 2025), Question: With reference to the Technological Readiness Level (TRL) scale, what is the TRL of the technology now? (Answer options: Numeric (1-9), Unsure)

4.4 As expected, beneficiaries noted that additional funding would have allowed them to make further enhancements and iterations to products, in turn increasing their TRL. While

TRL progression was considered a strength of the programme, several wider stakeholders said that this has not always been matched by similar momentum towards commercialisation, a theme explored later in this chapter (see section: ‘Commercial progress made by organisations’).

Intellectual property and information dissemination

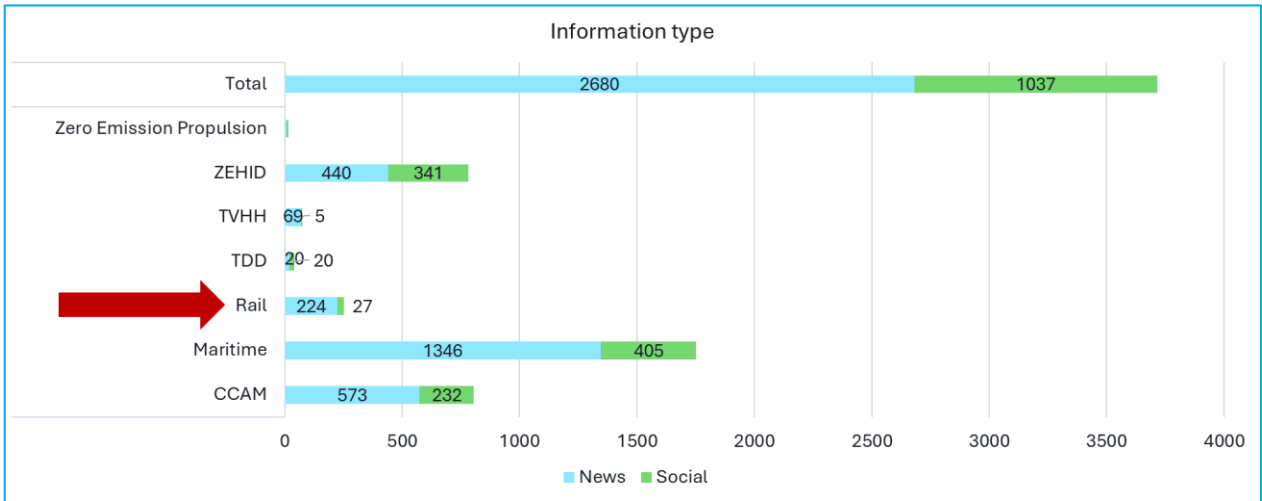
- 4.5 Alongside technical development, FOAK projects have generated new knowledge in the form of intellectual property, technical reports and wider outputs. According to the Wave 2 and 3 surveys, beneficiaries evidenced new knowledge generated and expect their information outputs to grow over the coming years.:
- **Patents:** Five of 22 Wave 2 organisations reported that new patents had been secured as a direct result of their FOAK project (and two of 23 Wave 3 respondents), while a further four anticipated securing a new patent within three years (and 13 Wave 3 respondents).
 - **Technical reports and outputs:** 21 of 25 respondents said they had produced technical documentation, reports or similar outputs, which are expected to play an ongoing role in knowledge transfer and capability building (and 17 of 23 Wave 3 respondents).
- 4.6 A few projects have had particularly notable impacts. The Trains with Brain(s) project (Appendix D) delivered lasting technical outputs that are shaping industry standards. Network Rail is adopting lessons from the trainbourne monitoring systems, shifting from manual inspections to more reliable trainbourne monitoring alternatives, and the project has enhanced the company’s sector leadership, with publications like the White Paper on Mentor Train Force Measurements influencing standards and practices.
- 4.7 Two university beneficiaries reported that their FOAK project has contributed to knowledge transfer in academic settings, highlighting that projects provided practical teaching examples, supporting knowledge transfer to students.

“Got an MSC project [...] and] a PhD student working on this so [...] for teaching and further research development, it has helped us.” – Wave 3 FOAK beneficiary

- 4.8 In regard to broader dissemination, meltwater media analysis shows that FOAK projects generated fewer references in social media and general news outlets compared to other LMT programmes (e.g. Maritime, CCAM and ZEHID). As shown in Figure 4-2, Wave 2 projects (FOAK22 and FOAK23) collectively received 251 media references - an average of 5.7 per Wave 2 FOAK projects⁹. Meanwhile, Wave 3 projects (FOAK25) received 220 media references (154 news and 66 social media), an average of 3.1.

⁹ Media references include news and social media platforms.

Figure 4-2: Number of individual media references to projects across different programmes

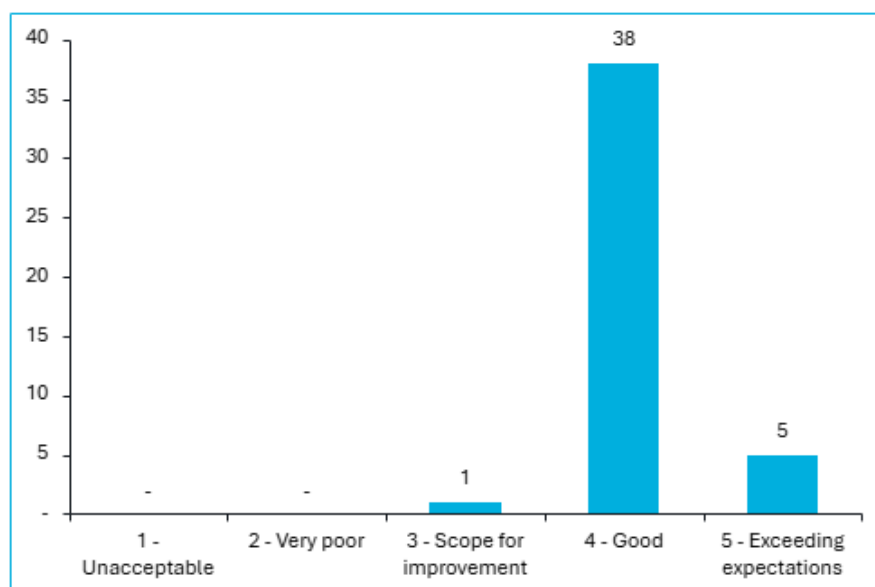


Source: Wave 2 Meltwater, Technopolis analysis (data collected August 2024 to August 2025)

4.9 Despite such FOAK media references, some beneficiaries were hesitant to share information about their projects online due to IP challenges and concerns that the technology could be copied, potentially undermining future outcomes. Some beneficiaries also highlighted the high costs associated with securing IP protection, noting that they do not have the budget to secure this. Others chose not to post online until the product had been proven to work effectively in real time.

Commercial progress made by projects

- 4.10 FOAK projects have achieved some notable commercial outcomes, but the overall picture is mixed. On the one hand, monitoring data and survey responses indicate that many projects are making good progress towards exploitation, with a number of new products and services already reaching the UK and overseas markets, and beneficiaries reporting improvements in their market position. At the same time, both beneficiaries and wider stakeholders emphasised persistent barriers to adoption and scaling, particularly around procurement, industry appetite and the fragmented nature of the rail market. This combination of strong early signals of market impact alongside continuing systemic challenges explains why FOAK’s commercial performance is assessed as mixed overall.
- 4.11 This mixed picture is first reflected in the QMS monitoring data, which shows that 38 (out of 44) Wave 2 FOAK projects (
- 4.12 Figure 4-3) and 20 (out of 26) Wave 3 projects were assessed by MSPs as making “good” progress towards exploitation of their technologies.

Figure 4-3: MSP reports of project exploitation (n=44)

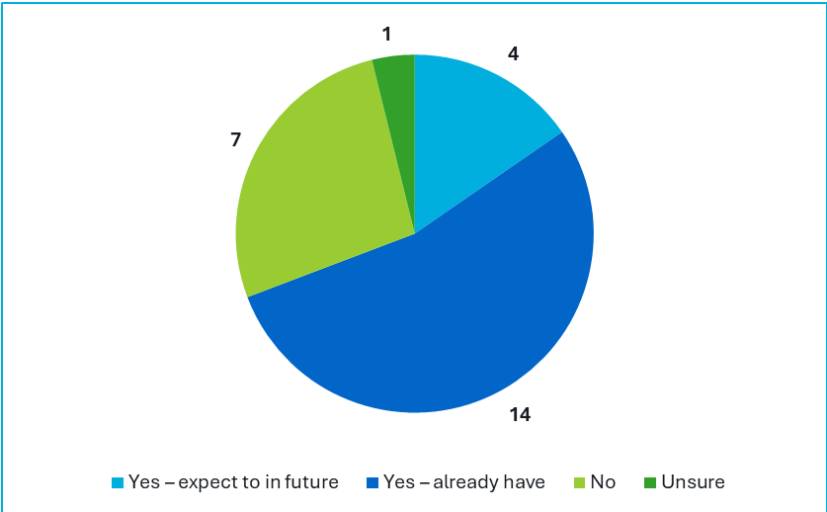
Source: Wave 2 QMS MSP reports (IUK), Steer-ED analysis (August 2025), Question: How strong is the business case and concept for commercialisation for the technology?

4.13 Wave 2 beneficiary survey data (presented in

4.14 Figure 4-4 and Figure 4-5), along with Wave 3 survey findings, reinforces this positive progress:

- **Products and services:** 14 of 26 Wave 2 respondents reported their projects had already resulted in new products or services being brought to the UK market, with a further four expecting to do so in the future. In contrast, no Wave 3 respondents reported new products or services had reached the UK market, which was expected given the earlier stage of the projects, and six out of 23 stated that no new products had yet been brought forward. However, 16 respondents indicated they expect to introduce new products or services in the future. These differences reflect the fact that Wave 3 projects have not yet concluded and remain in development, meaning their full outcomes are still emerging.
- **Exports:** Four out of 26 Wave 2 organisations that had introduced products to the UK market had also brought a product or service to one or more overseas markets (and seven out of 23 Wave 3 respondents).
- **Market position:** 13 out of 25 Wave 2 respondents reported that their market position had “somewhat” improved as a result of FOAK, with five indicating it had improved “very much” and none reported a decline. Wave 3 findings echoed this, with eight of 23 respondents reporting their market position had improved “very much”, eight indicating it had improved “somewhat” and none indicating “not at all”.

Figure 4-4: Whether FOAK projects have resulted in new products or services to the UK market (n=26)

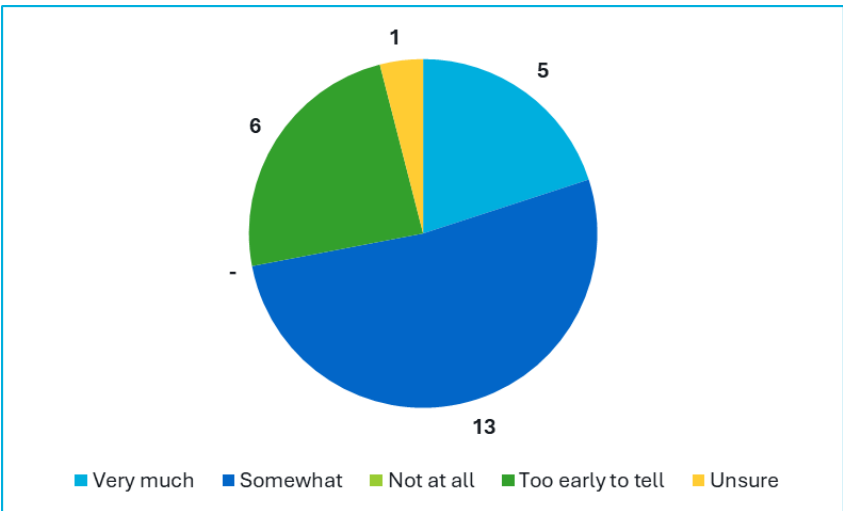


Source: Wave 2 LMT Beneficiary Survey, Steer-ED analysis (September 2025), Question: To date, have any new products or services been brought to the UK market as a result of this project? (Answer options: Yes – already have, Yes – expect to in future, No, Unsure).

- 4.15 These outcomes demonstrate that FOAK has created routes to market for the majority of supported projects, often by de-risking technologies to the point where operators or clients are willing to further invest in them. The Cross Freight project (Appendix C) developed a software platform to automate freight access right management. It has been commercialised with Network Rail, is in national use, and has established partnerships with 7 of 8 Freight Operating Companies (FOCs). Similarly, Trains with Brain(s) (Appendix D) has generated projected revenues of £3.8 million, safeguarding 20 existing jobs and creating five new ones. These examples illustrate how FOAK projects have de-risked technologies to the point where clients are willing to invest and adopt solutions.

“It’s de-risked primarily the speed with which we’ve been able to engage industry partners and other stakeholders, [...] The fact we are an awarded FOAK project comes with a lot of credibility [...], it’s thrown open doors way beyond what I would have thought possible.” - Wave 3 FOAK beneficiary

Figure 4-5: The extent to which beneficiaries’ market position improved as a result of the project (n=25)



Source: Wave 2 LMT Beneficiary Survey, Steer-ED analysis (September 2025), Question: To what extent would you say your market position as an organisation has improved as a result of this project? (If you are not a business, select 'NA') (Answer options: Very much, Somewhat, Not at all, Too early to tell, Unsure, NA)

4.16 As Figure 4-5: The extent to which beneficiaries’ market position improved as a result of the project (n=25) Figure 4-5 shows, beneficiaries reported improvement to market position as a result of the FOAK project which was further supported by Wave 3 survey data where 16 out of 23 beneficiaries said their market position has improved “very much” or “somewhat”. Interviews corroborated these findings, indicating that while some beneficiaries have experienced improvements in their market position, these gains remain preliminary and require further proof of concept. Additionally, several beneficiaries reported that the project has enabled them to establish new market opportunities.

It's completely changed the kind of narrative of the way that we're perceived within the market. [...] Now all of a sudden, they're [industry stakeholders...are saying] 'you're really making a difference in the rail market' - taking us a lot more seriously.” – Wave 3 FOAK beneficiary

“It's still early days in that sense, but the omens are very good. I think given some of the conversations we're already having, it feels very much like there is a coalition of the willingness around this, [but] we still have a big job to do in terms of proving out the technology, it's appropriateness and it's kind of suitability to the topic.” – Wave 3 FOAK beneficiary

4.17 Despite these positive outcomes, both beneficiaries and wider stakeholders emphasised that difficulties remain in securing contracts, especially with major industry players including Network Rail. Reported barriers include the slow adoption of innovative technologies by some TOCs, opaque contracting guidance, and procurement processes that are not well suited to SMEs.

- 4.18 In addition, stakeholders and beneficiaries agreed that additional support is needed for FOAK projects to achieve commercial progress, beyond the technological progress already enabled. This includes both continued public funding to bridge the gap from demonstration to market and greater use of UKRI's wrap-around commercialisation support, which some SMEs may struggle to access due to limited capacity or awareness. Other beneficiaries indicated that they would welcome support from IUK and DfT to facilitate greater engagement with potential clients and stakeholders, for example through emails, online newsletters or networking events presenting the projects and highlighting demonstration dates. They noted that increased exposure would help bridge the gap to commercialisation as IUK and DfT would have *"a lot more weightage"*.
- 4.19 In contrast, several stakeholders cautioned that ongoing FOAK funding risks allowing SMEs to rely on CFI funding without becoming commercially sustainable. To mitigate this, they suggested measures such as introducing match-funding requirements, scaled to organisation size, and clearer guidance from DfT/IUK on commercialisation pathways.

"We're seeing some of the technologies coming out of FOAK being deployed but then staying stagnant without further FOAK funding. I could probably name three companies that do that." – Wave 2 FOAK wider stakeholder

"Support wise, how to commercialise with these public funded bodies [Network Rail] would have been really, really helpful." – Wave 2 FOAK beneficiary

Barriers and enablers to technological and commercial development

- 4.20 All wider stakeholders noted that FOAK projects have a low commercialisation rate. While to some extent this is unsurprising given the nature of innovation, and suggests the programme effectively filters out unsuccessful technologies, wider stakeholders agreed that commercialisation is lower than expected for projects that achieve technological success. FOAK is widely regarded as effective in advancing technologies and raising TRLs, but stakeholders and beneficiaries expressed mixed views on its effectiveness in moving technologies beyond demonstration, scaling them and entering the complex procurement market.
- 4.21 Wider stakeholders and beneficiaries consistently pointed to regulatory uncertainties, with reference to renationalisation of rail, lack of innovation funding, slow procurement processes and a lack of clarity around "who pays" in the industry as structural challenges. Stakeholders noted that the fragmented responsibilities of TOCs, Network Rail, the DfT and GBR can create uncertainty, leaving SMEs without a clear customer pathway.
- 4.22 Other barriers identified by beneficiaries or wider stakeholders include:
- **Lack of committed clients:** Beneficiaries reported that many potential clients appear to lack the appetite or resources to invest in new technologies, even where long-term savings are clear. SMEs, in particular, face challenges covering upfront costs without

secure contracts. Some beneficiaries suggested that additional guidance from the DfT for TOCs would be beneficial in helping to drive uptake.

“Some of the latest more generic ones [competitions] have had a sponsor but they aren’t necessarily the person who wants the outputs... There is a disconnect in the market about what comes out of FOAK because there is not an identified client” – Wave 2 FOAK wider stakeholder

“Uptake is always the challenge [...] if Department for Transport start prescribing ‘this is what you should be looking at doing’ [...] and it aligns to their goals and also GBR’s, it [...] makes it far easier for small businesses to actually sell because we’ve aligned with the DfT”. – Wave 3 FOAK beneficiary

- **Broad competition themes:** Wider stakeholders reported that earlier competitions, including FOAK22, FOAK23 and some in FOAK25, were too generic, producing outputs less aligned with industry needs and therefore creating a “false impression” of market demand. One beneficiary expressed concern that broader competitions may attract a higher volume of applications, which could potentially reduce the overall quality of submission. They noted that this perception influenced their decision not to apply to the FOAK25: AI for complex processes competition.

“Through IUK and DfT, we often end up with a product which solves a problem we don’t have...FOAK needs to deeply consider how to ensure that problem statements are coming out from industry through to SMEs” – Wave 2 FOAK wider stakeholder

- **Procurement challenges:** Slow and complex procurement processes can leave SMEs exposed to financial strain during the lengthy gap between demonstration and adoption.

“When we designed FOAK it was to bridge the gap between [technology development and] commercialisation, but because of procurement issues it doesn’t actually move things on from pilots. This is not through lack of successful projects, it’s about the set up of the programme” – Wave 2 FOAK wider stakeholder

- **Reluctance to adopt innovative technology:** Solutions developed may be perceived by the rail industry as beneficial but not essential, underlining the importance of aligning innovations with genuine market needs to achieve commercial traction. One beneficiary noted the distinction between innovation and business as usual, emphasising that innovation does not always translate into a contract. Another suggested it may be more beneficial if innovation was more focused on areas where TOCs know they will spend more money.

"We definitely hoped that we would have more traction within the rail industry with the product, it's kind of transpired that the product [...] was more of a 'nice to have' for the rail industry rather than something that was...essential." – Wave 2 FOAK beneficiary

"Innovation is innovation and business as usual is business as usual, [...] don't assume working with your partners on the innovation route is going to lead to an annual contract."
– Wave 3 FOAK beneficiary

- **Lack of institutional backing:** Beneficiaries highlighted a lack of institutional backing which is preventing operators from adopting and implementing new innovative technologies.

"There might not be...institutional momentum and backing for new technologies at scale. There's certainly appetite for innovation and for this kind of thing, for trialling new technologies, but I'm not sure how much budget essentially there would be for implementing them." – Wave 2 FOAK beneficiary

- **Certification costs and timescale constraints:** One beneficiary highlighted the high costs and lengthy timescales associated with obtaining certification. They said that this constraint makes it difficult to generate revenue in the current UK rail sector and pushes them to explore overseas options

"We have to have our business heads on and think why would we spend so much time, effort and money doing certifications for the UK to unlock a relatively small market, whereas we could go somewhere where there's a lot less of that red tape." - Wave 3 FOAK beneficiary

- **Old train systems:** Older trains were found to be incompatible with some of the new technology. This means that before installing any new technology, older train systems require upgrading, incurring additional (high) costs.
- **Cultural resistance:** While senior industry leaders express strong support for innovation, both beneficiaries and wider stakeholders reported that operational staff often show reluctance to change entrenched practices, reflecting the sector's risk-averse culture and safety-critical priorities.
- **Skills gaps in the rail sector:** Some wider stakeholders and beneficiaries reported that skill gaps, particularly at operational levels, can slow the adoption of new technologies. Challenges include low digital literacy, limited software skills and unfamiliarity with AI and automated processes.

4.23 Alongside the barriers, several enablers for commercial progress were identified:

- **Direct customer involvement:** Projects that included operators or potential clients within their consortia reported clearer routes to market. The ability to iterate technology based on direct customer needs, feedback and trialling in real world

environments was effective in demonstrating the use case. However, beneficiaries noted that this is dependent on how engaged the project sponsor/ partner is.

“Allowed us to do this project but also allowed us to understand the underlying challenges they are facing at the moment [...], that allows us to demonstrate the scalability of the business.” – Wave 3 FOAK beneficiary

- **Targeted competition themes:** Wider stakeholders praised the narrower focus of FOAK25 themes, which were developed in closer collaboration with industry. This is expected to result in technologies with stronger demand and higher prospects for adoption.
- **Network Rail engagement:** In cases where Network Rail experts were actively involved in assessment and oversight, outcomes were reported as better aligned to industry priorities. Despite this, some beneficiaries highlighted challenges in engaging with Network Rail, including delays in scheduling trials and coordination difficulties linked to its size and fragmented decision-making processes.
- **Funding has enabled projects and accelerated delivery:** The majority of beneficiaries stated that they would not have undertaken the project without FOAK funding, while others noted that the funding has “fast-tracked” project delivery, improving their commercial readiness.

“[Without funding it would have taken] four years as opposed to three months [...] and there's always the risk that in that four-year period, somebody else does it, somebody with deeper pockets.” – Wave 3 FOAK beneficiary

- **Funding helped to de-risk commercialisation:** Several beneficiaries reported that IUK funding reduced the project risk, for both beneficiaries and clients, by enabling projects to demonstrate the technology's viability.

“It's enabled us to do this kind of proof of concept that's shown viability and so there's less risk in taking things forward.” – Wave 2 FOAK beneficiary

“[Funding] is important, company's not a big company, it's an SME, and a chunk of funding on a project which is a new commercial area for us and a new product area for us it just reduces the risk significantly.” – Wave 3 FOAK beneficiary

Case study vignette showcasing a project which has made notable commercial progress, plus commentary on the barriers and enablers experienced

The Cross Freight project (Appendix C) developed a modern software platform to automate freight access right management and enable service planning, replacing fragmented, out-of-date spreadsheet-based systems. The platform was designed to support a modal shift from road to rail, improve efficiency, reduce operational errors, and unlock underutilised rail freight capacity.

The project successfully delivered a baseline product that has been commercialised with Network Rail and is now in national use. Building on this foundation, the technology continues to evolve through ongoing development and further investment by Hack Partners.

Through the project, Hack Partners established partnerships with 7 of 8 FOCs, safeguarded three jobs, and created a pipeline of several follow-on revenue-generating opportunities.

The primary barrier to broader commercialisation is changing entrenched behaviours within legacy processes, including resistance from staff accustomed to existing manual practices. Key enablers include close engagement with end users, iterative development, and FOAK-facilitated access to commercial stakeholders, which helped to build trust, develop a strong use-case for the technology and accelerate adoption.

Conclusion

- 4.24 FOAK has demonstrated clear success in advancing the technological maturity of rail innovations. Projects consistently reported increases in TRLs, with live demonstrations and operational trials proving particularly effective for iterative improvement and validation. IP creation, technical reports, and outputs indicate that FOAK has also contributed to knowledge generation and capability building, though wider dissemination and public engagement remain somewhat limited, compared to other LMT portfolios.
- 4.25 However, commercial progress has been mixed. QMS monitoring data shows that most projects are making good progress toward exploitation, and several have already brought products or services to the UK and overseas markets, with beneficiaries reporting improvements in market position. At the same time, interview and survey evidence highlights persistent challenges including slow and opaque procurement processes, fragmented industry responsibilities, unsupportive regulations, cultural resistance within operational teams and lack of investment appetite.
- 4.26 Earlier competition rounds were criticised for broad themes that did not necessarily align with market needs, while SMEs face financial and capacity constraints that limit follow-on technology or commercialisation development. Where greater commercial success was evidence, enablers included direct customer involvement, Network Rail engagement and direct customer engagement.

5 Growing skills and organisational maturity through programme delivery

Key Messages

- FOAK projects have enhanced technical knowledge and sector understanding, enabling organisations to diversify services and respond to emerging industry challenges and priorities.
- A few beneficiaries reported implementing improved organisational practices, including structured project management and reporting, into day-to-day management.
- Due to the FOAK project, several beneficiaries have reportedly strengthened their credibility and visibility within the rail sector, leading to new business opportunities and client engagement.
- The programme has contributed to workforce growth; 12 of 26 Wave 2 survey respondents said new roles were created within their organisation to deliver the FOAK programme (supported by 10 of 23 respondents in Wave 3).
- Overall, FOAK has supported organisational resilience and positioned beneficiary organisations to continue innovating and contributing to sectoral growth.

Introduction

- 5.1 Delivery of FOAK projects is expected to stimulate growth in the capability, capacity, resilience, workforce and skills of beneficiary organisations, ultimately leading to growth in the maturity and scale of the rail sector, with corresponding economic benefits. This chapter sets out the mechanisms by which activities have impacted organisational skills and maturity, and the role of the programmes in creating and safeguarding jobs.

How projects have contributed to skills development among partner organisations

- 5.2 Interviews with beneficiaries highlighted several mechanisms through which FOAK projects have contributed to organisational skill development:
- **Enhanced technical and sector knowledge:** Many beneficiaries reported that FOAK projects strengthened technical knowledge and broadened understanding of their

client base. This has enabled organisations to diversify service offerings, plan strategically and respond more effectively to emerging industry challenges. Several beneficiaries noted that knowledge gained through the projects had catalysed the development of new products and services, providing a competitive advantage. A beneficiary from a university also highlighted that they have used their FOAK project in MSc research projects and has worked with PhD students on the project.

“FOAK has given us another product offering that we didn't have before the project. So, it's increased our...technology capability and in terms of who our clients are.” – Wave 2 FOAK beneficiary

- **Improved organisational practices:** Several beneficiaries have embedded processes introduced during FOAK projects into their day-to-day operations. For instance, project management teams have adopted structured reporting and monitoring approaches demonstrated by IUK officers, improving internal efficiency and project oversight.

“Our commercial progress in terms of our wider rail product portfolio, is massively significant [...and] in terms of wider benefits, there's been new methods as, as you do these things, you improve your processes and methods, and we've got more documentation and planning in place.” – Wave 3 FOAK beneficiary

- **Job creation and upskilling:** A few project beneficiaries reported that FOAK projects have provided opportunities to upskill staff in new roles and accelerate recruitment. For example, one beneficiary reported that FOAK provided the opportunity for an engineer to step into a lead project role, gaining broader experience, technical knowledge and confidence.

“Having that funding come in has allowed us to go through an entire process of recruitment cycle, talk to the young graduates coming out of the universities, and also talk to highly professional and skilled professionals.” – Wave 3 FOAK beneficiary

How projects have contributed to growth in organisational maturity among partner organisations

5.3 In the interviews with beneficiaries, various ways were identified in which FOAK projects supported organisational maturity:

- **Enhanced credibility and industry profile:** Many beneficiaries reported that their participation in FOAK raised their visibility and reputation within the rail sector, positioning them as trusted collaborators. For some organisations, this has led to new business opportunities and/or contracts and enhanced engagement with potential clients. The Cross Freight project (Appendix C), which required collaboration between

Hack Partners, Network Rail and FOCs significantly raised the SME’s industry profile, leading to follow-on, revenue-generating contracts.

“Helps in terms of reputation as industry experts.” – Wave 3 FOAK beneficiary

- **Integration of skills into future work:** Organisations have applied the skills and knowledge gained through FOAK to inform decision-making, product development, and ongoing innovation activities meaning they can respond to client requests *“much quicker”*.

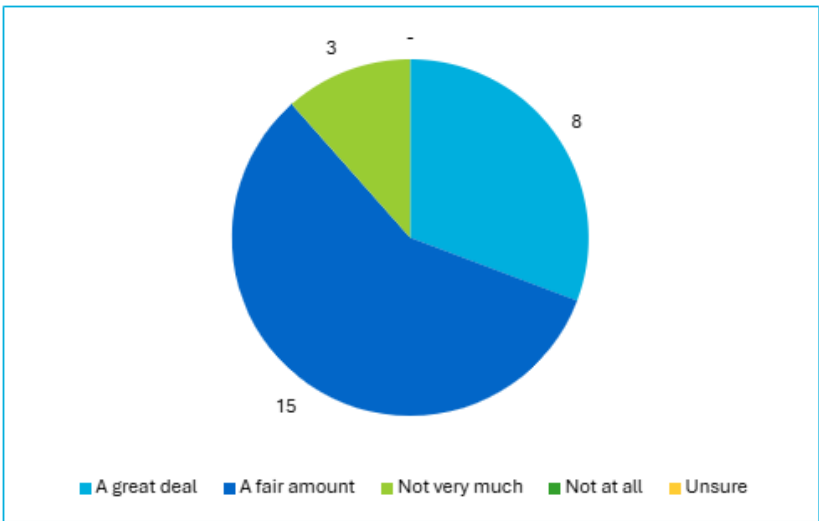
“Organisationally it's given us a real sort of leg up and a bit of a gear shift in our maturity and our ability to deliver on another level.” - Wave 3 FOAK beneficiary

- **Expansion to other sectors:** Beneficiaries reported that participation in the project has enabled them to explore opportunities to transfer and adapt their products for application across additional sectors, broadening their potential market reach.

“[Project has helped] build our internal skills [...] and by doing these proof of concepts, we’ve also been able to [...] think about what we could be doing in the wider context of rail and potentially how we can use our skills and demonstrate what we could do for other areas that we may not have previously worked in.” - Wave 3 FOAK beneficiary

5.4 The beneficiary survey findings support the qualitative findings (Wave 2 findings presented in Figure 5-1). For example, 15 (of 26) Wave 2 respondents said FOAK had strengthened organisational skills “a fair amount,” (echoed by seven of 23 Wave 3 respondents), while eight reported improvements of “a great deal” (strengthened by 13 Wave 3 respondents). Only three Wave 2 respondents reported “not very much impact” (three in Wave 3), with no respondents in either way indicated no effect. This suggests FOAK has had a broadly positive influence on organisational capability.

Figure 5-1: Self-reported impact of the FOAK project on organisational skill (n=26)



Source: Wave 2 LMT Beneficiary Survey, Steer-ED analysis (September 2025), Question: To what extent has the project had a positive impact on skill levels within your organisation? This could include for example commercial, technical, or regulatory knowledge/skills. (Answer options: A great deal, A fair amount, Not very much, Not at all, Unsure)

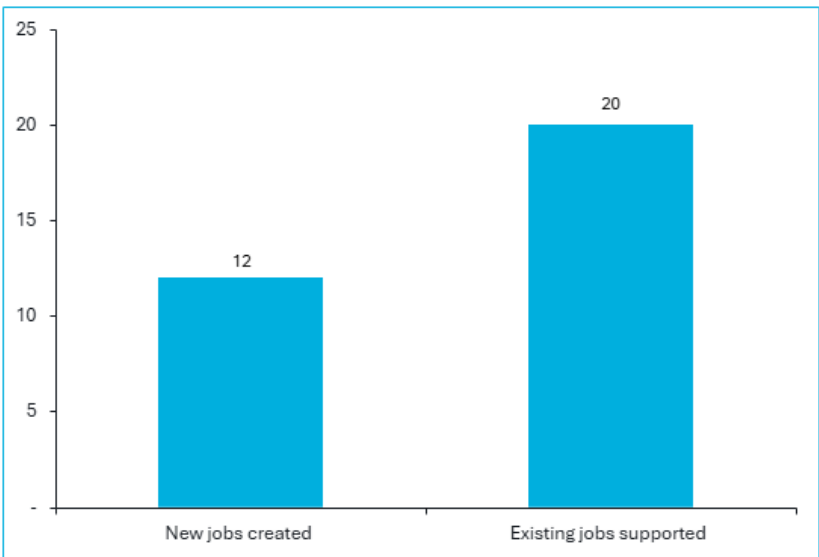
The role of programmes in creating and safeguarding jobs

5.5 FOAK projects have reported clear, positive employment outcomes. Wave 2 (shown in Figure 5-2) and Wave 3 survey data showed:

- **Job creation:** 12 of 26 Wave 2 survey respondents reported that the FOAK programme created new roles within their organisations (echoed by 10 of 23 respondents in Wave 3).
- **Job safeguarding:** 20 of 26 Wave 2 survey respondents reported that the FOAK programme supported existing jobs (supported by 16 of 23 respondents in Wave 3).

5.6 IMS data corroborates these findings, with 14 of 18 Wave 2 respondents and 24 of 25 Wave 3 respondents expecting additional full-time equivalent (FTE) roles as a result of FOAK participation.

Figure 5-2: Number of new jobs created and existing jobs supported by the FOAK programme (n=26)



Source: Wave 2 LMT Beneficiary Survey, Steer-ED analysis (September 2025), Question: Has the project resulted in the creation of new jobs, and/or existing jobs being supported? (Answer options: specify number, Existing jobs supported – specify number, None, Unsure).

5.7 While many beneficiaries reported positive impacts in terms of job creation, one beneficiary, who leads two FOAK25 projects, raised concerns about the long-term sustainability of roles created through the project. Specifically, concerns were expressed regarding the ability to retain staff once project funding ends. The beneficiary suggested that Innovate UK could provide additional post-competition support to help small companies bridge the funding gap and maintain their teams beyond project completion, including through clearer signposting to follow-on funding or more strategic support on staff retention strategies.

Conclusion

- 5.8 FOAK projects have delivered significant benefits to lead and partner organisations by enhancing technical knowledge, embedding improved organisational practices and creating opportunities for upskilling and staff development. In many cases, participation in the programme has strengthened organisational maturity, increased credibility within the rail sector, and accelerated project delivery, while also supporting job creation and safeguarding existing positions.

6 Impacts on wider framework conditions and long-term outcomes

Key Messages

- FOAK has strengthened credibility and trust in new technologies through operational demonstrations, affiliation with Innovate UK and partnerships with trusted organisations.
- Technology adoption faces challenges, including funding constraints, regulatory barriers and market uncertainties.
- Regulatory influence by FOAK has been limited, but emerging developments including Global Centre of Rail Excellence (GCRE) and Great British Rail (GBR) may provide future opportunities for longer-term demonstrations and simplified procurement.
- Early benefits from FOAK projects include reduced carbon emissions, improved safety, enhanced passenger experience, operational efficiency, financial savings and potential for international and multi-modal deployment.

Introduction

- 6.1 This chapter discusses the role that projects have played in affecting trust in, and adoption of, new technologies, plus contributions to the regulatory environment. It then goes on to discuss evidence about potential longer-term outcomes that may be delivered by the portfolio.

The role of projects in driving the adoption of new technologies

- 6.2 Many beneficiaries reported that their FOAK projects have played a significant role in increasing the rail sector's willingness to adopt new technologies. Beneficiaries reported multiple mechanisms through which the programme has facilitated this shift.
- **Strong partnerships and credibility:** Several beneficiaries reported that affiliation with IUK and collaboration with established, trusted organisations, including Network Rail, has enhanced the credibility of FOAK-supported technologies. While one beneficiary observed that this growing trust coincided with their organisation securing contracts with well-known operators, the commission collected limited independent evidence to confirm that these partnerships directly drove wider adoption of new technologies.

“[Industry stakeholders] trust the fact that we have been backed by Innovate UK... and then thereafter because we partnered with Network Rail...a very trusted name as well.” - Wave 2 FOAK beneficiary

- **Proof of concept and demonstrations:** The trial phase of FOAK projects emerged as a crucial enabler for adoption. Demonstrating technologies in operational settings allowed stakeholders to validate performance, reliability and usability. Beneficiaries consistently emphasised that trials helped overcome early concerns, particularly for innovations involving AI or automated processes.

6.3 Alongside these strengths, beneficiaries identified several key challenges around technology adoption:

- **Funding constraints:** A few beneficiaries reported that high upfront costs associated with embedding new technologies is a key challenge; in particular, if there are subsequent resulting effects from the requirement to update other outdated hardware or software. While innovations often promise long-term savings or efficiency gains, beneficiaries reported organisations find these initial expenses to be “*quite daunting*,” prompting some to explore alternative business models, including subscription-based approaches.
- **Regulatory and structural barriers:** Some beneficiaries highlighted structural constraints, noting that while TOCs show interest in new technologies, decision-making authority often sits with GBR and must align with its strategy. Others noted that regulatory frameworks for emerging technologies, particularly AI and drone applications, are relatively immature and still developing. They noted that clearer policy support and successful use cases will make the application and approvals process easier.
- **Market uncertainty:** Structural changes in the sector, including the re-nationalisation of rail services, create uncertainty for potential clients. Beneficiaries reported that while potential clients have expressed interest in innovative solutions, the lack of clarity regarding future organisational structures and industry bureaucracy make it difficult to secure investment.

“One of the first questions is if it’s mandated by DfT. [...] Some TOCs are hesitant to take on any new products because it might just change [...]. It’s been quite tricky, especially because no one knows what’s happening and its quite hard for us to navigate without that guidance” - Wave 3 FOAK beneficiary

The role of projects in shaping the regulatory environment

6.4 Some beneficiaries noted that FOAK projects have had limited direct impact on environmental regulations to date. This is largely because current regulations are immature or provide little incentive for clients to support advanced environmental innovations, making adoption challenging. Stricter central government regulations or alternative incentives, including performance-based bonuses or government subsidies,

were suggested by stakeholders as potential ways to encourage uptake. One beneficiary also suggested a national strategy led by DfT and GBR would be beneficial. They also proposed that categorising funding schemes like FOAK, according to their contribution to the strategy would help TOCs identify relevant projects and increase their confidence in allocating innovation funding.

- 6.5 Looking ahead, wider developments may influence the adoption of FOAK-supported technologies. The GCRE in Onllwyn, Wales, a new railway infrastructure and technology testing facility, is expected to enable longer-term operational demonstrations, helping to de-risk innovations and build industry confidence. Wider stakeholders were positive about GCRE's potential to support FOAK projects.
- 6.6 The transition to GBR, which will consolidate passenger services and infrastructure under a single public entity, was also noted. Stakeholders were uncertain about GBR's short-term effects on innovation, with some suggesting it may temporarily slow adoption as focus shifts to operational delivery. However, in the longer term, GBR could simplify procurement and create a more coherent environment for innovation.

Case study vignette showcasing how a project has helped to contribute to changes in the regulatory environment

The Trains with Brain(s) project (Appendix D) captured continuous, real-time data on pantograph-OLE interactions and other infrastructure components under actual operating conditions. Previously, data collection relied on manual inspections or infrequent monitoring runs, which were limited in accuracy and coverage. The project introduced image-based analytics and automated monitoring, enabling more precise and representative measurements of pantograph height, wire traversal, acceleration, and other parameters.

FOAK-supported demonstrations generated robust data that has informed regulatory discussions, supporting updates to maintenance and safety standards and enabling a move toward dynamic, condition-based monitoring. These outputs are helping Network Rail explore the shift from manual inspections to more reliable, trainborne monitoring systems and could reshape how standards are applied across the network. Publications such as the White Paper on Mentor Train Force Measurements further reflect the project's influence on working practices, enhancing Transmission Dynamics reputation as a sector leader.

Long-term outcomes

- 6.7 Although the commercialisation of FOAK-supported technologies has been limited to date, beneficiaries identified a range of early and anticipated long-term benefits:
- **Environmental benefits:** Seven (out of 19) Wave 2 survey respondents indicated their technologies have directly contributed to measurable decreases in the carbon impact of transport (and two out of 23 Wave 3 survey respondents). Some beneficiaries also highlighted that their technologies improve air quality in trains, depots and stations, reduce road and rail congestion and reduce the risk of flooding, having positive environmental impacts.
 - **Safety improvements:** Seven (out of 20) Wave 2 respondents indicated their technology enhances transport safety, reducing risks to infrastructure and passengers (and five out of 23 Wave 3 respondents). Some beneficiaries highlighted

that these systems could prevent serious operational incidents, with implications for human safety, wellbeing and asset protection.

- **Passenger experience and accessibility:** 11 (out of 21) Wave 2 survey respondents reported that their products are improving transport reliability (and three out of 23 Wave 3 respondents). Six (out of 20) Wave 2 survey respondents said their product is making transport more inclusive/ accessible (echoed by four out of 23 Wave 3 respondents).
- **Reputational benefits:** Some projects are expected to increase confidence in public transport networks, supporting long term government strategies by encouraging greater uptake of multimodal public transport.
- **Operational efficiencies and financial savings:** Innovations are expected to improve network efficiency, reduce delays, and lower compensation and maintenance costs. Beneficiaries highlighted potential financial savings, noting that delays and bridge strikes currently cost operators millions annually. Longer asset lifespans and reduced maintenance requirements also provide ongoing economic value.
- **Overseas interest:** 13 (out of 18) Wave 2 survey respondents said they are developing solutions which can be applied globally (and six out of 23 Wave 3 respondents). Several beneficiaries highlighted opportunities to adapt solutions for overseas markets or other sectors, including highways, bus networks, CAM, surveillance and healthcare. However, many beneficiaries emphasised the need to embed technologies more widely within the UK before scaling internationally.

- 6.8 Wider stakeholders, while often less sighted on the full FOAK portfolio, reinforced the significance of FOAK technologies in delivering outcomes related to decarbonisation, safety and passenger benefits. They noted that large-scale operational benefits are harder to achieve due to the scale, cost and complexity of implementation, but emphasised digital and AI solutions as areas where FOAK is particularly effective.

Case study vignette showcasing the long-term impacts of one of the technologies being developed

The Trains with Brain(s) project (Appendix D) has improved operational efficiency, safety and reliability on UK railways. Network Rail reports that real-time monitoring of pantographs, OLE, and track components has reduced high-impact incidents by 30% (2018/19–2023/24), saved 17,000 delay minutes over the past 18 months, and cut manual patrolling, contributing to forecasted annual savings of £2.5 million.

Longer-term, the project supports dynamic, condition-based maintenance, extends asset life, and reduces service disruptions. Environmental benefits are expected as improved reliability encourages a modal shift to rail and lowers the carbon footprint of maintenance operations. In addition, FOAK enabled Transmission Dynamics to commercialise a technology with the potential to influence industry practices and standards (see previous case study vignette showcasing how a project has helped to contribute to changes in the regulatory environment).

Conclusion

- 6.9 The evidence generated suggests that FOAK projects have played an important role in increasing the trust in, and adoption of, new technologies within the rail sector. Beneficiaries highlighted that strong partnerships, credible backing from IUK and

operational trials have been critical in demonstrating the value and reliability of innovations. While regulatory influence has been limited to date, developments including GBR is expected to create more of an environment for innovation. In regard to longer term benefits, early evidence indicates that FOAK-supported technologies are beginning to deliver outcomes, including:

- Environmental improvements.
- Enhanced safety.
- Operational efficiencies.
- Improved passenger experience.
- Reputational benefits for the rail sector.
- Potential international and multi-modal applications.

7 Conclusion & Next Steps

Key Messages

- Overall, the evidence suggests that the FOAK programme is delivering positive outputs and outcomes, including innovative technologies, knowledge development and dissemination and enhanced organisational capacity and capability.
- Commercialisation and wider adoption of technologies has been limited to date. This highlights the ongoing challenge of translating proof-of-concept and operational demonstrations into sustained market uptake and business as usual.
- FOAK has successfully supported technological progression, helping the majority of projects advance through TRL stages, generate intellectual property, produce technical outputs and demonstrate proof of concept through live demonstrations.
- Barriers to commercialisation and adoption include fragmented and opaque procurement processes that are often unsuitable for SMEs, limited investment appetite, market uncertainty, occasional misalignment between competition themes and industry priorities, and cultural resistance within operational teams. Enablers have included CFI funding, operational trials, monitoring support, networking events, and early engagement with potential clients.
- Opportunities to enhance long-term impact include supporting data-driven and AI innovations, passenger-facing technologies, and decarbonisation initiatives. Achieving sustained adoption and commercialisation will require clearer commercialisation pathways, stronger alignment with industry priorities, and more effective brokering between innovators and industry

Summary of monitoring findings

- 7.1 This report is structured around the LMT portfolio logic model, which is divided into five themes: programme delivery; partnerships and collaboration; technology development, deployment and commercialisation; skills development; and wider framework conditions. The key findings from the monitoring commission in each of these areas are set out below.
- 7.2 The FOAK programme supported 70 projects across FOAK22 and FOAK23, with £16 million in funding and an average award of £230,000 per project. Beneficiaries were predominantly SME-led, with partnerships including TOCs, supply chain companies and academic organisations. Projects ranged from three months to nearly two years in duration, with an average project length of 8 months, and addressed a wide array of

innovation areas, including decarbonisation, digital and AI-enabled solutions, passenger experience enhancements and maintenance automation.

- 7.3 IMS monitoring data indicates that the majority of projects met their planned milestones, with any slippage typically linked to practical constraints including site access, specialist components, or third-party dependencies rather than technical feasibility. The majority of beneficiaries consistently reported that FOAK facilitated progression through TRL with several projects advancing by multiple TRL stages. Intellectual property creation, technical outputs, and operational demonstrations were key indicators of knowledge generation, while live trials and collaborations with operators helped establish proof of concept and credibility within the rail sector.
- 7.4 Partnerships were generally strengthened during project delivery. Early involvement of train operators, technical partners and supply chain organisations helped ensure projects were deliverable and aligned to market needs. Beneficiaries highlighted commercial opportunities arising from these relationships, including follow-on contracts, new client engagement and improved market position.
- 7.5 FOAK also contributed to organisational maturity and skills development. Beneficiaries reported that participation enhanced technical knowledge, project management capability, and market awareness. Projects created new roles and safeguarded existing jobs, while also providing staff with opportunities to take on leadership and specialist responsibilities.
- 7.6 Evidence on additionality indicates that FOAK played a critical role in enabling these benefits. The majority of beneficiaries reported that FOAK de-risked projects, with many stating that their projects would not have progressed as quickly, or in some cases, at all, without FOAK funding. Even where projects could have proceeded independently, the programme accelerated development, increased organisational capacity, and allowed more ambitious work than would have been possible otherwise. FOAK also facilitated the creation and strengthening of collaborative network with innovators, operators and the supply chain, generating commercial opportunities and partnerships that might not have arisen without FOAK support. This suggests that FOAK not only advances technologies but also enhances industry skills, organisational capability and collaborative networks.
- 7.7 Barriers to commercialisation and adoption were mainly practical and structural. Fragmented and opaque procurement processes, often unsuitable for SMEs, hindered contract opportunities and scaling beyond proof-of-concept. Earlier FOAK competitions with broad themes sometimes misaligned with industry priorities, producing technically strong but commercially less attractive innovations. Cultural resistance within operational teams, especially in safety-critical environments, further limited adoption.
- 7.8 Enablers included operational demonstrations, clearly defined objectives with KPIs and evaluation evidence, and early engagement with genuinely interested potential clients.

Next steps for the programme

- 7.9 Stakeholders highlighted several areas where future FOAK delivery could increase impact and accelerate adoption of innovations.
- 7.10 Stakeholders highlighted the potential for FOAK to play a greater role in data-driven innovation, including AI and automated decision-making. As data collection in the rail sector becomes increasingly sophisticated, FOAK is well-placed to support projects that

exploit these datasets to improve business processes, operational intelligence, risk management and decision-making. To maximise impact, future competitions should focus on clearly defined, high-value problems where AI and automation can deliver tangible benefits, rather than broadly exploring all possible applications. FOAK25 reflects this approach, but further refinement of problem focus and alignment with industry priorities will ensure that projects address real, industry-recognised challenges.

- 7.11 Passenger-facing technologies also remain a priority. While FOAK has contributed to improvements in accessibility, reliability, and user experience, the current landscape remains fragmented, and many technologies are still at an early stage of development. Future delivery could focus on coordinating efforts across the sector, reducing duplication, and integrating innovations developed outside FOAK. FOAK25, which target platform-train interfaces, is expected to support this, with GBR's simplification initiatives providing additional opportunities for sector-wide alignment.
- 7.12 Decarbonisation technologies were identified as a successful area of FOAK activity. These initiatives typically involve fewer stakeholders and simpler operational pathways, increasing the likelihood of commercialisation and adoption. Building on this success, the programme should continue to support high-impact environmental innovations, ensuring that promising technologies are effectively demonstrated and de-risked for the market.
- 7.13 Future competitions should also be designed with strategic alignment in mind. Challenge statements and themes should closely reflect industry priorities as outlined in documents including the Rail Technical Strategy and guidance from the DfT, GBR and RSSB. Early engagement with operators and other stakeholders is essential to ensure that competitions target genuine market needs.
- 7.14 A recurring theme among beneficiaries and wider stakeholders was the need for stronger commercial pathways and client engagement. Beneficiaries highlighted that support for contracting and commercialisation with public-sector clients including Network Rail would help innovations progress beyond the prototype stage. Establishing dedicated advisory support alongside FOAK and facilitating closer collaboration between innovators and end users, would enable clearer routes to procurement and adoption. Wider stakeholders, including potential FOAK clients, suggested aligning procurement planning with FOAK development timelines to reduce risk for SMEs, while additional funding targeted at commercialisation could bridge the gap between product development and market integration.
- 7.15 Finally, stakeholders emphasised the importance of increasing visibility and knowledge-sharing. FOAK could play a more active role in brokering connections between innovators, industry partners and investors. This could include networking events that showcase innovations and their real-world potential.

Recommendations for future evaluation

- 7.16 Many of the most significant impacts of the FOAK programme are likely to emerge over the medium to long term, as projects transition from demonstration to market integration. Continued evaluation beyond the immediate delivery window is therefore essential to capture these effects and to understand the full value of the programme.

- 7.17 Future evaluations should place greater emphasis on commercialisation challenges, tracking how innovations progress from live demonstrations to adoption, and identifying barriers that limit uptake. Sharing these insights more widely across the rail sector could help address the current low visibility of FOAK commercialisation and broader impacts.
- 7.18 FOAK25 removed the previous requirement for a letter of support from a senior individual at a railway organisation with potential to become a customer. At present, wider stakeholders are uncertain about the impact of this change on commercialisation. Some suggested that the letters may have been ineffective, either by creating unrealistic expectations of guaranteed commercialisation or by lacking contractual obligations to secure genuine customer commitment. The implications remain unclear, and the effect on commercialisation should be explored in future evaluations to determine whether this change acts as an enabler or a barrier to adoption.
- 7.19 An economic impact assessment is also needed to explore growth of SMEs, commercialisation outcomes, inward investment, and export opportunities. Capturing these indicators, alongside supply chain development and follow-on finance, will be critical to assess the programme's contribution to sector productivity.

Appendices

A Sources of evidence utilised

Monitoring data analysis

- A.1 Three forms of programme monitoring data are captured by IUK and were provided to Steer-ED for analysis, as described below.

1) Applicant information data

- A.2 Basic ‘demographic’ data covering organisations awarded funding. The data includes the beneficiary’s name, project name, project description, competition programme, the total amount of funding, which was initially bid for, the grant funding amount provided, project start and end date.

2) Quarterly Monitoring Scores (QMS) monitoring reports

- A.3 Quarterly assessments undertaken by external MSPs; typically, industry professionals who are knowledgeable about the technology in question and are contracted to provide an independent assessment of project progress on a quarterly basis. Their assessment covers the project’s scope, time, cost, exploitation, risk, and project management. Officers score each of these project aspects as well as providing commentary as to the reasoning behind their scores.
- A.4 For Wave 3, QMS data was only provided for five programmes; CCAM, FOAK (2025 specifically), TVH, Maritime and ZEHID.

3) IUK’s impact management system (IMS)

- A.5 IMS is a data collection system which, at the time of writing, is being rolled out across all IUK programmes. It captures data upon project commencement, during project delivery, and following project completion, and is provided in the form of short-answer multiple choice, quantitative, or character-limited free-text responses. It covers subjects including patents, technology progression and partnerships (amongst others).
- A.6 For Wave 3, IMS data was provided for only three programmes: CCAM, FOAK (2025 specifically); CCAM; and Maritime.
- These programmes had additional data available in Wave 3 and this information was therefore included within this Monitoring Report (as text updates rather than generation of new graphs).
 - It should also be noted that the data available varied across these four programmes, with fewer questions being asked of FOAK beneficiaries compared to CCAM beneficiaries. We anticipate additional data from IMS will be available for subsequent monitoring activities.

Analysis of secondary data sources

- A.7 Three sources of secondary data were explored for inclusion within this document:

Crunchbase

- A.8 To further explore whether businesses participating in LMT programmes are attracting external investment, and whether LMT participation aligns with investment-raising events, Technopolis have made use of Crunchbase – a platform that provides information on businesses and funding events.
- A.9 Of the ~430 unique organisations participating in LMT projects (at the time of undertaking Wave 2 analysis), Technopolis were able to identify 215 (50%) in Crunchbase (the remainder were mainly public orgs and universities). Of these, 88 have one or more instances of securing external funding (251 deals in total, 2010- July 2025). Crunchbase provides details on the type of funding, the date and the financial amount.
- A.10 Findings evidenced that investment/ funding activity was relatively low pre-project participation, and increased gradually, peaking during IUK LMT project period — with the highest number of investment/funding rounds in 2023 (63). This suggests a clear increase in funding and investment round announcements following the start of IUK LMT project participation.
- A.11 Table A-1 shows the different types of funding / investment round that are captured.

Table A-1: Funding / investment round

Investment Type	Number	Investment Type	Number
Grant	131*	Non-equity assistance	4
Seed	28	Post-IPO debt	5
Pre-seed	7	Private equity	3
Series-A	16	Series-B	6
Equity crowdfunding	5	Corporate Round	2
Convertible Note	2	Series-C	2
Debt Financing	7	Undisclosed / Unknown	28
		Grand Total	251*

Source: Technopolis Crunchbase data, 2025. *Note: 13 LMT grants are included, which have then been removed from the subsequent analysis.

- A.12 For the 88 companies with funding data, Technopolis have tracked deals (both volume and value) over time at the company level. Technopolis have analysed the total number and value of deals for each company since the start of their LMT project, and then also compared this with the number and value of deals achieved in an equivalent period prior to the project start date (i.e. if the LMT project started two years ago, Technopolis has compared the two years, pre- and post- this start date).
- A.13 At the overall portfolio level, this reveals:
1. LMT participants have achieved 110 deals since their project started. This is 43% higher than the 77 deals they achieved in the same length of time before project start.
 2. LMT participants have achieved deals worth \$4.7bn since their project started. This is more than five times higher than the \$0.8bn achieved in the same length of time before project start.
 3. On average (per company, amongst these 88), organisations have secured 1.3 deals worth \$52.9m since project start, and 1.0 deals worth \$9.7m in the same period before.

- A.14 An additional, updated analysis was also undertaken in Wave 3 for the Maritime and FOAK programmes, covering the period 2018 to the end of 2025. This update also included the additional 26 FOAK projects awarded in 2025.

Meltwater analysis

- A.15 To assess the public dissemination of LMT projects, a structured search of media output was conducted using Meltwater, a media monitoring and analytics platform. The data collection for each project covered the one year period from 12 August 2024 to 12 August 2025, capturing online news and print, as well as social media activity on platforms, blogs, and forums. An additional, updated analysis was also undertaken in Wave 3 for the Maritime and FOAK programmes, covering the period from 30 January 2025 to 29 January 2026. This updated analysis also includes 26 FOAK projects awarded in 2025.
- A.16 For accuracy, search queries were tailored for each project by combining project titles or acronyms with lead organisation names, and articles were manually screened to remove irrelevant results. The search process also involved an iterative refinement of keywords to ensure that retrieved content was directly attributable to the projects.
- A.17 Meltwater's metrics enabled assessment of both the quantity and quality of media coverage. Estimated views gauged the average exposure of articles, reach measured the potential audience size, and engagement captured interactions across platforms including Facebook and Twitter. These data points were collected for each project and aggregated at the programme level, providing a comprehensive overview of LMT projects' media performance.

Dimensions

- A.18 Dimensions is a comprehensive research database that provides patent and publication data. The LMT projects were identified within the Dimensions dataset. However, only FOAK of the seven programmes were associated with patents and only FOAK and CCAM were associated with publications within the dataset.
- A.19 As not all the programmes were associated with patents and publications from the dataset, there is some discrepancy to self-reported information from project beneficiaries which will be further explored with the Dimensions team. Dimension data has therefore only been included for programmes where patents and publications have been linked.
- A.20 It should be highlighted that for Wave 3 specifically¹⁰:
- A dimensions search was done for FOAK 2025, however there was no data regarding linked patents or publications for these. This is likely due to Rail awards are quite recent compared to the Maritime awards and are subsequently yet to be added to Gateway to Research.
 - A dimensions data search was also undertaken for Maritime.

Beneficiary survey

- A.21 An online survey of beneficiaries was developed and distributed to all project beneficiaries during each of the research Waves across the full portfolio, amounting to 582 recipients. Both project leads and partners were invited to complete the survey,

¹⁰ This data was based on metadata [as of 01/09/2025 for Wave 2 and 10/02/2026 for Wave 3] from Digital Science's Dimensions platform, available at <https://ukri.dimensions.ai/>. Access was granted under licence agreement with UKRI.

meaning that multiple responses could be captured from each project. The survey included a range of multiple choice and free text questions and allowed for the gathering of valuable additional data beyond the core data collected by IUK via IMS, QMS monitoring reports and applicant information data.

- A.22 Unique surveys were created for each programme and whether a beneficiary had responded in the previous Wave. The number of questions therefore varied slightly between programmes and whether a beneficiary had responded in the previous Wave. However, the core survey questions remained consistent between programmes and whether a beneficiary had responded in the previous Wave.
- For Wave 1: The survey was open for a period of approximately three weeks from 15 July 2024 to 3 August 2024 (for six programmes) and for approximately four weeks between 16 September 2024 to 11 October 2024 for the TDD programme. Overall, the survey was issued to 464 recipients across the portfolio (236 responded).
 - For Wave 2: The survey was open for a period of approximately six weeks from July to September 2025, issued to 220 recipients across the portfolio (145 responded).
 - For Wave 3: The survey was open for approximately four weeks between January and February 2026, issued to 347 recipients across the portfolio (201 responded).

- A.23 Table A-1 shows the beneficiary survey response rates and number of responses from unique organisations within each of the seven programmes.

Table A-1: Beneficiary survey response rates and overall number of responses (all Waves)

Programme	Number of responses	Number of beneficiaries sent the survey	Response rate
ZEHID	85	125	68%
CCAM	146	179	82%
Hydrogen	26	29	90%
FOAK	74	102	73%
Maritime	196	481	41%
Net Zero propulsion	28	76	37%
TDD	27	39	69%
Total	582	1,031	56%

Source: Steer-ED survey response analysis, 2026

- A.24 Across the LMT portfolio, the beneficiary survey achieved the following project response rates per Wave:
- Wave 1 = 51%, which is still considered good representation.
 - Wave 2 = 66%, which is still considered good representation.
 - Wave 3 = 58%, which is still considered good representation.

Depth interviews with beneficiaries and wider stakeholders

- A.25 The qualitative research component comprised one-hour depth interviews conducted with programme beneficiaries and a selection of wider stakeholders. The interviews were held using MS Teams and were guided by a topic guide.

Beneficiary interviews

- A.26 As Table A-1 shows, a total of 183 interviews were undertaken with project beneficiaries (project leads, and in some cases project partners) during the three-year LMT research period, split per Wave as follows:
- Wave 1 – 70 interviews.
 - Wave 2 – 61 interviews.
 - Wave 3 – 52 interviews.
- A.27 The number of interviews undertaken varied by programme, in accordance with the number of stakeholders involved in the programme. The ZEHID and CCAM programmes were a key focus for beneficiary interviews due to the substantial number of beneficiaries participating in these initiatives.

Wider stakeholder interviews

- A.28 Interviews with wider stakeholders took the same format and were conducted with a selection of knowledgeable industry stakeholders (from both commercial and academic institutions), based on recommendation by IUK and programme sponsors. These interviews were conducted over the three-year research period under the LMT portfolio. As Table A-1 shows, a total of 118 interviews with wider stakeholders were completed across all three research Waves combined.
- Wave 1 – 53 interviews.
 - Wave 2 – 50 interviews.
 - Wave 3 – 15 interviews.
- A.29 Priority was given to programmes with the largest funding allocation, and therefore ZEHID and CCAM were a key focus for wider stakeholder interviews.

Summary

Table A-1: Beneficiary wider stakeholder interviews (all Waves)

Programme	Number of Beneficiary Interviews	Number of Wider Stakeholder Interviews
ZEHID	24	27
CCAM	52	18
Hydrogen	11	16
FOAK	29	16
Maritime	38	22
Net Zero Propulsion	18	9
TDD	11	10
Total	183	118

Source: Steer-ED interview analysis, 2025

Interview notes and analysis

- A.30 All interviews were recorded and transcribed using the automatic transcription facility on Microsoft Teams. A note-taker also attended each interview and took detailed notes of the conversation between the interviewer and the interviewee.

- A.31 Following the interview, the notes taken by the note-taker and any notes taken by the interviewer were either manually coded or analysed using qualitative analysis software, Atlas.ti. Both forms of analysis were guided by a coding frame aligned with the study's research questions and topic guide to ensure consistency. Coding was conducted by the programme leads and project team support to ensure consistency and reduce bias, with openness to emerging themes.
- A.32 Learnings from these interviews, supported by quotations, have been provided throughout this report.

Case studies

- A.33 A total of 21 case studies have been developed for the monitoring commission (two, three or four case studies for each programme). These are presented as vignettes within the report and as separate full write-ups within remaining parts of the appendices. The case studies were developed through interviews with project leads and supporting desk research. All case studies have been reviewed by the programme's independent panel of subject-matter experts, selected for their expertise in relation to the programme or technology in question. This provides a valuable external perspective on the importance and potential long-term impact of the technology in question.

B Case study: PROLECT - Protection and Resilience for Overhead Line Equipment using Computer Vision Techniques

Introduction	
Project Value	£247,115
Project Duration	6 months
Start date	October 2022
End date	March 2023
Context & Objectives	
Project summary	The "Protection and Resilience for OLE using Computer Vision Techniques" (PROLECT) project was funded through the FOAK 2022 competition, under the theme of cost efficiency and performance prioritisation for a reliable railway. The PROLECT project aimed to target maintenance and monitoring of overhead line equipment (OLE) on electrified trains and received FOAK funding for two use cases. For the first use case, the project aimed to mitigate the impact of high temperatures on OLE wires, which expand and droop in hot weather, disrupting electrified train routes. By using machine learning algorithms, the project optimised means of measuring the placement of balance weights captured in train borne video imagery, in efforts to assist engineers to keep the wires taut based on temperature. This solution - now supported by Network Rail R&D - has been deployed across hundreds of miles train track. For the second use case, PROLECT sought to address structural risks caused by electrical discharge on damaged or dirty OLE; the project installed a Corona monitoring camera, which detects discharge using UV light. Despite some delays to implementation the technology is receiving further funding from Network Rail's OLE Engineering team and will be installed on in-service trains within six months, with full commercialisation expected in a year.

Context	PROLECT addresses two key maintenance challenges OLE: • Rising external temperatures cause OLE wires to expand and droop, leading to service restrictions, delays to customers, and financial losses. As global temperatures increase, ensuring the reliability of OLE infrastructure becomes more critical for the railway network. • High-voltage OLEs can suffer from corona discharge—dangerous electrical discharges from damaged or dirty components, which can lead to fires. Early detection with the corona camera allows problem areas to be quickly identified and isolated, minimising service disruption and improving safety for engineers. An industry expert highlighted the need for increased resilience, especially with increased pressure on operational budgets and climate challenges. Automated maintenance technologies like PROLECT’s machine learning-based balance weight placement and automated detection technologies like corona cameras can help address these concerns by preventing disruptions and reducing manual interventions. PROLECT’s approach offers more targeted, condition-based maintenance, potentially improving reliability, reducing downtime, and enhancing passenger safety.
Objectives	The key aims of the project were: • Reduce downtime of OLE lines, by improving maintenance processes and assisting engineers to prevent issues like drooping OLE wires or corona discharge. The project aimed to create a more reliable service with fewer disruptions, benefitting passenger experience, freight and generating overall industry cost savings. • Reduce the need for engineers to work on live high-voltage infrastructure, improving their safety by replacing manual maintenance with machine systems. • By automating the inspection and maintenance process, the project aimed to reduce the need for engineers to travel to sites, cutting down on vehicle emissions. • Increase the resilience of the electrical transport infrastructure to rising temperatures.
Project Activities	

	FOAK funding supported live demonstrations of the PROLECT technology on trains and fixed infrastructure, which were delivered through six work packages over six months: • Work package 1 setup and stakeholder engagement: project initiation, stakeholder engagement, and preparing documentation. • Work package 2 requirement analysis, interface design, and procurement: designing the computer vision systems, mitigating design risks, submitting designs to train operators via engineering change requests, and procuring corona camera equipment. • Work package 3 detection and positioning: footage from the system was reviewed and interpreted for both use cases, and the machine learning model was programmed. • Work package 4 camera installation: The camera was installed, ensuring the train ran smoothly and the footage collected was valuable. • Work package 5 demonstration: event at Westminster with Rail Industry Association, followed by the production of an evaluation report. • Work package 6 business case and exploitation plan: included analysis of the technologies' commercial viability and establishing a future exploitation plan. In terms of key challenges, the time to acquire the camera was originally quoted at three months which would have caused delays to implementation, but this was negotiated with the supplier and brought forward. Once delivered the camera was faulty, however the supplier personally flew the camera to and from their headquarters to ensure it was fixed. The train in which the Corona camera was installed unexpectedly had to undergo maintenance shortly after installation and led to project delays. For the balance weights as well, the initial input data into the model was not 100% accurate, whilst this was not initially realised by the engineers, however it was later diagnosed and rectified. Despite challenges, the balance weights element has been very successful, and the corona cameras has plenty of potential, the team also successfully met critical timing milestones, including the installation and testing dates. Strong partnerships were developed with Network Rail engineers (from Northwest and Central Region), Angel Trains (the rolling stock company), and OFIL Systems (camera manufacturer). The collaborative working amongst stakeholders was an important factor in the project's success. The involvement of industry experts was essential for the technology's development and commercialisation. The involvement of these industry experts also supported the technology's commercialisation after FOAK by providing further R&D funding for both products. The FOAK experience was highly positive. Having access to technical rail experts through the IUK team enabled One Big Circle to engage with a broader range of stakeholders and ask challenging questions.
Outcomes & Impacts	
Outcomes	The project has resulted in significant technological advancements. The balance weights model developed during the project represents one of the first

	One Big Circle technologies to utilise frame-by-frame analysis, allowing for greater detail to be captured in high-speed environments. This innovative technology has since been applied to other projects. One Big Circle has also significantly boosted its internal research and development spending. The company is now able to fund its own R&D projects, allowing for the development of new software and hardware solutions while taking on more innovative risks. The PROLECT project was also reported to have significantly enhanced One Big Circle's market position and technological capabilities. It provided opportunities for the company to connect with new suppliers and expand into EU markets, broadening its business reach. Additionally, the project's success contributed to organisational growth, with an increase from 25 to 58 employees.
Impacts	PROLECT is reported to have impacted the safety, efficiency and sustainability of railway operations, through the roll out of balance weight modelling technology. This technology will create a more reliable service with fewer disruptions, delivering direct benefits to passengers and freight and generating cost savings. It will also enhance the climate resilience of rail networks and reduce carbon emissions, as a result of the automation of maintenance processes. The external expert emphasised the significance of the technological advances made by PROLECT, particularly the balance weight system, which automates a key maintenance survey process. In the broader context of OLE maintenance, this innovation could reduce service disruptions due to temperature-induced wire expansion, a major cause of train delays. Additionally, by integrating the corona camera for detecting dangerous discharges, the technology has potential to enhance the safety of rail operations, potentially reducing both the frequency and severity of failures in electrified systems. From an operational standpoint, PROLECT has the potential to greatly improve efficiency. As noted by the expert, targeted maintenance can minimise unnecessary interventions, reduce delays and improve train punctuality. Furthermore, automating these processes reduces the need for engineers to work in dangerous, high-voltage environments, directly enhancing worker safety. However, any changes may take time to embed as there is necessarily a need to ensure that changes to activity are providing long-term benefits, and that the accompanying processes, and competency management are fully updated and aligned. Environmentally, the project aligns with the industry's push toward decarbonisation. The biggest impact is likely to arise from greater train service reliability acting to support mode transfer to rail from modes with higher per passenger emissions. Also, by cutting down on manual maintenance trips and optimising the condition of OLEs, the technology reduces carbon emissions related to maintenance processes. Furthermore, the expert pointed out that climate resilience—ensuring infrastructure can handle rising temperatures—is

	increasingly important as the railway sector seeks to adapt to the effects of climate change.
Additionality	Without the PROLECT project, the balance weight technology would likely still have been developed, as it relied on existing footage and incurred relatively low costs. The CFI funding and project however were critical for advancing the corona camera technology. The upfront procurement cost for the corona camera was substantial, at ~£50,000, and there was no existing data from on board vehicles available prior to its development. This lack of data increased the project's risk for One Big Circle, making the support from the CFI funding essential for developing the technology.
Successes and lessons learnt	
Key lessons	The success of PROLECT was driven by strong collaboration with key stakeholders like Network Rail engineers, Angel Trains, and OFIL Systems. These partnerships combined diverse expertise to ensure the technology met rail industry needs and bridged knowledge gaps, aiding the development and commercialisation of the technology. However, the expert partner that was interviewed in relation to the case study project, pointed out that even when new technology, like PROLECT's corona camera, functions as intended, operational processes often lag. Ensuring these technologies lead to tangible changes in maintenance practices will be key to their long-term success. Understanding the broader industry context, especially balancing efficiency with cost constraints, will be vital for scaling PROLECT. Continued financial support from Network Rail post-FOAK is essential to overcoming commercial challenges. Potential barriers to widespread deployment include high implementation costs. OLE failures, while infrequent, are very costly, making justifying the expense difficult without clear immediate benefits. User trust and adoption also pose a challenge, therefore, gaining user confidence and demonstrating reliable performance will be critical for PROLECT's success.
Next Steps	The balance weight model has been fully commercialised and is now deployed on Network Rail systems. The corona camera is receiving additional funding for commercialisation from Network Rail. Over the next six months (by January 2026), this technology will be installed on in-service trains, with plans for full commercialisation expected within a year.

C Case study: Cross Freight

Introduction	
Name of case study project	Cross Freight: Automating freight access right management and spot bidding using novel and modern software to drive modal shift from road to rail
Project Value	£322,420 (inc VAT)
Project Duration	9 months
Start date	October 2022
End date	June 2023
Context & Objectives	
Project summary	The “Automating freight access right management and spot bidding using novel and modern software to drive modal shift from road to rail” project was funded through the FOAK 2022 competition, under the theme of rail freight. The FOAK-funded project delivered Cross Freight, a modern software system that consolidates multiple data sources into a single, robust platform. Cross Freight enables freight operators and Network Rail Freight Account teams to manage access rights efficiently and quickly identify unused capacity. By replacing manual processes, which were essentially an array of varied excel spreadsheets across organisations, with a scalable, robust, digital system, the project also has the potential to deliver multi-million-pound efficiency savings, grow the freight industry, improve data integrity and streamline decision-making. Ultimately, the project led by CrossTech (Hack Partners Limited), aimed to build a user-focused software system that could handle complex and messy legacy data, automate key processes, and enable more efficient freight operations.
Context	The project addressed a national strategic priority to grow freight on the rail network, as set out in the National Freight Strategy. An industry expert emphasised the need to encourage a shift from road to rail transport. For this to succeed, rail freight must continually demonstrate that it can offer a reliable and flexible option that can move goods at short notice. Engagement with Freight Operating Companies (FOCs) and Network Rail revealed that freight access rights were managed using multiple spreadsheets in different formats, an outdated method, creating inefficiencies and limiting scalability. There was a clear need for a digital, automated system to manage capacity, identify underutilised access

	rights and facilitate the growth of rail freight. The project addressed this by taking on multiple, different data feeds, amalgamating them in a scalable, robust way and then delivering software to the different user groups across the industry to streamline how access rights are managed.
Objectives	The key aim of the project was to: • Build a modern freight access right management system, integrating user needs to generate efficiency savings for the industry.
Project Activities	
	FOAK funding supported a live demonstration of the technology, which were delivered through several work packages: • Software development and data engineering: Building the core system architecture and data models, incorporating multiple industry data feeds. • User engagement: Running workshops to understand user needs and iteratively refining the system. • Data science: Designing algorithms to handle messy, disparate legacy data, ensuring robustness and scalability. • Pilot testing: Conducting 6–8-week trials with freight teams, collecting feedback to refine functionality. • Integration: Connecting the system with open data platforms and marketplace feeds to ensure accurate, real-time information. • Demonstration and evaluation: Showcasing the tool to the industry, gathering insights, and formalising findings in reports. Challenges during development included poor-quality and inconsistent data and overcoming cultural resistance from stakeholders accustomed to legacy processes. Despite these obstacles, Cross Freight was successfully developed, trialled, and commercialised, with adoption by Network Rail and ongoing development to expand its capabilities. The FOAK experience was highly positive, providing access to commercial stakeholders, live trial opportunities and early user feedback which allowed for iterative development.
Outcomes & Impacts	
Outcomes	The project successfully delivered a baseline product that has been commercialised with Network Rail and is now in national use. Building on this foundation, the technology continues to evolve through ongoing development and further investment. At its core, the system provides a digital platform to manage freight access rights, offering a single source of truth that allows users to quickly identify conflicts and uncover new service opportunities. By leveraging advanced data science and machine learning techniques, the platform transforms disparate and legacy datasets into a modern, robust digital system, improving operational efficiency and knowledge management across the industry.

	The project has delivered tangible commercial and operational benefits. For Network Rail, it has generated efficiency savings, created revenue opportunities by enabling additional freight services and contributed to the broader objective of increasing rail freight capacity and promoting a modal shift from road to rail. A key challenge, however, lies in driving the behavioural change needed to encourage this modal shift, particularly by ensuring that rail can demonstrate its credentials as reliable option. Cross Freight plays a role in supporting this transition, which could take many years and depends on several external factors, including fixed timetabling, fuel prices and broader costs associated with powering units. An industry expert emphasised that although the technology could be seen as being a very pragmatic means to provide the features, and benefits to offers the deliver significant operational and efficiency gains for the end user. They noted that it seemed that the product was focused on end-user benefits. For Hack Partners, the project has safeguarded three jobs, supported partnership development (they now have partnerships with 7/8 FOCs), and established a foundation for expansion into other areas of railway operations and potential international markets. New partnerships have also led to subsequent revenue-generating projects. FOAK's exhibitions and networking events have been instrumental in showcasing the technology and building industry connections.
Impacts	The project establishes a foundation to support long-term transformation in freight operations, creating opportunities to drive lasting efficiency improvements across the industry. The product enhances revenue generation and efficiency for freight operations, with the potential to expand into other core railway functions, improving industry-wide efficiency and delivering better services to end users. For Network Rail, it enables increased freight capacity, generating ongoing revenue while streamlining operational processes. An industry expert supported the applicability to scale this technology across Network Rail. CrossTech have invested £300,000 in further product development, positioning the platform as a core growth engine in a new product domain, providing market diversification and significant future growth potential.
Additionality	FOAK funding was critical to the success of the project. Without it, the risk of development would have been too high, and access to key, commercial stakeholders would not have been possible. The support of commercial stakeholders was key to maintaining momentum.
Successes and lessons learnt	

Key lessons	Key lessons from the project include the importance of iterative development and close user engagement for software success. Legacy data quality and organisational resistance can create barriers that must be managed through technical solutions and relationship management. Additionally, software requires continuous development, testing, and refinement to remain effective. Aligning software development cycles with traditional procurement models is a challenge, but necessary to deliver value in the rail industry. The project has strongly welcomed the DfT and IUK’s focus on system interfaces, recognising it as highly valuable problem to solve. A key future area of focus will be engaging both the FOCs and firms that contract FOCs to deliver their product. This will require strong relationship management and clear demonstration of the benefits of new processes and technologies to encourage adoption as well as an awareness of the external factors that may support or create barriers to this modal transition. An industry expert highlighted that CrossTech will need to work closely with Network Rail and FOCs to gather feedback and develop the technology iteratively. They noted it is encouraging that CrossTech has committed to further investment to explore new functionalities and improvements.
Next Steps	As an initial product, Cross Freight has been commercialised with Network Rail, and future work will focus on expanding its capabilities to new market segments and additional railway operations. There is also potential for overseas adoption. Continued iteration and user engagement will ensure the platform remains robust, scalable, and aligned with industry needs.

D Case study: Trains with Brain(s)

Introduction	
Name of case study project	Trains with Brain(s)
Project Value	£248,046
Project Duration	6 months
Start date	October 2022
End date	March 2023
Context & Objectives	
Project summary	The Trains with Brains project was funded through the FOAK 2022 competition, under the theme “More efficient use of access for infrastructure maintenance”. The project demonstrated how a suite of rail infrastructure monitoring technologies, collectively branded as Trains with Brains, provides critical intelligence to improve the efficiency and safety of rail operations. The project, led by Transmission Dynamics, combines roof-mounted cameras with pantograph and bogie mounted accelerometers which deliver continuous, real-time insights into the dynamic interactions between trains and OLE, as well as other critical components. The project successfully integrated these technologies onto passenger rail services, showcasing bi-directional data flows between on-train monitoring devices and Network Rail’s digital systems. The demonstration highlighted how improved data integration could help Network Rail to plan maintenance work more effectively, through smarter decision making informed by AI machine learning. The project was delivered by Transmission Dynamics, an independent SME Industrial Internet of Things solutions provider. Key project partners included Network Rail (infrastructure owners and operators), Angel Trains (rolling stock leasing company) and West Midlands Trains (a Train Operating Company).
Context	Trains with Brain(s) solutions address several key maintenance challenges facing overhead line equipment and rail maintenance. • De-wirements and pantograph/OLE faults: Failures in these systems can cause severe service disruption, safety risks and costly infrastructure repairs (c.£1.5m per incident). • Undetected faults: Without continuous monitoring, small anomalies may go unnoticed, deteriorate over time and eventually result in failures.

	• High reliance on manual inspection: Traditional approaches require manual patrols or infrequent monitoring fleet runs, which are costly, less accurate and potentially hazardous for engineers. As the rail industry navigates CP7¹¹, with increasing pressures on budgets, and climate resilience, there is growing demand for insightful and frequent monitoring of overhead line assets, capable of detecting anomalies including arcing, broken/missing wires, dropper faults, wheel flats, wheel pits and more. By providing early alerts, PANDAS-V® (pantograph and overhead line monitoring solution) from Trains with Brain(s)) enables targeted maintenance, reducing both operational disruption and risk to safety. Similarly, there is growing demand for intelligent, real-time monitoring of critical mechanical systems such as gearboxes, axles and bogies. SmartBugs® and Smart Oil Plugs® provide continuous insight into equipment health, capable of detecting anomalies such as temperature spikes, vibration irregularities, lubrication degradation, and early signs of mechanical wear. By delivering timely alerts, these solutions enable targeted maintenance, helping operators reduce downtime, extend asset life, and safeguard both performance and safety. Without holistic monitoring it is difficult to ensure the right parameters are being monitored to avoid failures. Combining solutions on the roof and undercarriage of the trains through Trains with Brains® enables visibility of the dynamic interactions between rail and overhead line for the first time. This increases intelligence, optimises predictive maintenance and reduces the likelihood of critical faults occurring. An industry expert emphasised that, given the economic pressures on the rail sector and the key challenges related to maintenance, including the impacts of climate change, greater automation of maintenance processes, particularly those which have potential to reduce on-site in person requirements, is likely to represent a robust investment in productivity.
Objectives	The key aims of the project were: • Demonstrate the benefits of integrating multiple condition-monitoring technologies onto a passenger train. • Provide visibility of interactions between OLE and track components in real-time, supported by AI and machine learning.
Project Activities	
	FOAK funding supported live demonstrations of the Trains with Brains technology on trains, which were delivered through five work packages over six months: • Project management & stakeholder engagement – planning, contracting, and stakeholder alignment.

¹¹ CP7 is the seventh five-year planning and funding cycle for Network Rail. It spans from 1 April 2024 to 31 March 2029. These periods are used to plan, fund, and regulate the operation, maintenance and renewal of the rail network infrastructure in Great Britain.

	• Algorithm development – developing machine learning algorithms to classify faults and combine datasets from multiple monitoring devices for a full operational picture. • Bi-directional integration – ensuring seamless communication between Transmission Dynamics’ cloud platform and Network Rail’s systems via APIs. • Live demonstration – installation of devices on passenger services and demonstration of data flows • Evaluation & exploitation – reporting against KPIs, producing evaluation outputs and disseminating findings to commercial stakeholders. In terms of key challenges, the project was delivered under tight timelines (6 months), which placed pressure on all partners to prioritise and deliver at pace. Obtaining engineering approvals, installing the technologies and demonstrating tangible benefits within such a short duration was particularly difficult. Despite this, the structured contract and defined work packages with committed partners enabled the team to stay on track. The project successfully delivered all objectives on time and in full. The exploitation work package was completed with full demonstrations, and the team is now actively rolling out deployment of all products across the UK and globally. Direct engagement with stakeholders proved crucial. Having stakeholders signed up to support the evaluation enabled the collection of meaningful KPIs and demonstrated benefits, strengthening the business case and supporting commercialisation. This structured stakeholder collaboration was a key enabler of success, providing clarity and momentum. The FOAK experience was highly positive. The project leader emphasised the relevant competition theme, developed through listening to the rail sector, which reinforced relevance, practical value of the project and therefore credible potential for commercialisation post project
Outcomes & Impacts	
Outcomes	The project achieved significant commercial, technical, and strategic outcomes. After project completion, the technology developed were launched under the product line Trains with Brains. The tangible and positive evaluation evidence gained through FOAK was key for developing the project business case. The project has already self-reportedly generated millions of pounds of revenue from UK and global orders of Trains with Brains solutions, representing a strong return on investment for both the SME and IUK. Commercially, the project is now in contract with all of the project partners and more, including Mainland UK Network Rail, Network Rail Scotland, Network Rail High Speed and various train operating companies, and Rolling stock leasing companies (ROSCOs), in the UK and their equivalents globally (including in the EU, US, Australia, Brazil and India. Stakeholder engagement fostered strong word-of-mouth referrals and long-term relationships. The

	project has resulted in back-to-back procurement framework with Network Rail, which accounts for around 80% of the UK revenue achieved. From a market perspective, the initiative strengthened the company's position, increasing LinkedIn and website engagement by 20% since January 2024. The commercialisation of the products has also safeguarded 20 existing jobs and created five new ones, with rail now accounting for over half of the company's income (previously 25%). Technically, the project delivered lasting knowledge outputs that are influencing industry standards. Network Rail is adopting lessons from the trainbourne monitoring systems, shifting from manual inspections to more reliable trainbourne monitoring alternatives, and the company is increasingly recognised as a sector leader, with publications including the White Paper on Mentor Train Force Measurements influencing standards and working practices. An industry expert highlighted that a key innovative aspect of Trains with Brains lies in its ability to make sense of the vast amounts of data across different asset components and infrastructure, cross-reference these datasets and use the insights to identify the causes and effects of maintenance needs more quickly.
Impacts	Trains with Brain(s) has demonstrably improved the safety, efficiency and operational reliability of rail infrastructure through the deployment of a combination of train-borne monitoring technologies. Network Rail has self-reported the following benefits to date: • 30% reduction in high impact incidents (2018/2019 – 2023/2024). • 18% work bank reduction between 2021–2025. • Efficiency forecasted at £5.1m by end of CP7. • 17,000 delay minutes saved in last 18 months. • At least six dewirements saved in last 18 months. • MENTOR being retired for OLE monitoring. • Drive to reduce manual patrolling, targeting £2.5m per annum saving. • Driving standards change to dynamic monitoring. The technology is also reshaping how standards are applied across the network. Previously, data collection relied on manual or infrequent monitoring fleet runs, which were limited in accuracy and frequency. With Trains with Brains, measurements including pantograph height, overhead line wire stagger, arcing, dropper wire failures and foliage and rail component baseline temperature and acceleration exceedances are now captured in real-time under actual operating conditions. Image-based analytics allow for more precise and representative data collection, enabling standards to evolve towards dynamic, condition-based monitoring and reducing reliance on expensive and less frequent traditional surveys and reducing 'boots on ballast' as per Network Rail's critical safety campaign aims. We understand that safety improvements have been significant. Manual patrols, which previously exposed engineers to potentially hazardous

	environments, have been reduced and in some cases eliminated in regions where the system has been deployed. Maintenance teams are now able to prioritise interventions based on automated alerts, preventing incidents before they escalate. This targeted approach has also decreased operational costs, as staff can be redeployed from routine inspections to critical fault resolution. The project also contributes to potential to support asset longevity. Continuous, accurate monitoring allows mechanical components and overhead line infrastructure to operate more smoothly, extending service life. This proactive management generates further cost savings and efficiency improvements, including service reliability and safety for passengers. Indirectly, this improved reliability also supports environmental benefits as more consistent rail services encourage modal shift from higher-emission transport, while reductions in manual inspections and emergency repairs lower the carbon footprint associated with rail maintenance and repairs.
Additionality	The FOAK grant played a critical role in accelerating the development and integration of Trains with Brains. While Transmission Dynamics already had individual products in operation, the project enabled them to be combined and demonstrated together on a single train, something unlikely to have been achieved under a modular, incremental approach within the same timeframes. Without FOAK, it is likely that the technologies would still have been commercialised, but the process would have been significantly slower and less coordinated. The project also provided the structure and stakeholder engagement needed to secure widespread buy-in. The formal demonstration and evaluation framework, requiring Network Rail and other partners to provide feedback, was essential in proving the business case and ensuring the solutions were adopted into long-term commercial frameworks.
Successes and lessons learnt	
Key lessons	The success of Trains with Brains was underpinned by strong collaboration with partners, the clear alignment of FOAK themes with industry needs and the structured approach to evaluation and reporting. Transmission Dynamics highlighted that having commercial KPIs embedded into the project design was crucial, as it ensured that technical demonstrations translated into tangible business benefits. Another key lesson was the importance of timing. The project succeeded partly because the products were already at a high technology readiness level and ready to be deployed innovatively. FOAK provided the opportunity to integrate and evaluate them collectively, which demonstrated strategic value and directly supported commercialisation. Looking ahead, Transmission Dynamics suggested that longer project durations (still with well-defined themes that meet sector demand) and earlier announcement of imminent funding competitions would help SMEs

	maximise value from FOAK programmes. Nevertheless, the company emphasised that the programme structure, with its defined themes, contract structure, proportional reporting and stakeholder involvement, has been invaluable in de-risking innovation and enabling rapid commercialisation.
Next Steps	Transmission Dynamics is now actively commercialising the Trains with Brains product globally. Contracts are already in place with Network Rail, Angel Trains, and TOCs, both in the UK and overseas and they have a healthy pipeline of new contracts to build on. The company continues to develop additional software capabilities for the existing future-proof hardware platform. An industry expert highlighted that several additional asset types could be integrated into the Trains with Brains software. They noted that as the technology develops to incorporate more inputs, this expansion will occur naturally should it become more widely used and embedded.

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Progressive thinking
No time for business as usual