Global Safety Evidence Centre

Learning from innovation: Case study synthesis of Safetytech Accelerator projects

Safe Work

Evidence Review

Briefing

1. The quick read

The Lloyd's Register Foundation's Global Safety Evidence Centre partnered with researchers at Nottingham Trent University Business School to conduct a synthesis of 26 case studies developed by *Safetytech Accelerator (STA)*. Established by the Foundation in 2018, Safetytech Accelerator aims to create a safer, more efficient, and sustainable world by connecting safety-critical industries with technology innovators.

Over several years, Safetytech Accelerator has published case studies online that outline a safety problem, describe how it was tackled through the adoption of new technologies, the subsequent results, and an explanation of what it means for the industry in question.

Innovation programmes often operate in environments where conventional forms of evidence – such as formal evaluations or peer-reviewed research – are limited, fragmented, or still emerging. This work aimed to test an established methodology for case study synthesis in an innovation and commercial context, providing useful insights around technologies and safety. This adds to the growing body of evidence compiled by the Foundation's Global Safety Evidence Centre.

This case study synthesis found that:

1. New technology and existing technology used in novel contexts can improve safety.
2. The successful implementation of innovation pilots depends on stakeholder cohesion and flexibility.
3. Smaller, focused groups of stakeholders lead to greater innovation stability and faster implementation.
4. Tackling a safety issue often requires stakeholders to consider how the meaning of safety can vary in different contexts. This scrutiny can be beneficial for the overall outcome of an innovation pilot.
5. The competency and compliance of those working in complex or dangerous areas are frequently identified as separate areas in need of improvement. Innovation can be used to address both simultaneously.
6. The methodology used for this synthesis is robust and well-suited for application within innovation and commercial contexts, yielding reliable and actionable insights.
7. The following steps can help scale innovation and strengthen evidence-based decision-making among funders, innovators and practitioners:
   - Improving and standardising case study reporting.
   - Recognising case studies as legitimate forms of evidence.
   - Planning for long-term learning at an early stage of development or implementation.
   - Tailoring evaluation to different stages of innovation instead of using uniform success metrics.
   - Encouraging collaboration across sectors.

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2. Why this is important

Technology can improve safety in commercial settings, but it can be hard to provide evidence when it is newly implemented.

Case studies are valuable, especially in innovation programs and early-stage projects. They offer practical, real-world insights into enablers, barriers, and outcomes, supporting learning on project implementation and scaling - insights that are highly relevant to both funders and delivery organisations.

Advancing the methodology for creating and synthesising innovation case studies means they are more systematic and credible.

Case study synthesis complements other evidence forms and helps demonstrate the value of funder investments.

The report shows how, by applying this approach to the Safetytech Accelerator programme, case studies can inform innovation strategies and decision-making.

Robust case study synthesis strengthens evidence-based decision-making and supports safer, more sustainable innovation outcomes.

3. The research

Case study synthesis is a structured way to bring together findings from several case studies, helping to draw wider and more reliable conclusions. This process looks for common themes and important lessons across different cases, allowing researchers to spot patterns and key factors in various settings.

The case study synthesis process

Researchers at Nottingham Trent University Business School used a structured process following these steps:

1	**Developed research questions and conceptual framework**	— Research questions were collaboratively developed with stakeholders. — Framework created to categorise interventions or outcomes of interest.
2	**Identified and searched for evidence**	— Clear selection criteria developed. — Relevant websites and case study collections identified.
3	**Selected studies**	— Criteria for inclusion remained open as the data sources were already identified through Safetytech Accelerator case studies.
4	**Extracted and organised data**	— Structured template was used to systematically gather relevant data fields from each case study. — Data were organised using common fields/domains to display extracted data.
5	**Assessed quality**	— Quality assessed according to domains of integrity, transparency, completeness, responsibility, format, and learning reported
6	**Cross-case analysis and synthesis**	— Framework analysis: Thematic coding was applied, and matrices were developed to identify patterns and themes.
7	**Developed overarching framework**	— Produced an explanatory framework that fitted with the data from the case studies
8	**Reported findings**	— Findings reported narratively by grouping results around major themes.

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Expert interviews

Expert interviews were conducted to gain deeper insights into underreported areas and validate findings. This involved developing interview questions, selecting participants, conducting interviews, recording and transcribing, and analysing the data.

Research questions

The questions guiding this synthesis ensured a focused, practical, and methodologically sound synthesis process:

1. What were the settings, sectors, technologies, and outcomes of the pilots?
2. What patterns, trends, and gaps could be identified across these dimensions?
3. What were the enablers, barriers, and implementation challenges of the pilots?
4. What was the specific role of Safetytech Accelerator in influencing implementation and outcomes?
5. How suitable were the case studies for synthesis, and what was the overall robustness of this methodological approach?

The case study analysis could fully address questions 1, 2, 3 and 5. Questions 3 and 4 were partially answered with stakeholder interviews.

4. The findings

The quantitative results provide important details about sector, safety issues, technologies, and locations as well as the quality appraisal of the case studies.

The qualitative analysis offers the rich insight around the ways in which technology can be used to improve safety.

Quantitative analysis

The quantitative analysis summarises data from 26 STA-backed pilot or feasibility case studies. Published between 2019 and 2024, these studies increased markedly after 2022, showing rising institutional focus on innovation pilots linked to post-pandemic recovery and digital transformation agendas.

Safety challenges addressed

Faster fire detection in containers on ships	3
Manual data collection and operational inefficiencies	2
Working at height and fall prevention	2
Mental wellbeing and stress detection	2
Food safety and allergen transparency	2
Predictive maintenance and digital twins	1
Compliance automation and document analysis	2
Remote inspection and defect detection	2
Construction site safety and AI-based risk detection	2
Safety in ports and terminals	2
Data security and anonymisation	1
Crew alerting and positioning in emergencies	1
Training and simulation for maritime operations	1
Listeria detection in food production	1
Pipeline defect identification	1
Robotic hull cleaning and biofouling prevention,	1
Electrical cabinet inspection and error detection	1
Human error and behavioural risk	1

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Sectoral distribution

Characteristics of Safetytech Accelerator case studies

Technologies used	Software-based solutions were the most prevalent among a wide range of technologies. These included AI-driven analytics platforms, computer vision systems, and digital twins. Hardware innovations such as robotic devices and sensor networks were also well represented.
Geography	The case studies were spread across Europe, North America, Asia, and Australia, with the most frequently cited locations being Singapore, Germany, and the US.
Commissioning clients	Global corporations, public sector bodies, and industry consortia were all represented among participating clients. Notable names included Cargill, Seaspan, PepsiCo, Phillips, Sellafield National, Nuclear Laboratory, the UK Health and Safety Executive (HSE), University of Manchester, Lloyd's Register Foundation, and Safetytech Accelerator.
Technology suppliers	A diverse set of technology providers were engaged, ranging from start-ups to established firms, with expertise spanning AI, robotics, sensor networks, and digital platforms.

Quality appraisal

- Each case study was assessed using a structured quality appraisal framework containing five domains: **Integrity, Transparency, Completeness, Responsibility, and Format and Learning.**
- Each domain received a score between 1 and 4, giving a maximum score of 20.
- The average quality score across all studies was 10.3, with a median score of 10, indicating moderate consistency in reporting.
- A two-person review team conducted most assessments independently, using sense-checking meetings to ensure consistency. While regular check-ins and updates aimed to reduce reviewer bias, some concerns about consistency and inter-rater reliability remain.
- Variability in completeness and transparency suggests opportunities for improving future case study documentation. Lower scores do not indicate an intervention was low quality, rather that some details are missing from the case studies which were originally developed by Safetytech Accelerator for marketing purposes.

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Qualitative analysis

Researchers analysed both case studies and interviews to find common themes and patterns. Findings show a number of interesting similarities and differences around each stage of the pilots detailed in the case studies.

1. Defining and addressing safety challenges

Safetytech Accelerator case studies start by letting stakeholders identify the main problems. Technology developers are then chosen to tackle these issues, usually through a competitive process. Many different safety challenges are explored, which leads to questions about how safety is understood and managed.

a. Defining a safety problem

Exploring how safety problems are defined across the case studies, findings reveal several key themes and insights:

Stakeholder network stability:

The success of safety interventions often depends on the stability and size of the stakeholder network in both the challenge definition and the implementation of the intervention. For example, Case Study 1 (CS1) highlighted the need for further work involving crews, managers, and ship-owners to deploy sensors effectively. CS5 shows how, with fewer stakeholders, the innovation process can be more stable and the implementation quicker. This is likely due to a more cohesive approach to achieving the project's goals (for case study details see Appendix A).

New solutions to old problems:

Innovative solutions are seen to address longstanding problems either using existing tech in a new context, such as CS20 (pioneering WiFi based fire detection technology) or innovation that accounts for the changing scale of a challenge such as cargo loss at sea.

Evaluation of new technologies:

Projects like CS4 evaluated the efficacy of new technologies, such as the robotic device 'Roverclean' for hull cleaning, and identified further development needs for operational implementation.

Transformation of safety problems:

Some case studies, like CS3, transformed existing safety practices by introducing non-invasive, real-time data collection and analytics, which established new safety-relevant relationships.

b. Addressing a safety problem and defining an intervention

Projects differ in how they frame safety challenges, whether as problems to solve, manage, prevent, or reinvent, and these choices shape both technological and social solutions:

- **Solving**, such as in CS5. The intervention addresses and eliminates a defined issue, though most challenges were too complex for single 'solution' approaches.
- **Managing** focuses on improving the handling of ongoing, well-understood risks through enhanced practices or data analytics, as shown in CS19 and CS22.
- The **preventing** approach, exemplified by CS4 and CS16, seeks to stop safety issues before they occur, often by replacing hazardous tasks with alternative methods, though this can introduce new challenges to be addressed.
- **Reinventing** involves redefining or expanding the safety problem's scope, as in CS12 and CS14, either by addressing emerging risks or shifting the context in which safety is considered.

Some interventions combine more than one of these approaches. Overall, the case studies demonstrate that while some safety issues can be decisively solved, many require ongoing management, prevention strategies, or even a rethinking of what constitutes the safety problem, reflecting the complex and evolving nature of safety challenges.

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2. Routes to safety outcomes – a continuum of upstream to downstream

The case studies show a range of safety interventions, from those that directly tackle an immediate safety problem to those that address related conditions or issues that could impact safety in the future. Some examples include:

- CS15: Introduced new technology to detect early signs of fires on large container ships, moving slightly towards spotting potential fire risks before they happen.
- CS27: Focused on monitoring crew behaviour to identify stress and fatigue as possible warning signs of safety incidents, aiming for real-time solutions as the technology matures.
- CS21: Used AI to analyse historical health and safety data, helping to spot hazards in new construction site images and connect past information to current safety needs.
- CS5: Worked on anonymising safety data to create large, compliant datasets that could inform better safety guidance in the future.

Overall, these interventions range from "downstream" approaches that deal directly with the safety problem, to "upstream" ones that address underlying factors or future opportunities for improvement. Downstream solutions can show clear and immediate results, while upstream interventions may require further development before their safety benefits are fully realised.

3. Fostering competence and ensuring compliance

Several case studies targeted either improving competence or compliance in safety-critical environments. Sector differences influence whether competence or compliance is prioritised, but hybrid models are emerging to address both needs. For example, CS24 looked at the issue of electrical engineers making mistakes or leaving behind tools and waste after working on electrical cabinets. The pilot tested a computer vision system that used deep learning to automatically spot errors in photos of finished work that engineers uploaded. The system then gave engineers instant feedback before they left the site. This approach helps with compliance by catching and recording mistakes, but it also supports engineers' skills by giving them technical help, rather than taking over their decision-making.

4. Evaluation and assurance of safety interventions

Safety outcomes depend on both technological reliability and the willingness of professionals to integrate new systems into their workflows:

Many safetytech case studies are feasibility or pilot studies, so there is limited long-term data on their effectiveness. Success is typically measured by operational metrics—like detection accuracy or speed—rather than direct reductions in incidents. Some pilots showed a significant drop in safety incidents during testing. The journey from pilot to implementation involves scaling from controlled tests to real-world use, with effectiveness assessed at each stage against evolving standards, professional judgment, or industry norms. The quality of data and expert involvement underpin AI-based interventions, while successful adoption often hinges on user acceptance and feasibility. Some interventions depend on gaining trust from workers about privacy and usability.

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General observations

- The concept of 'safety' within Safetytech Accelerator projects is dynamic, often redefined throughout the development and implementation process, rather than being a fixed criterion from the outset.
- Case studies illustrate a range of approaches: some address well-defined safety standards, while others explore and establish new norms—particularly in areas such as food service and seafarer wellbeing.
- The Hierarchy of Controls and Actor-Network Theory (ANT) are valuable frameworks for understanding how safety interventions displace, transform, or reinvent existing problems, and for analysing how interests among stakeholders are aligned.
- Success of technological interventions depends not only on technical effectiveness but also on their integration into social and operational networks, which can be vulnerable to 'failures in translation'—misalignments of interests, adoption, or compliance.
- Projects that support professional judgment and competence, as well as those that simply enforce compliance, raise questions about whose expertise is privileged and how interventions affect end users.
- Sector differences influence approaches: construction and logistics often focus on compliance, engineering on operational readiness, while food and maritime projects may be more innovative or stakeholder-driven.
- The complexity of stakeholder interests, especially in the maritime sector, means that successful safety interventions require both robust technology and effective alignment among a diverse range of actors.

Hierarchy of controls approach

The Hierarchy of Controls ranks hazard control methods by effectiveness, helping reduce or eliminate exposure.

This was useful during the formulation of the research questions for this work.

Actor-Network Theory

Actor-Network Theory (ANT) is a theoretical and methodological approach to social theory that proposes that everything in the social and natural worlds exists in constantly shifting networks of relationships. Objects, ideas, processes, and other relevant factors are seen as equally important in creating social situations as humans.

The researchers who conducted this synthesis have concluded ANT provides a more rounded understanding of how safety problems are translated across Safetytech Accelerator projects.

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5. Recommendations

The findings of this work provide useful considerations for innovators, practitioners and funders alike, whether responsible for the formulation or interpretation of case studies discussing safetytech pilots. Case studies may highlight important insights in isolation, but they are much more likely to provide rich, applicable findings through collective analysis.

Recommendations for the presentation and formulation of case studies:

Stakeholder roles and input:

- Providing details of the process involved and contributions/requirements of each partner helps improve understanding of how challenges evolve through negotiations, and how outcomes helped shape the needs of stakeholders.
- Including feedback from all stakeholders involved can lend strength to the overall narrative of the case study.
- Potential broader impacts on the network of stakeholders are also worth considering and detailing, particularly in the case of disruptive innovation.
- Knowledge of what happened after a trial, pilot or intervention provides additional opportunity for learning. Similarly, follow up interviews to establish the impact of the project on the organisation/beneficiaries would help to judge long term outcomes.
- Useful to include details of how issues arising throughout the process are resolved e.g with the acceptability of technologies.

Understanding and addressing the problem:

- Context setting with background helps to better understand why particular approaches have been taken to the problem.
- A typology for the different ways of addressing the problem (e.g. solving, managing, reinventing, etc.) might help in better appreciating some of the broader implications of the projects.
- Clarify the theory underpinning the approach, especially when the project is exploratory.
- More data on the results of the studies would assist in evaluating the pilot work. This might include sample sizes, number of trials, outcomes etc.
- Specifying safety outcome criteria can help to understand how individual projects contribute to the overall mission.
- Specifying resourcing where relevant can help to provide insight on where there are returns on investment.

How can funders, innovators, and practitioners build on case study synthesis?

1. Use findings to inform Areas of Research Interest and to identify risks.
2. Ensure the methodology used to conduct a case study synthesis is appropriate and robust so as not to risk quality and credibility.
3. Transform professional knowledge by identifying new ways of conceptualising and addressing problems.
4. Recognise case studies as a legitimate form of evidence, if done well and used appropriately, particularly in early-stage innovation contexts where formal evaluations may not exist.
5. Support longitudinal and iterative learning from the outset with follow on studies that revisit case study interventions over time.
6. Adapt more targeted and appropriate criterium for each case study rather than applying uniform success markers.
7. Foster cross-sectoral and interdisciplinary collaboration.

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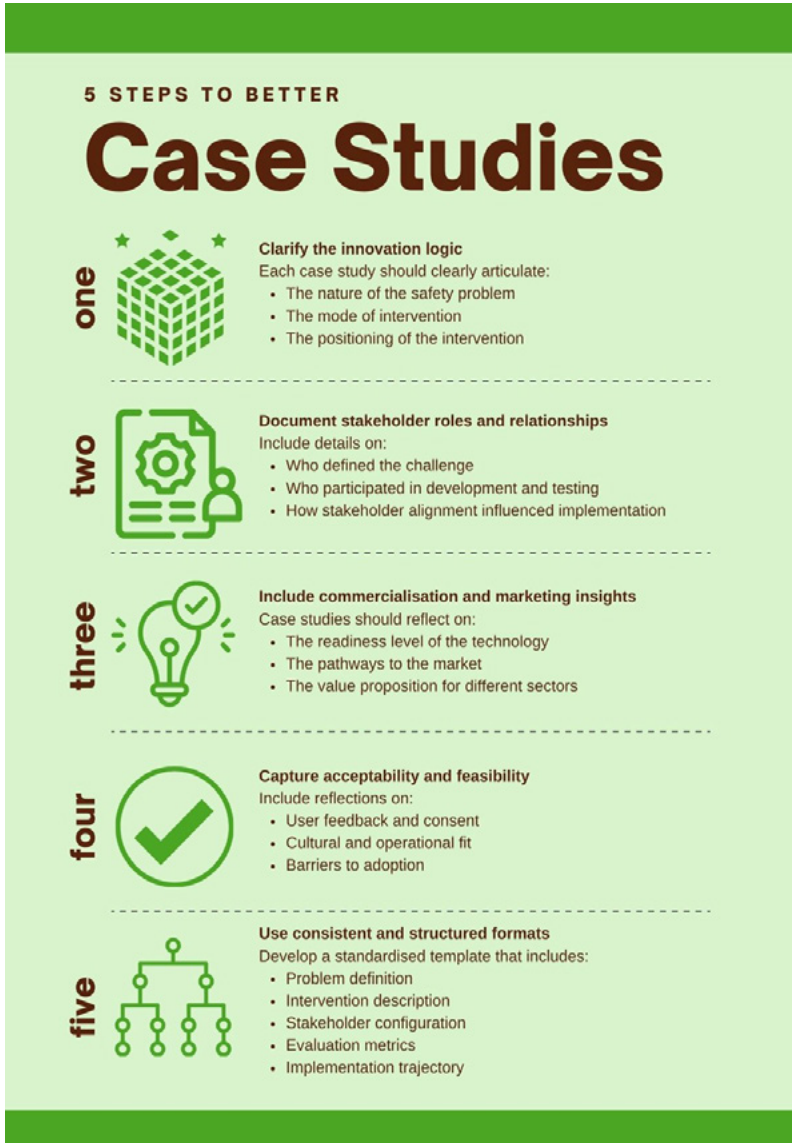
Appendix A: List of Safetytech Accelerator case studies

#	Name
CS1*	A Feasibility Study into Using Energy Harvesting Sensors to Detect Fires
CS2	Case Study: Onboard Positioning to Enhance Fire Response Times at Sea
CS3	A Pilot to Explore Automated Data Collection From Ship Machinery
CS4	A Pilot to Explore Robotic Hull Cleaning and Inspection Technology
CS5	Anonymising and Desensitising Health and Safety Data
CS6	Case Study: A Pilot to Optimise Port Visits for Ships
CS7**	Case Study: A Pilot to Test Whether Technology Can Recognise Safety Hazards Within the Workplace
CS8	Case Study: An Open Innovation Challenge to Transform Industrial Inspection and Improve Safety of Workers
CS9	Case Study: Automating Safety Compliance in Construction
CS10**	Case Study: Mitigating Work at Height Risk with Computer Vision
CS11	Case Study: Using Human Voice to Uncover Mental Wellbeing Insights in Maritime
CS12	Communicating Accurate Ingredient Data in School Canteens
CS13	Developing Ship-Handling Skills Using Virtual Reality Data
CS14	Discover the Safetytech Solution that can Assess if a Crew is Fit for Duty
CS15	Case Study: Early Fire Detection on Container Ships using E-Nose Technology
CS16	Exploring Robotic Solutions to Remove the Need for Humans to Conduct Inspections in Confined Spaces
CS17	How Can We Enable Engineers Working with Safety Critical Equipment to Use Predictive Analytics?
CS18	Improving Defect Identification in Pipelines
CS19	Pilot to Speed Up Detection of Listeria in Food Production
CS20*	Case Study: Pioneering WiFi-Based Fire Detection Technology with University of New South Wales (UNSW) and Ginigai (formerly Envision)
CS21	Providing Construction Safety Guidance Using Visual Observations and Historical Reports
CS22	Reducing Risk in Ports Using AI-Based Analytics
CS23	Startup Deploys Wireless Sensors Across Ship's Cargo Hold to Predict Fire
CS24	Startup Improves Safety Using Deep Learning-Based Computer Vision
CS25	Transforming Food Safety, Assurance and Compliance Using AI Technology
CS26	Transforming Operational Risk Assessments to Better Inform Personnel
CS27	Understanding Decision-Making on a Ship Through Sensing

** Denotes feasibility study*

*** Denotes a short and longer version of the same project*

Appendix B: Five steps to better case studies



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About the Lloyd's Register Foundation Global Safety Evidence Centre

The Lloyd's Register Foundation Global Safety Evidence Centre is a hub for anyone who needs to know 'what works' to make people safer. The Centre collates, creates and communicates the best available safety evidence from the Foundation, our partners and other sources on both the nature and scale of global safety challenges, and what works to address them. It works with partners to identify and fill gaps in the evidence, and to use the evidence for action.

To find out more about the Global Safety Evidence Centre, visit *gsec.lrfoundation.org.uk*

About Lloyd's Register Foundation

Lloyd's Register Foundation is an independent global safety charity that supports research, innovation, and education to make the world a safer place. Its mission is to use the best evidence and insight to help the global community focus on tackling the world's most pressing safety and risk challenges.

To find out more about Lloyd's Register Foundation, visit *lrfoundation.org.uk*

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doi.org/10.60743/720G-KB20

About Nottingham Trent University Business School

This work was conducted by researchers at the Centre for People, Work and Organizational Practice (*CPWOP*) at Nottingham Business School (*NBS*), Nottingham Trent University (NTU). NBS is distinguished by its *EQUIS*, *AACSB*, and *AMBA* accreditations, reflecting its excellence in business and community engagement. CPWOP has a proven track record of delivering employer- and industry-focused research, supported by a robust infrastructure.

NTU has collaborated with Lloyd's Register Foundation on a series of reports addressing psychological wellbeing and safety in employment contexts. These include a rapid review of evidence on psychological wellbeing and safety in a global context; an exploration of the wellbeing agenda in relation to safety issues in the wake of COVID-19; and a rapid evidence assessment of the core literature around seafarer wellbeing.

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