National Satellite Test Facility Construction Phase Impact Evaluation Final Report

External Publication date: July 2026

FNC 030299

60658R Issue: 1

Prepared for: Science and Technology Facilities Council (STFC)

SYSTEMS ● ENGINEERING ● TECHNOLOGY

FRAZER-NASH CONSULTANCY
A KBR COMPANY

National Satellite Test Facility Construction Phase Impact Evaluation

Final Report

Client:	Science and Technology Facilities Council (STFC)
Publication Date:	July 2026
Classification:	PUBLIC

Project No:	030299	Compiled By:	Lewis Baxter
Document No:	60658R	Verified By:	Adam Cox, Lithin Elias
		Approved By:	Andy Sweeting
		Signed:	A. Sweeting

Originating Office: FRAZER-NASH CONSULTANCY LIMITED
Hill Park South, KBR Campus, Springfield Drive, Leatherhead, Surrey, KT22 7LH
Tel: +44 (0)1306 885050

Executive Summary

The National Satellite Test Facility

The National Satellite Test Facility (NSTF) was constructed at Harwell Campus to provide the UK with world-class, co-located environmental test capabilities for large and complex spacecraft. Construction ran from 2017 to 2023, and cost £117 million, funded through UKRI's Industrial Strategy Challenge Fund. The NSTF was designed to reduce reliance on overseas testing, shorten mission development cycles, and strengthen the competitiveness of the UK space sector by enabling domestic and international clients to validate spacecraft in the UK.

Purpose of this evaluation

The Science and Technology Facilities Council (STFC) commissioned Frazer-Nash Consultancy to undertake an independent impact evaluation of the NSTF's construction phase. The evaluation examines the economic, technological and social impacts generated to date, and the mechanisms through which these have materialised. As the operational phase is yet to deliver most expected long-term benefits, this study provides early, exploratory evidence, rather than a full assessment of the NSTF's lifetime value for money. The evaluation assesses the construction phase against its original objectives, which were to:

- OBJ 1: Construct the facilities required to provide testing capabilities that will allow the UK to construct more satellites and deliver payloads into orbit.
- OBJ 2: Develop the skills required to construct a high-quality testing facility complete with specialist testing equipment.
- OBJ 3: Facilitate the partnerships required to construct the facility.
- OBJ 4: Drive economic growth locally and in the rest of the UK.

Methodology

The evaluation applies a mixed-methods, theory-based approach, aligned with HM Treasury's Green Book, the Magenta Book[1]. and Department for Science, Innovation and Technology (DSIT) and UK Research and Innovation (UKRI) evaluation guidance. Figure 1 presents a high-level overview of the three-stage methodological approach:

1. Scoping and theory development: Establishing a clear understanding of the construction, identifying expected impact pathways, and defining evaluation questions.
2. Collect evidence: Acquiring quantitative and qualitative data from suppliers, STFC staff, contractors and secondary datasets.

[1] The methodology is aligned to the 2020 edition of the Magenta Book, which has since been updated in May 2026

3. Analysis and validation: Synthesising evidence through qualitative and quantitative methods within a process-tracing framework to assess impact magnitude, attribution and counterfactual plausibility.

The construction phase took place during the COVID-19 pandemic. This evaluation did not specifically investigate the pandemic's effects on the construction, as evidence collection focused on impact pathways rather than delivery factors. COVID forms part of the operating context for the findings presented in this report.

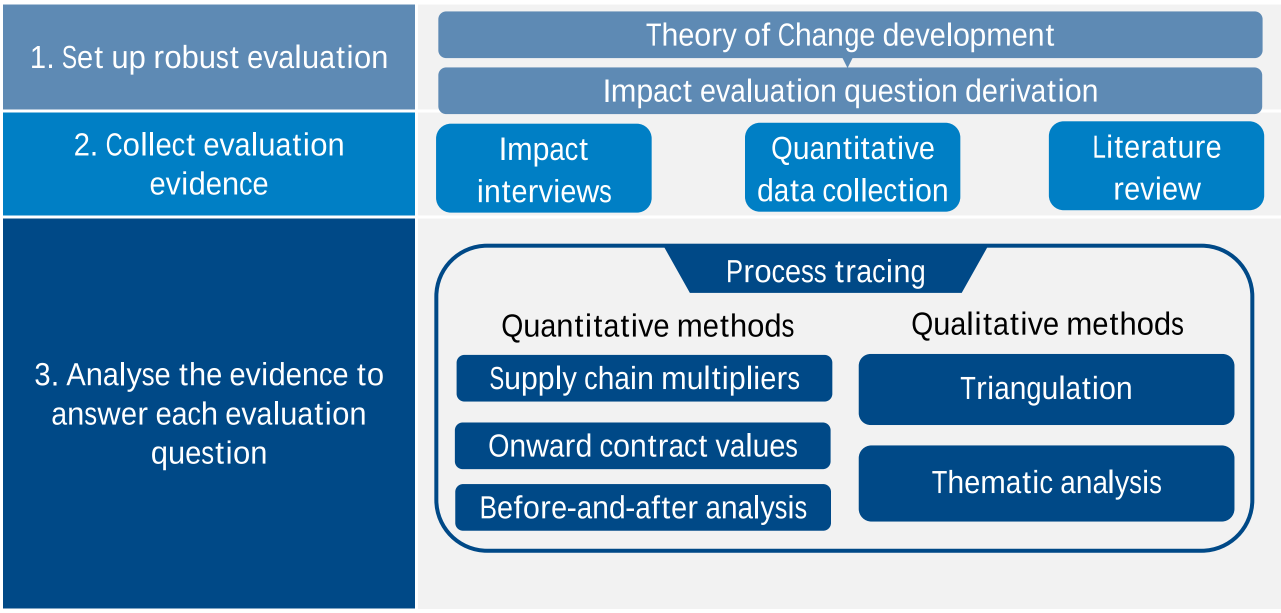


Figure 1. A high-level summary of the evaluation methodology

Key messages

Supporting economic growth in the UK construction sector

The NSTF generated substantial economic value during its construction, with strong quantitative evidence and attribution:

- £36 million of construction activities were classified as highly innovative, involving first-of-a-kind engineering and bespoke scientific installations.
- £22 million of this innovative spend was retained in the UK, generating £20.4 million of additional (net) GVA, £6.6 million in additional tax revenue, and over 460 job-years across the innovative construction supply chain.

These supply chain impacts are highly additional because they represent support to the innovative construction sector supply chain, which would not have been supported if the NSTF was not built, or if a more generic construction project had been undertaken instead. In addition, suppliers attributed at least £180 million of subsequent construction contracts directly to experience gained through the NSTF's construction, and a further £250 million was partially influenced by it. These contracts produced between £63 million and £151 million in direct GVA and 1,600–3,800 job-years, although not all of this represents net additional activity at the UK economy level. There is strong evidence that these contracts are additional to the NSTF suppliers, these suppliers would not have won the contracts if not for the specialist knowledge and marketing assets they developed throughout the construction. Overall, each £1 of innovative NSTF construction activity generated £1.60–£3.70 in innovative activity elsewhere, consistent with established literature on the procurement of advanced research infrastructures.

Catalysing innovation and technological capability

There is strong qualitative evidence that the construction has generated innovation. The project's technical complexity drove suppliers to develop specialist knowledge in R&D facility design, cleanroom construction, acoustic testing and electronics. The Suppliers also undertook fundamental research and rigorous testing, implementing process improvements including refined quality assurance and component selection procedures. These outcomes are strongly attributable to the NSTF, with suppliers reporting they would not have occurred otherwise. Many improvements have since been applied to new projects, strengthening long-term supplier capability. While the highly bespoke nature of some R&D limits broader reusability, several design-stage research activities contributed to improvements that could double the NSTF's annual satellite throughput in its operational phase.

No new commercial technologies or IP emerged directly from construction, although several systems were adapted or reconfigured to meet the NSTF's unique requirements.

Strengthening the local labour supply

There is good quantitative and qualitative evidence for the impact of the construction on the local labour supply, though the overall scale of labour supply expansion is modest relative to sector size. The construction phase contributed to workforce development by creating at least 40 new roles across the supply chain and STFC, supporting upskilling and progression into more advanced roles, and attracting experienced staff required for technically demanding work. Evidence for diversity-related impacts is limited, mirroring wider construction-sector challenges.

Enhancing collaboration across the supply chain capability

There is strong qualitative and quantitative evidence that the construction enhanced supply chain collaboration. The NSTF's three-tier supply chain benefitted from extensive collaboration, driven by the need to resolve complex engineering challenges:

- Upper-tier suppliers gained specialist knowledge from collaborative problem-solving with technical subcontractors.
- Lower-tier contractors benefitted from sustained demand, becoming more familiar with prime contractors' standards and systems.
- The primary supplier strengthened relationships with specialist firms, improving its readiness and mobilisation capability for future technically advanced projects.

Boosting the UK space sector's international reputation

There is good qualitative evidence that the NSTF’s construction was a focal point for highly productive engagement. The facility hosted more than 90 stakeholder visits, including government representatives, industry primes and public groups. Evidence suggests these visits enhanced the visibility of the UK space sector, encouraged commercial interest and contributed to positive perceptions of UK capability. However, impacts on inward investment, policy decisions and local attitudes are difficult to quantify or attribute with confidence.

Improving STFC’s internal capability

The construction enhanced STFC's technical understanding of advanced research infrastructures through learning-by-doing, particularly in areas such as vibration damping, environmental control and precision conditioning. This specialist knowledge is expected to support more informed requirements-setting in future complex procurements.

During evidence collection, interviewees reflected on the operational and organisational aspects of delivering the NSTF during the 2017–2023 construction period, including resourcing, governance, procurement, project management and the capture of learning. These reflections provide useful insight into lessons identified through the delivery of the project. However, assessing the extent to which these lessons have subsequently been embedded into STFC’s current procurement, estates and project management practices is beyond the remit and resources of this evaluation, given the scale and complexity of these functions. As a result, the evaluation’s conclusions in this area are intentionally cautious. The evidence gathered indicates areas of learning, but is not sufficient to make robust findings on the extent to which specific organisational changes have been implemented, or whether they have made the future procurement and delivery of similar facilities easier, cheaper or more effective.

A separate process evaluation is recommended to assess these themes against current practice (see Looking to the future).

Conclusions

The NSTF construction phase has already generated significant economic and non-economic value. A consistent underlying mechanism emerges across findings: overcoming the facility’s technical challenges required deep collaboration, intensive problem-solving and specialist research activities. This created learning-by-doing benefits that improved supplier capability, strengthened the supply chain and contributed to future contract wins.

The evaluation estimates £20.4 million of net additional UK GVA from innovative construction, £63–£151 million of supplier direct GVA enabled or influenced by the construction, and significant non-economic impacts across capability, skills, collaboration and organisational learning. These findings represent an important early contribution to understanding the NSTF’s long-term economic value.

The construction phase met all its objectives. The NSTF’s construction:

- Met OBJ 1 by successfully completing construction and serving its first client.

- Met OBJ 2 by supporting specialist knowledge and skills development across the supply chain and within STFC.
- Met OBJ 3 by fostering a significant number of partnerships across the supply chain.
- Met OBJ 4 by providing quantifiable economic benefits, both in supply chain support and economic spillovers.

Lessons learned to optimise the impact of similar constructions

Two areas stand out as critical for maximising impact in future infrastructure projects:

1. There should be a structured process for the review, reporting and dissemination of lessons learned from large-scale construction projects. The NSTF construction generated valuable technical insights, including in the design and delivery of soundproofing, vibration damping, cleanrooms, environmental control and bespoke scientific apparatus, which should be captured and institutionalised so that future facilities can be procured more efficiently. Lessons relating specifically to STFC's procurement and delivery approach would be most robustly assessed through a separate process evaluation, as recommended below.
2. Where possible, UK-based procurement should be prioritised to maximise UK benefit, particularly for the most innovative aspects of the NSTF. While 91% of all construction spend went to UK firms, only 72% of innovative spend did. This reflects current gaps in the UK's skills base and capability, which meant that nationally based suppliers could not be procured to deliver every innovative part of the construction. If all innovative elements had been UK-sourced, the NSTF's contribution to the domestic innovative construction sector (in GVA terms) could have been 46% higher.

Lessons learned for evaluating research infrastructure construction

The evaluation identifies three lessons learned for future research infrastructure construction phase evaluations:

1. Impact evaluations should be undertaken for technically complex research infrastructure constructions. This is the UK's first evaluation of research infrastructure construction phase impacts.[2] It demonstrates that construction phases can generate significant impacts, particularly where technical novelty drives learning-by-doing. The scale of the impacts identified in this evaluation suggests that construction phase evaluations can meaningfully enhance the understanding of a facility's lifetime benefits and value for money. The approaches used in future evaluations should reflect the scale and novelty of the facility.
2. This evaluation provides useful resources (such as the Theory of Change and evaluation questions) that may should be utilised to support future construction phase evaluations. Each of the evaluation questions studied in this evaluation yield useful evidence for the impact of the NSTF's construction phase. The Theory of Change and evaluation questions thus provide a basis for future construction phase impact evaluations. Utilisation of these resources is likely to make future evaluation efficient and comprehensive.
3. Future evaluations should take note of the causal mechanisms uncovered during this evaluation to develop useful construction phase Theories of Change. This evaluation builds on STFC's preliminary understanding of the mechanisms by which research infrastructure

[2] A significant body of construction phase impact literature was reviewed as part of this evaluation, and no UK evaluations of similar scope were identified. It is possible that unpublished or otherwise unidentified research of a similar scope has been conducted in the past.

construction phases generate impacts. The evaluation questions and methods employed in this study could provide a framework for future construction phase evaluations, although their relevance for future work will depend on programme context.

Looking to the future

The NSTF is now in its operational phase, having begun servicing its first client in May 2024. To complete the evaluation picture across the NSTF's lifecycle, three further evaluations are recommended, aligned with the Magenta Book framework:

1. A process evaluation of the NSTF's construction phase, to assess the design, procurement and delivery approach. This impact evaluation surfaced themes relating to operational and organisational aspects of delivery (resourcing, governance, knowledge capture) that fell outside its scope. A process evaluation would investigate these themes robustly, drawing on current evidence and reflecting STFC's subsequent organisational changes.
2. An operational phase impact evaluation, conducted approximately ten years into the operational phase, to capture the NSTF's impacts over the remainder of its lifecycle. Monitoring of key outputs and outcomes should take place before this evaluation to maximise its effectiveness.
3. A value for money (VfM) evaluation, undertaken alongside the operational phase impact evaluation. Combined with information about the NSTF's lifetime cost, this would enable a full assessment of the facility's lifetime net present value and benefit-cost ratio.

In preparation for the operational phase evaluation, this report provides a draft operational phase Theory of Change. It anticipates the operational phase will produce a wide range of impacts by:

- Enabling direct cost savings and performance improvements in UK satellite testing.
- Facilitating ongoing knowledge and skills development across the supply chain.
- Supporting sustained increases in highly skilled and specialised employment.
- Enabling technological development across the space sector.
- Anchoring a strengthened supply chain collaboration and outreach activity.

Contents

1 Introduction

The Science and Technology Facilities Council (STFC) commissioned Frazer-Nash Consultancy to undertake an independent impact evaluation of the National Satellite Test Facility's (NSTF's) construction phase. This is UK's first research infrastructure construction phase impact evaluation.[3] It assesses the evidence for the economic, technological and social impacts of the NSTF's construction, thereby contributing to an early understanding of the facility's lifetime impact. The evaluation is designed to be exploratory in nature, providing an understanding of what the construction's impacts are, their magnitude and how they have manifested.

This report presents the findings of the study. It provides a mixed-methods theory-based analysis of the impacts, focusing on the extent to which impacts are *attributable* to the NSTF and *unique* to technologically advanced constructions.

1.1 Scope

This evaluation focuses on the NSTF's construction phase and does not assess its operational phase, where most benefits are expected to materialise. As a result, this study does not provide a full assessment of the facility's lifetime value for money.

Some themes that emerged during evidence collection, particularly those relating to the operational and organisational aspects of delivering the NSTF, were better suited to assessment through a process evaluation rather than an impact evaluation. These themes are summarised in Chapter 8, and a process evaluation is recommended in Section 10.4.3.

Impacts are examined through a set of evaluation questions derived from the Theory of Change using a Magenta Book-compliant approach. These questions reflect the original objectives of the NSTF's construction, which were to:

- Construct the facilities required to provide testing capabilities that will allow the UK to construct more satellites and deliver payloads into orbit.
- Develop the skills required to construct a high-quality testing facility complete with specialist testing equipment.
- Facilitate the partnerships required to construct the facility.
- Drive economic growth locally and in the rest of the UK.

1.2 Summary of the methodological approach

The methodology draws on Green and Magenta Book guidance and the evaluation strategies of the Department for Science, Innovation and Technology (DSIT) and UK Research and Innovation

[3] A significant body of construction phase impact literature was reviewed as part of this evaluation, and no UK evaluations of similar scope were identified. It is possible that unpublished or otherwise unidentified research of a similar scope has been conducted in the past.

(UKRI) to provide a coherent approach to the evaluation of a diverse set of impacts.[4] Figure 2 presents the methodological approach at a high level.

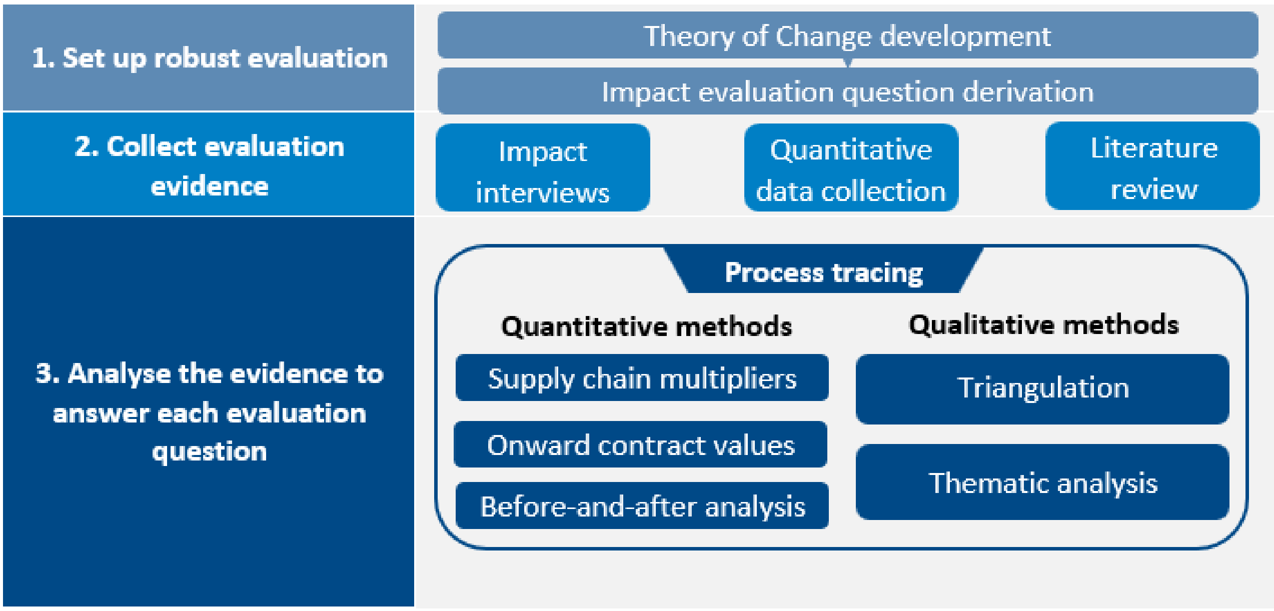


Figure 2. A high-level summary of the evaluation methodology

The evaluation methodology is detailed in full in the technical annexes. The approach is conducted in three stages:

1. Stage 1 develops an initial understanding of the NSTF construction phase and uses this to hypothesise potential impacts and their mechanisms. It also defines a set of evaluation questions to be answered in Stage 3.
2. Stage 2 collects a range of quantitative and qualitative evidence from stakeholders, targeting insight that aligns with the evaluation questions.
3. Stage 3 analyses the collated evidence, employing quantitative and qualitative methods within an overarching process tracing framework to understand the NSTF construction's impacts and how they have manifested.

The NSTF evaluation draws on established methods from UKRI and infrastructure studies while incorporating lessons from Big Science constructions such as the Large Hadron Collider (LHC).[5] Borrowed methods include expenditure accounting to map direct GVA, employment, sectoral focus, and leakage, and input–output (IO) modelling restricted to UK-retained, highly innovative spending to reflect additionality.[6] [7] Qualitative and supplier-level outcome analysis are used to

[4] Green Book (2022); Magenta Book (2011); DSIT evaluation strategy (2025); UKRI evaluation strategy (2024)
[5] (Bastianin et al., 2021)
[6] Independent Evaluation of the National Capability in Behavioural Research
[7] Evaluation of the UK Research Partnership Investment Fund

capture contract wins, capability development, and non-economic impacts, following UKRI and infrastructure literature precedent for process tracing and causal explanation.[8]

Table 1 collates the possible approaches and highlights their inclusion in this evaluation.

Table 1. The methods available to calculate the construction phase's economic impacts.

Method	Summary of approach	Magenta Book compliant?	Used in this evaluation?
Expenditure accounting [9]	Tabulate construction spending by activity	Does not demonstrate impact	✓
Input-output modelling	Use multiplier analysis to calculate economic contributions	Only with clear reasoning about additionality	✓
Qualitative analysis [10]	Recorded engagement with the supply chain	Only with clear reasoning about additionality	✓
Supplier-level outcome analysis	Measure the outcomes of participating suppliers	Only with clear reasoning about additionality	✓
Quasi-experimental evaluation	Compare the outcomes of participating suppliers to a robust counterfactual	Yes	✗

- Expenditure accounting provides an estimate of the direct gross value added (GVA) and jobs supported by the construction. It demonstrates the sectors in which spending was focused and can be extended to evaluate leakage (spending not retained in the UK) and the proportion of spending that is highly innovative. It sets up more detailed analysis and is used to understand the construction supply chain.

- Input-output (IO) modelling calculates supported GVA, jobs and tax receipts throughout the supply chain. In general, the impacts calculated via IO modelling do not have strong additionality. To combat this, the modelling approach focuses only on the NSTF construction's highly innovative spending that is retained within the UK, thereby identifying impacts on a supply chain that would not have been supported if:
  - the NSTF was not built; or
  - a more generic building was built instead.

[8] Transforming Infrastructure Performance Roadmap to 2030
[9] For example, ex-ante analyses of the employment and economic impacts of HS2's construction. (HS2, 2013); (HS2, 2021)
[10] The Impacts of Large Research Infrastructures on Economic Innovation and on Society: Case Studies at CERN

- Qualitative analysis and supplier-level outcome analysis are employed together to provide information about both economic and non-economic impacts. The qualitative analysis is necessary to conduct supplier-level analysis in this evaluation, because it collects data (such as the values of new contracts won) that is otherwise not publicly available. Again, strong reasoning about causal mechanisms is required to ensure additionality, since no counterfactual is observable for comparison.

- Quasi-experimental evaluation, where outcomes are compared to a matched or otherwise robust counterfactual, would provide the additional impacts associated with the construction. Quasi-experimental methods have previously been applied to assess the impact of the Large Hadron Collider's construction on economic and innovation outcomes.[11] Quasi-experimental methods are not feasible in this evaluation, because:
  - The NSTF construction is highly innovative and technically bespoke. It is difficult to determine a set of other suppliers in the UK that would be capable of delivering the facility to form a counterfactual group.
  - The level of innovation and technical challenge associated with non-NSTF constructions is not observable, so suppliers of non-NSTF constructions cannot be used as a counterfactual.
  - Some important economic outcomes (e.g. new contracts won) can only be measured through stakeholder engagement, and no counterfactual group of suppliers is available for this engagement process.
  - The impact of the construction on supplier-level economic outcomes, such as revenue or profit, is likely to vary significantly based on supplier size, and for smaller suppliers, comprehensive data is not readily available.

The employed methods provide a multi-faceted assessment of the NSTF's economic and non-economic impacts, using process tracing to robustly link evidence for outputs, outcomes and impacts while considering additionality. The study's limitations are as follows:

- The qualitative analysis is based on a small sample of five interviews. The sample size is small because the population of suppliers that delivered the facility's innovative aspects is also small. Evidence is triangulated where possible and assessed holistically to mitigate the effects of the small sample. Additionally, some evidence provided by the lead supplier includes data for the rest of the supply chain, which reduces the impact of the small sample further.

- Impacts are drawn from the self-reported experiences of stakeholders, which could carry unobservable biases. Information is triangulated between stakeholder responses and cross-referenced to established literature where possible to identify and reduce bias.

[11] (Castelnovo et al., 2018)

1.3 Report structure

This report is structured as follows:

1. Chapter 1, this introduction, provides an overview of the study scope and approach.
2. Chapter 2 provides background on the NSTF, including a brief description of the facility, a breakdown of its funding, a summary of the Theory of Change and the impact evaluation questions.
3. Chapters 3 summarises the construction's economic impacts, including support to the innovative construction supply chain and an assessment of new contracts won as a result of supplying the NSTF.
4. Chapters 4-8 analyse the construction's non-economic impacts, including the contribution to:
    a. Technological progress.
    b. The development of the local labour supply.
    c. A collaborative supply chain.
    d. The UK space sector's international reputation.
    e. Specialist technical knowledge developed within STFC and reflections requiring further investigation through a process evaluation.
5. Chapter 9 looks ahead to the NSTF's operational phase, including the Theory of Change and anticipated impacts.
6. Chapter 10 draws conclusions.

2 The National Satellite Test Facility

2.1 Background to the NSTF

The NSTF is a facility on the Harwell Science and Innovation Campus that aims to accelerate the growth of the UK space sector by providing world-class, co-located satellite testing facilities. Located at the heart of the Harwell Space Cluster, alongside more than one hundred national and international space organisations, the NSTF provides state-of-the-art infrastructure to strengthen the UK's satellite manufacturing sector. It offers a comprehensive suite of capabilities to test satellite resilience under conditions that replicate actual launch environments and in-orbit operations:

- Acoustic testing: Satellites are subjected to an array of direct field noise amplifiers that collectively reach up to 146 decibels.
- Vibration testing: Satellites are shaken vertically or horizontally from 5 to 2,000 times per second.
- Mass property measurement: A satellite's centre of mass, moments and products of inertia are precisely measured.
- Electromagnetic compatibility chamber: Signals are isolated and assessed so that a satellite's communications system can be validated.
- Large vacuum test chamber: Hosts a satellite in a sealed vacuum environment and can subject the satellite to either extreme heat (100 degrees Celsius) or extreme cold (-178 degrees Celsius).

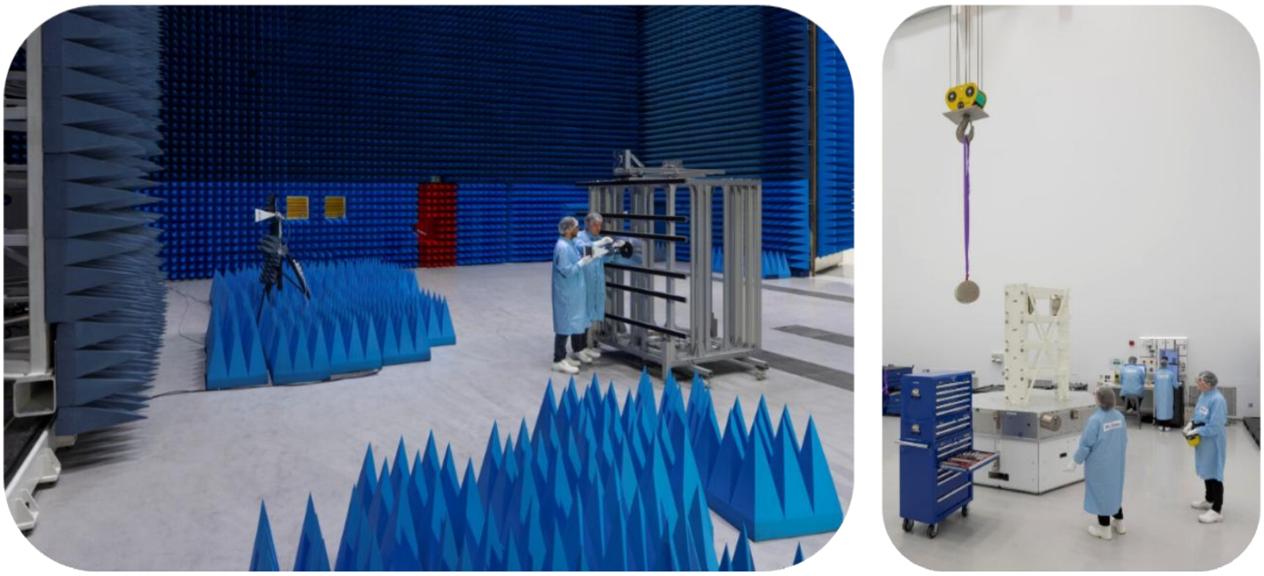


Figure 3. The electromagnetic compatibility chamber (left) and the mass property measurement facility (right)

The NSTF is designed to deliver a unified set of capabilities that is unique in the UK and rare throughout Europe and the rest of the world.

Construction began in 2017 and finished in 2023. The facility serviced its first client in May 2024. In total, the construction cost £117 million and was funded through UKRI's Industrial Strategy Challenge Fund (ISCF). The facility is designed to be commercially viable during the operational phase, so no further external funding is anticipated. As such, the value for money realised by the facility is expected only to increase throughout its operational lifetime. A further evaluation of the operation phase is expected to fully understand the value for money of the NSTF over its lifetime.

2.2 The NSTF's construction spending

The NSTF's total spend is summarised in Table 2. The cost totals are based on STFC's internal financial information and are subject to any assumptions or approximations STFC may have implemented. The £117 million total spend compares to a forecasted total spend of £99 million in the 2017 NSTF full business case.[12]

Table 2. Direct spend on the NSTF's construction, by spend category (GBP nominal)

Category	Approximate spend
Major fixed equipment	12,000,000
Core construction	65,000,000
Facility equipment	16,000,000
Internal fitout	13,000,000
Project management & resource costs	1,000,000
Small contracts, COVID allowance and other labour	10,000,000
Grand total	117,000,000

The construction phase took place during the COVID-19 pandemic. The budget breakdown in Table 2 includes a COVID allowance within the small contracts and other labour line. This evaluation did not investigate the specific effects of the pandemic on the NSTF's construction; doing so would have required a different scope and evidence base focused on cost, schedule and delivery factors rather than impact pathways. The pandemic forms part of the operating context within which the findings of this report should be interpreted.

2.3 The NSTF as a 'Big Science' construction project

The NSTF is an example of 'Big Science': it is a large, technically complex research infrastructure that enables clients to perform scientific tests to better understand their satellite equipment. Most of the economic benefits of the NSTF are likely to be realised during the operational phase,

[12] National Satellite Test Facility Full Business Case (2017)

when clients utilise the domestic testing capability to validate systems, thereby accelerating time-to-market and reducing development costs. However, existing literature highlights that the process of constructing research infrastructures can have tangible economic benefits.[13] [14] These benefits can be classified as:

- The benefits associated with any significant and geographically concentrated construction effort, such as local economic growth, job creation and development.
- The unique benefits that stem from Big Science constructions. These benefits are realised by overcoming the unique challenges associated with constructing large research infrastructure, such as:
  - Enabling precise control of environmental conditions such as temperature, humidity and radiation.
  - Constructing complex scientific apparatus at large scale.

  By addressing these challenges, the literature suggests that suppliers experience innovation, industrial knowledge spillovers, and the leveraging of learning to build new capabilities or spin-off companies.

Previous studies conducted on the European Organisation for Nuclear Research's (CERN's) research infrastructures (most notably the Large Hadron Collider, LHC) suggests that the construction of research infrastructures can generate measurable impacts on suppliers' revenue, profitability and innovation.[15] Although significantly smaller in scale,[16] the NSTF's construction:

- Supports similar sectors to the LHC, including construction, engineering, technical services, technologically advanced manufacturing and installation of large equipment.
- Challenges suppliers to overcome the same types of technical hurdles as the LHC, which are typically not present in generic construction projects.

Therefore, the impacts associated with the construction of the LHC provide a relevant basis for examining the potential impacts of the NSTF's construction.

Foundational literature - The impact of supplying (including constructing) the Large Hadron Collider

The following literature examined the impact of supplying construction, technical and manufacturing services to CERN (mostly for the LHC). It used a mix of survey and quasi-experimental analysis of administrative data.

Table 3. Summary of findings for the impact of the LHC on the outcomes of CERN suppliers

[13] A comprehensive review by Technopolis Big science and innovation
[14] The Economics of Big Science 2.0: Essays by Leading Scientists and Policymakers
[15] Studies include: (Florio et al., 2018); (Castelnovo et al., 2018); (Bastianin et al., 2021)
[16] The LHC cost $4.75 billion (£3.7 billion) to build, around 32 times the cost of the NSTF (with no inflation adjustment)

Florio et al., 2018 Survey of 669 CERN suppliers	▸ 42% of suppliers developed new products; 30% introduced new services; and 21% developed new technologies ▸ 62% of suppliers used CERN as a marketing reference; 62% improved their credibility as a supplier; and 23% acquired new domestic customers ▸ 18% of suppliers reported an increase in sales outside CERN and 16% entered a new market
Castelnovo et al., 2018 Panel data analysis of 360 CERN suppliers	▸ There is a statistically significant impact of CERN involvement on: – R&D effort and patent creation – Productivity, revenue and profitability ▸ The benefits of involvement are concentrated in the most high-tech activities. Particularly, increases in R&D effort and patent applications only manifested for companies classified as high tech.
Bastianin et al., 2021 Quantitative analysis of 263 firms	▸ Affirms the statistically significant impact of supplying CERN on innovation and finds that impacts largely only materialise with a 7–8-year lag.

The results provide a useful basis to understand the potential impacts of the NSTF. They motivate this evaluation to assess similar metrics to understand the extent to which results are transferrable between research infrastructures of different scale, location and context.

Perhaps the most notable result from studies of the LHC is that a significant proportion of the benefits are concentrated in the most high-tech suppliers. It suggests that the proportion of the NSTF's construction that is associated with unique and innovative activity is an important driver of the NSTF construction's economic and technological impact.

2.4 The Theory of Change

The Theory of Change provides a framework to understand the potential outcomes and impacts associated with the NSTF's construction. It is a graphical tool used in impact evaluation to present the hypotheses for a programme's impacts before any evaluation evidence is collected. It maps the programme's inputs, activities and outputs through to its (short- to medium-term) outcomes and (long-term) impacts in a logical chain. The Theory of Change also sometimes maps a programme's impacts to organisational, local or national-level strategic objectives to demonstrate the underlying rationale for the programme. The Theory of Change was developed as part of this evaluation, building on a preliminary construction phase logic model developed by STFC. A full Theory of Change with an accompanying logical framework is provided in the technical annex, demonstrating how each stage is expected to lead to the next. Figure 4 below presents a summary of the Theory of Change.

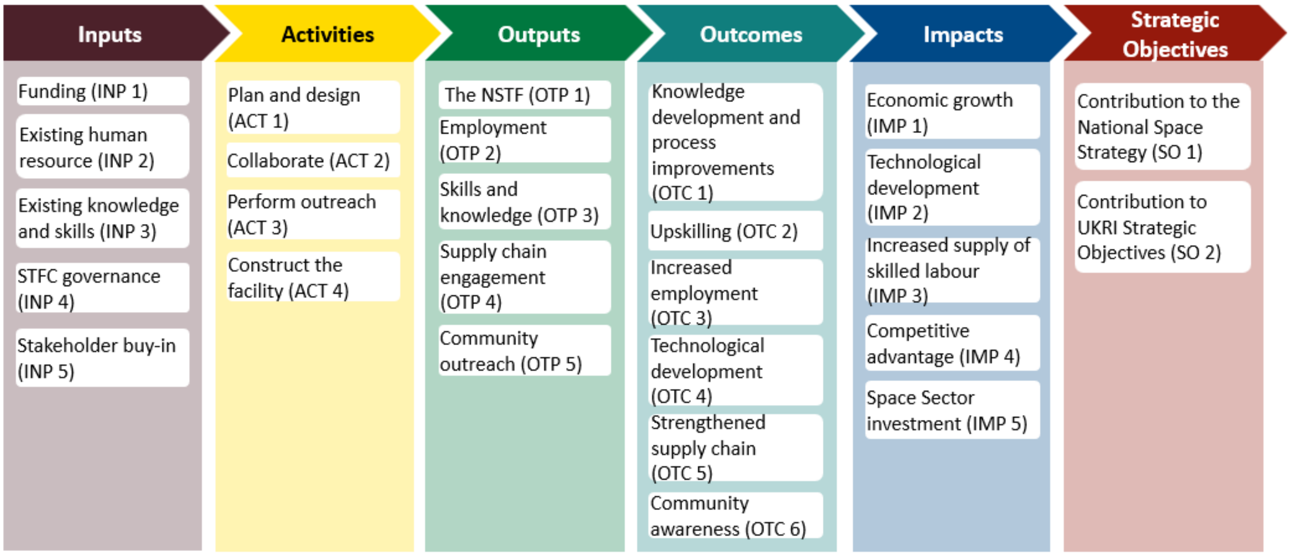


Figure 4. A summary of the NSTF construction phase Theory of Change

The Theory of Change reflects the exploratory nature of the construction phase evaluation. It is designed to capture a wide range of potential impacts, even if the mechanisms by which they materialise are contentious or highly uncertain. This approach ensures that a wide range of evaluation evidence is collected and minimises the chance that the evaluation fails to capture any realised outcomes and impacts.

2.4.1 The rationale for the NSTF’s construction

Prior to the NSTF, the UK did not have an integrated, comprehensive spacecraft test facility; existing test facilities were rare, thinly spread and, importantly, not open access. This capability gap was acknowledged in the 2017 Space Facilities Review,[17] which identified the Harwell Space Cluster as the ideal location for a comprehensive testing facility. By providing a co-located set of facilities, the NSTF avoids the risk and expense of moving a spacecraft across multiple facilities and reduces testing costs and time, encouraging space companies to test in the UK. The UK’s decision to invest in the NSTF was rooted in the recognition that economic growth potential in the space sector was high and capturing global market share was important.[18] Investing in space infrastructure, particularly to support the eight ‘great space technologies’, which included satellites, was seen as an important mechanism to maintain the UK’s competitive advantage in space.[19] Without the NSTF, the UK risked stunting its space sector growth by failing to adequately support a critical part of the satellite development lifecycle, providing a strong justification for investing in the NSTF.

[17] UK Space Facilities Review 2017
[18] National Satellite Test Facility Full Business Case (2017)
[19] Eight great technologies (2013)

Since the NSTF full business case was issued in 2017, the space market and policy context has evolved. These developments affirm the rationale for building the NSTF:

- Satellite launch costs have continued to decline due to the commercial operation of partially reusable launch vehicles. Further cost reductions are expected with the near-term introduction of fully reusable heavy launch vehicles. This trend has enabled a large rise in the number of assets,[20] particularly in Low Earth Orbit (LEO), as launch is a significant contributor to overall system costs. As launch costs fall further, enabling new commercial opportunities, demand for satellites is likely to increase, requiring world-class testing sites.
- The construction of the facility represents a key part of 'Unleashing innovation in the space sector' as part of the 2021 National Space Strategy.[21]

2.4.2 Inputs, activities and outputs

Theory of Change inputs, activities and outputs are the events that reflect the scope of the construction and are in the direct control of STFC. The inputs are the resources required to complete the construction, including funding, human resource and knowledge, governance and buy-in. The activities reflect the tasks required to construct the NSTF. The outputs are the direct result of these activities, including the facility itself, learning-by-doing, employment, supply chain collaboration and outreach.

2.4.3 Outcomes

Outcomes, like impacts, are follow-on events that are influenced by the NSTF's construction but not within the direct control of STFC. Conventionally, the NSTF's construction is said to contribute to these events. There is some dependency on external stakeholders. For example, for the construction to result in knowledge development and process improvements in the suppliers, these suppliers must take voluntary actions that leverage the outputs of the construction activity. The construction is expected to contribute to:

- Knowledge development and process improvements (OTC 1), including specialist knowledge that direct suppliers, the supply chain and STFC can make use of in future work. Collaboration between suppliers is expected to generate knowledge spillovers, and they are expected to develop specialist processes and tools that they can subsequently use in other projects.
- Upskilling (OTC 2) of workers within these organisations, who are expected to develop specialist transferable skills that increase their productivity and improve their career opportunities. These outcomes are expected to materialise due to the high-profile and technical nature of the NSTF's construction.
- Increased employment (OTC 3) within STFC or suppliers by expanding their capability.

[20] (NanoAvionics, 2025)
[21] National Space Strategy (2021)

- Technological development (OTC 4), including increased development of low technology readiness level (TRL) tools and machinery and, potentially, inventions and IP from new technologies used for the construction.
- A strengthened supply chain (OTC 5), owing to an increase in local and national-level collaboration, particularly between a diverse array (in terms of specialisms, size and location) of suppliers.
- Community awareness (OTC 6) of the NSTF, including increased awareness of the facility (e.g. for prospective clients or government organisations) and increased awareness in the local community of opportunities related to the NSTF (such as in STEM fields). More widely, the NSTF's construction reflects the UK's commitment to space infrastructure and is expected to increase UK space sector public support and improve its international reputation.

2.4.4 Impacts

Impacts are the long-term effects that the NSTF's construction is expected to contribute to. These are:

- Economic growth (IMP 1), enabled by the construction activity itself (as value moves throughout the UK supply chain) and because of growth in the suppliers' capabilities, which is expected to enable them to win future contracts that they would not otherwise be able to. Economic growth is expected to manifest through several metrics: a gross value added (GVA) contribution, increased employment and wages, and higher tax receipts.
- Technological development (IMP 2), including the commercialisation of technologies that were invented or refined through the NSTF construction.
- Increased supply of skilled labour (IMP 3), following the apprenticeships and STEM engagement that the NSTF's construction required. This could be realised as an increase in applicants to space-related opportunities, a reduction in hard-to-fill vacancies, or a more diverse and inclusive workforce.
- A UK construction competitive advantage (IMP 4), particularly in the context of complex and technologically advanced projects. The NSTF's construction is expected to contribute to a more capable construction ecosystem with a better linked and more collaborative supply chain. Additionally, it is expected to encourage UK capability development to reduce reliance on imported skills and equipment.
- Increased space sector investment (IMP 5) due to international recognition of the UK space sector's capability and more effective design, procurement and project management of future advanced space facilities, drawing from the learnings NSTF provided.

2.5 Impact evaluation questions

The impact evaluation questions are drawn from the Theory of Change to ensure the evidence collected in the evaluation explores all potential impacts of the NSTF's construction. Table 4 provides a mapping between the evaluation questions and the Theory of Change impacts.

Table 4. The NSTF construction phase impact evaluation questions

Evaluation question	Impacts
Q1: To what extent have learnings from the NSTF's construction been leveraged to win new contracts?	IMP 1; IMP 4
Q2: To what extent has the NSTF's construction contributed to economic growth in the UK construction sector?	IMP 1
Q3: To what extent have learnings from the NSTF's construction been leveraged to invent and commercialise new technologies?	IMP 2
Q4: To what extent has the NSTF's construction improved the quality, quantity and diversity of the labour supply?	IMP 3
Q5: To what extent has the NSTF's construction enabled a more diverse and collaborative supply chain?	IMP 4
Q6: How might the NSTF's construction have improved the UK space sector's international reputation?	IMP 5
Q7: To what extent has the NSTF's construction led to specific changes within STFC that make the future procurement of similar facilities easier, cheaper, or more effective?	IMP 5

The following chapters present an analysis of each evaluation question. The next chapter presents the economic impacts of the construction (evaluation question one and two). The chapters thereafter present an analysis of the non-economic impacts (the five remaining evaluation questions).

3 Supporting construction sector economic growth

Key messages

£36 million of the NSTF's construction spending is classified as highly innovative, reflecting activities that involved technically complex, first-of-a-kind engineering, bespoke scientific apparatus installation, and the creation of precision-controlled environmental systems (attributed to NSTF-specific project design and delivery). £22 million of this spending is retained in the UK, accounting for foreign suppliers and leakage. These innovative construction activities contributed £20.4 million in additional GVA, increased tax receipts by £6.6 million and supported more than 460 job-years throughout the innovative construction sector supply chain. The largest economic effects were concentrated in the construction & civil engineering and architecture sectors.

The NSTF's construction played a key role in enabling suppliers to win at least £180 million of new construction contracts and contributed to winning at least £250 million of additional contracts. These contracts contributed to the production of between £63 million and £151 million of additional direct GVA and between 1600 and 3800 additional supplier job-years, although these figures may not represent net additions to the whole UK economy. On average, each £1 of the construction's innovative activity is estimated to generate between £1.60 and £3.70 in innovative activity in new contracts won. This is consistent with the foundational literature, which suggests £3.38 of innovative activity is generated for every £1 procured.

Table 5 compares the hypothesised impact mechanisms drawn from the Theory of Change to the causal mechanisms in the evidence base. Strength of link conclusions are made using process tracing.

Table 5. Hypothesised impact mechanisms versus evidenced impacts

Mechanism	Hypothesised strength of link	Evidenced strength of link
The new skills and knowledge acquired by suppliers through the construction are leveraged to bid more competitively and win new contracts	Strong	Strong evidence across the supply chain
Supply chain engagement leads to relationships that result in new access to contracts through collaboration or alternative routes to market	Strong	No substantial evidence, plausible in the future
The NSTF, as a technically advanced construction project, acts as a flagship project to advertise suppliers' capability, leading to new contracts	Not explicitly mentioned in the Theory of Change	Strong evidence across the supply chain

3.1 The NSTF's impact on the UK's innovative construction supply chain

3.1.1 The NSTF's innovative spending

The proportion of NSTF construction spending classified as innovative is determined through an analysis of the specific construction activities and the industries of the companies delivering the facility, using Standard Industrial Classification (SIC) codes. The innovative elements include the facility design, specialist equipment and its installation, bespoke engineering work, scientific testing, calibration, and R&D. In total, £36 million (31%) of construction expenditure was associated with these innovative elements, with £26 million delivered by UK-registered companies. [22]

It is important to distinguish between spending delivered by UK-registered companies and spending retained in the UK, as these amounts can differ for two reasons:

- The budget allocated to UK-registered companies could flow to foreign companies via subcontracting.
- Foreign companies could employ UK labour and similarly pass through a portion of their budget to UK companies.

The first effect is quantified using stakeholder estimates and UK supply-use tables, which provide sector-specific domestic output ratios. The second effect is less observable due to limited data on UK contributions through foreign firms; to maintain a conservative estimate, this effect is assumed to be zero. Using this approach, the estimated amount of innovative construction spending retained in the UK is £22 million, representing a lower-bound estimate.

By focusing on elements that are technically complex, first-of-a-kind, and unique to the NSTF, this approach isolates the portion of spending and associated outcomes that can reasonably be attributed to the programme, distinguishing them from standard construction or service activities that would likely have occurred regardless of NSTF delivery.

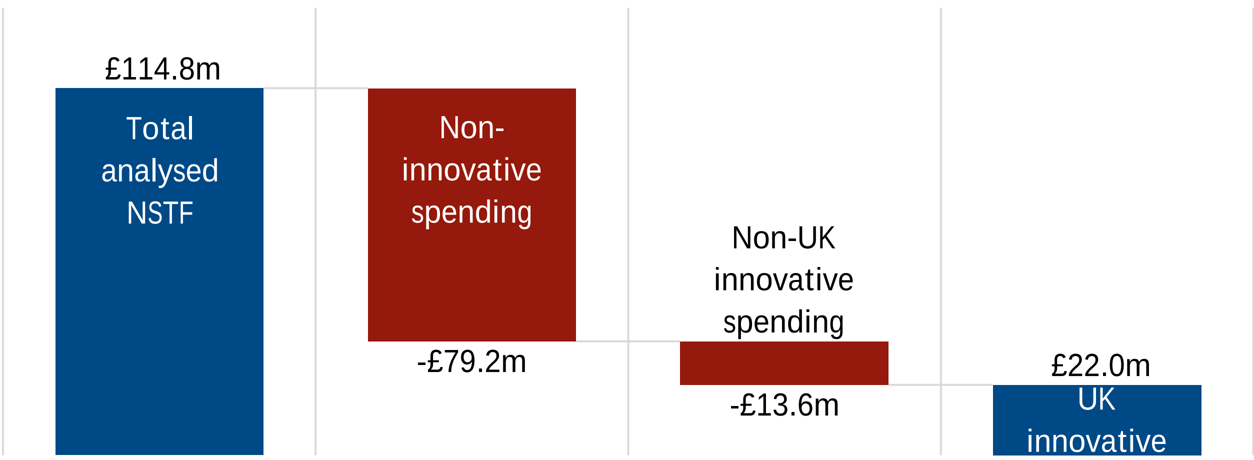


Figure 5. Total NSTF spending, categorised by whether it was innovative and retained in the UK

[22] The total spend on the NSTF was £117 million; only £115 million could be analysed.

As Figure 5 presents, the majority of NSTF spending is considered non-innovative. These elements include the core construction and building work, IT systems, wholesale manufacture, and transport, storage and leasing. Most of the construction's innovative spending was retained in the UK. Table 6 provides a further breakdown of innovative spending.

Table 6. The NSTF's innovative spending retained in the UK, by SIC code

SIC code	SIC code description	UK-based innovative spending (£ 000s)
F41, F42 & F43	Construction	16,800
M71	Architectural activities and technical testing	3,610
C33	Repair and installation	565
C28	Manufacture of machinery and equipment	353
C244, C245	Manufacture and casting of metals	254
C26	Manufacture of computer and electronic products	194
C27, C32	Manufacture of electronic equipment, other products	109
C25	Manufacture of fabricated metal products	72
M74	Professional, scientific and technical activities	50
M72	Scientific R&D	46

3.1.2 The NSTF's support to the innovative construction supply chain

3.1.2.1 Approach to measuring the impact of wider economic activity

An input-output approach is taken to understand the extent to which the NSTF's direct spending supported economic activity in the rest of the UK economy. The model captures the ripple effects of expenditure: when a good or service is purchased, the supplier increases demand for intermediate goods, which in turn stimulates demand for the inputs required to produce those goods. This chain of transactions generates indirect and induced economic activity throughout the supply chain, allowing the analysis to estimate the broader impacts of the programme beyond the initial direct expenditure. Three effects sum to the total economic impact:

- Direct effect: economic activity and employment that is directly related to the construction itself.
- Indirect effect: economic activity in the remainder of the supply chain following from the direct suppliers' purchases of goods and services to perform the construction. This includes, for example, purchases of tools and equipment.

- Induced effect: economic activity supported in the wider economy, as a result of the workers in the construction supply chain spending their wages.

Estimates based on a naive IO model cannot, on their own, be interpreted as additional, as they do not account for the extent to which impacts would have occurred without the NSTF. To address additionality and attribution, the analysis applies two filters:

- Leakage adjustment: Only funding retained in the UK is included, excluding impacts that materialise outside the target area.
- Innovation-based filtering: Only the innovative elements of construction - technically complex, first-of-a-kind activities - such as specialist equipment installation, bespoke engineering, and scientific testing, are included. These are activities that would not have occurred in the absence of the NSTF, so impacts linked to them can be reasonably attributed to the programme.

This approach addresses deadweight, as it excludes activity that would have occurred under a generic construction project. Displacement and substitution effects are not directly measured; however, they are expected to be minimal given the highly specialised, first-of-a-kind nature of the NSTF construction and the limited pool of capable suppliers. Consequently, the estimated impacts provide a robust approximation of programme-attributable additionality.

3.1.2.2 Impact on Gross Value Added

The NSTF's construction injected £22 million of innovative spending into the UK construction sector. This spending represents the value of output produced by those conducting innovative construction activity. A smaller amount, £8.7 million, (the direct effect) is the GVA contribution associated with this activity, calculated as the direct output minus intermediate goods consumed. Intermediate goods are products like raw materials and components, that are used ('consumed') in the creation of more advanced products. They are subtracted from output in the calculation of GVA to avoid double counting when calculating the total value added in an economy.

The £22 million of innovative spending increases demand for intermediate goods by £13.3 million, which in turn contributes another £8.6 million to GVA (the indirect effect) across upstream sectors.

Additionally, the increased demand throughout the supply chain enables workers to spend more in the wider economy, contributing £3.2 million in GVA (the induced effect). In total, the estimated contribution of the construction to GVA in the innovative construction supply chain is £20.4 million.

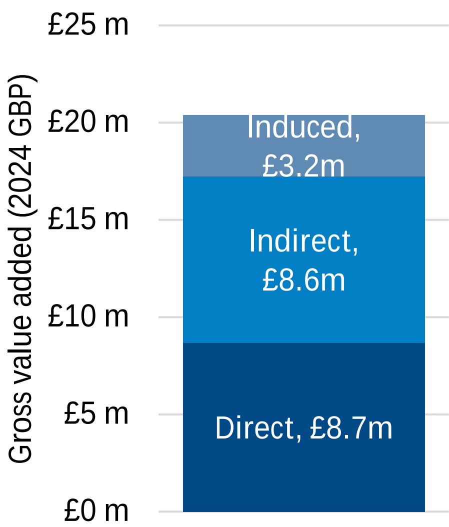


Figure 6. The GVA contribution of the NSTF's innovative activity

Some of the key innovative elements of the NSTF, including the environmental test chamber and the mass properties measurement facility, were delivered by foreign companies. As a result, this highly innovative activity was not retained within the UK. If sufficient skills were available to deliver these elements in the UK, the NSTF's contribution to innovative construction sector GVA would have been larger. Assuming these elements would support similar sectors to the rest of the NSTF, and with similar rates of leakage, the NSTF's contribution to innovative construction GVA would increase 46% to £29.7 million. This effect is visualised in Figure 7, alongside the total economic impact of the NSTF's UK-retained spending, which is £116.8 million. Of the £116.8 million total impact, £96.8 million stems from non-innovative activity. Note that this non-innovative impact is considered non-additional: any generic construction with a similar scope and budget would have achieved a similar effect.

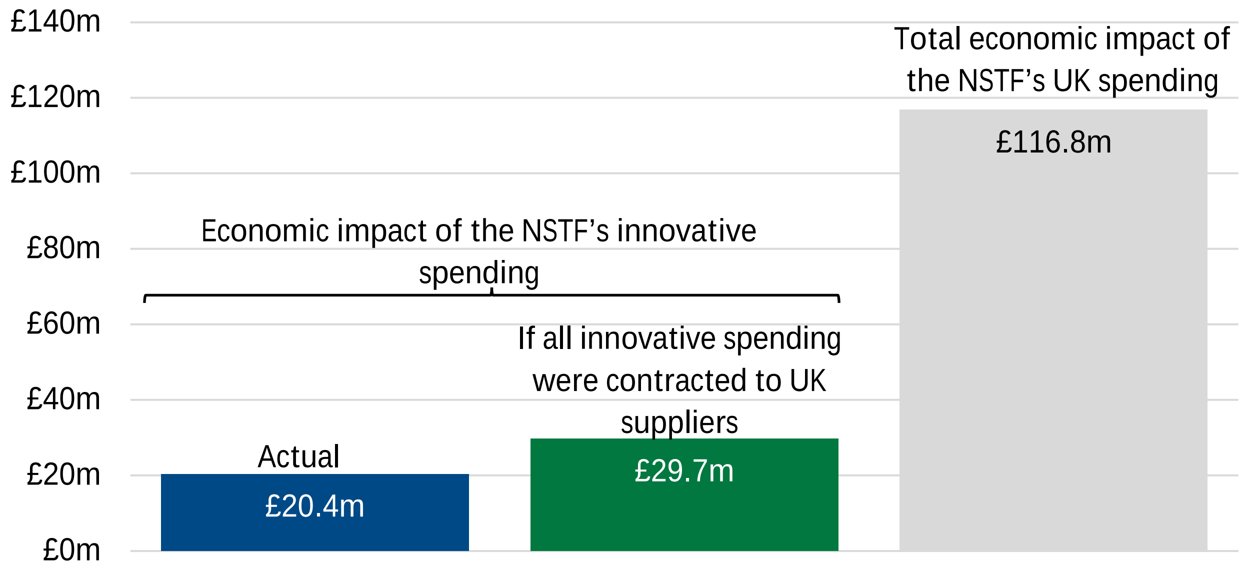


Figure 7. The total contribution to GVA provided by the NSTF's innovative and total activity.

Different elements of the NSTF's construction support the UK supply chain to different degrees. Some activity results in a large amount of economic activity throughout the supply chain (a large economic impact multiplier), while other activity produces a smaller cascading effect. Figure 8 summarises the total economic multipliers (direct, indirect and induced effect) associated with different elements of the NSTF construction's innovative activity.

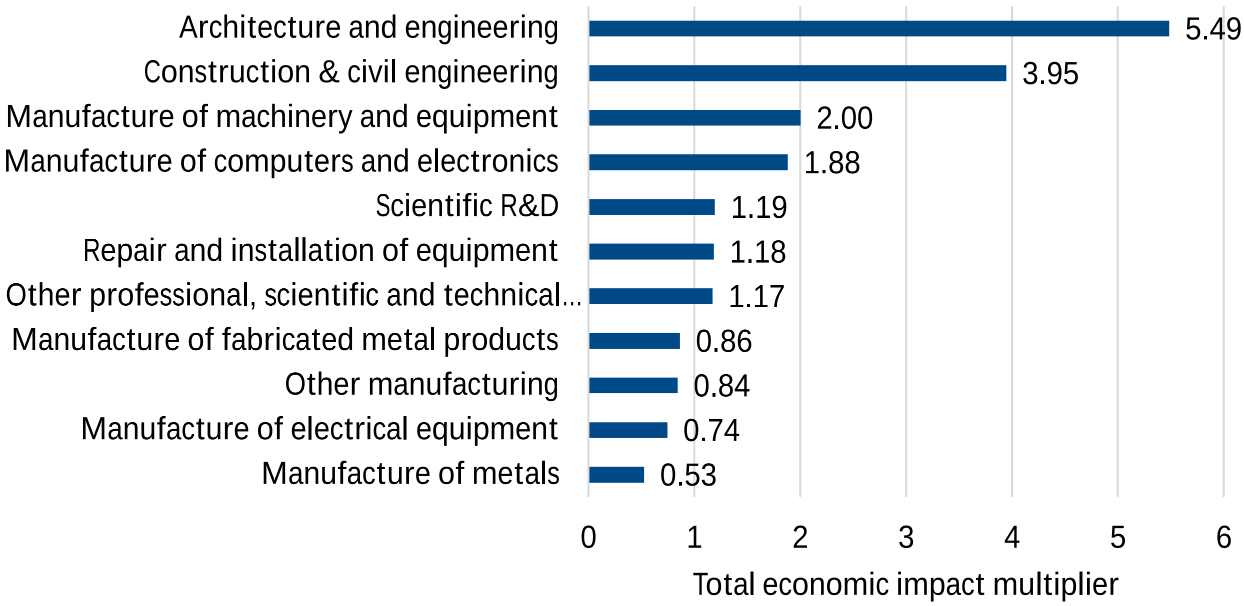


Figure 8. The design portions of the construction are associated with the highest economic impact multipliers.

A total economic impact multiplier of X means that for every £1 of direct output in that sector, the whole economy gains £X in GVA, accounting for direct, indirect and induced effects. Therefore, £1 of NSTF construction spending on architectural and engineering services generates £5.49 of GVA throughout the wider economy. Architectural and engineering activity is a high-skill service that draws on the services of multiple downstream sectors, including construction itself, planning, legal, consulting and environmental services. As a result, the indirect and induced economic activity flowing from this element of the NSTF's construction is significant. Similarly, the construction sector requires materials, design, labour and transport, so spending on construction activity produces a cascade of spending through the economy.

3.1.2.3 Impact on tax revenues and employment

The NSTF construction's contribution to additional output in the innovative construction supply chain yields an associated increase in tax revenues and supports jobs throughout the construction period, measured by job-years.

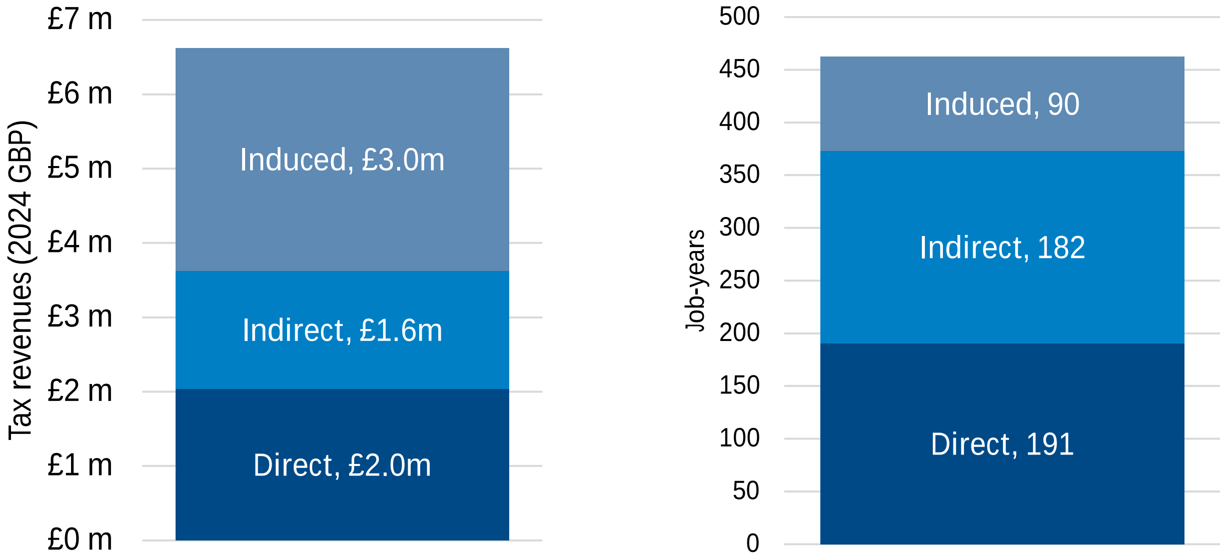


Figure 9. The tax revenues and job-years supported by the NSTF construction's innovative activity.

The NSTF's innovative construction activity contributes to £6.6 million in additional tax revenues and supports 463 job-years across the innovative construction supply chain. The NSTF construction's total impact, including non-additional, generic elements of the NSTF, is £48.5 million in additional tax revenues and 2826 job-years supported.

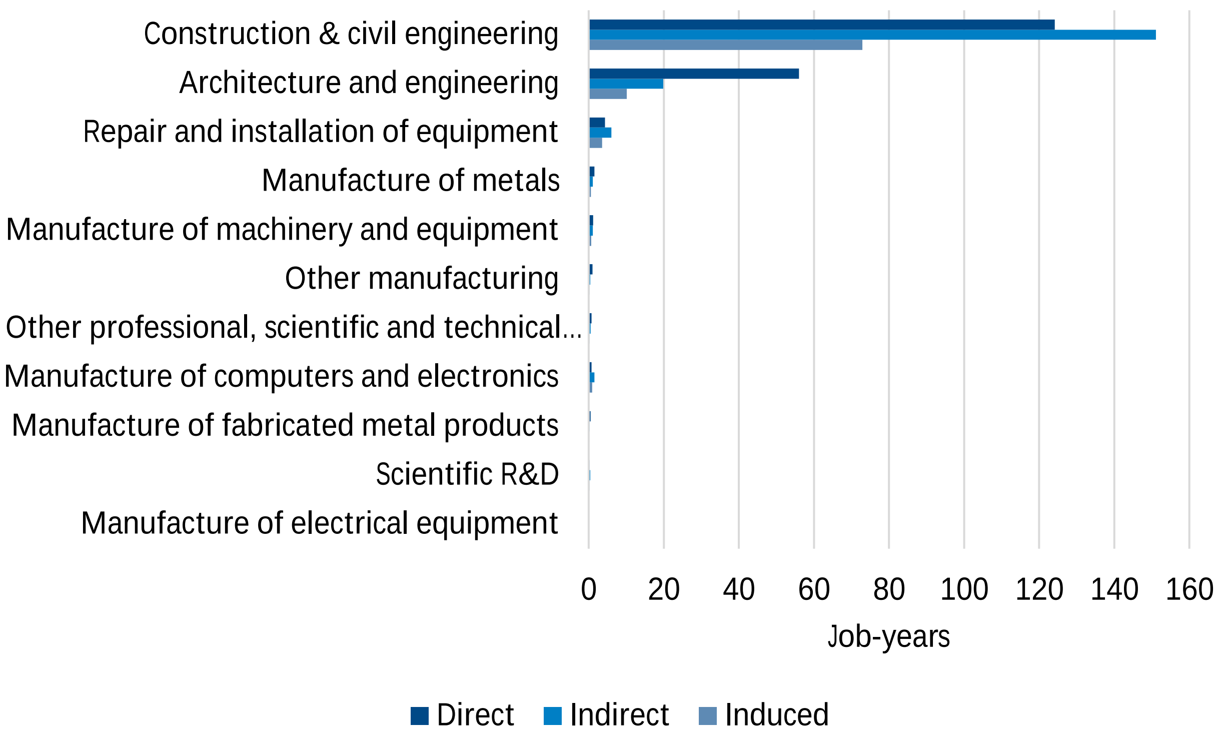


Figure 10. A breakdown of the number of job-years supported by industry (two-digit SIC code).

Most of the jobs supported by the NSTF construction's innovative activity lie in the construction and architecture and engineering sectors. The jobs in these industries carry the learning-by-doing benefits of the NSTF's construction, so the support to these jobs is likely to be a key facilitator of any wider NSTF construction benefits, including career progression and innovation.

3.1.3 Leveraging the NSTF's construction to win new construction contracts

3.1.3.1 How the NSTF's construction has enabled suppliers to win new work

The foundational research from the LHC indicates that suppliers involved in Big Science projects may gain productivity benefits and competitive advantages within their industry. Some of these benefits are difficult to quantify or only materialise after a significant delay. One of the most tangible and easily measurable impacts is the supplier's enhanced ability to secure new contracts that build on the experience and reputation gained by participating in the NSTF construction. The metric serves as a quantitative measure of the spillover effect: specifically, the gain in capability to deliver complex, innovative construction work that NSTF suppliers experience. This analysis focuses specifically on contracts closely related to the NSTF build - those that the supplier would likely not have won without their involvement in the project.

The Theory of Change provides several mechanisms by which participation in the NSTF's construction could enable new work to be won:

1. The complex nature of the NSTF means that substantial knowledge is developed by undertaking the construction. Suppliers can leverage this knowledge to bid for work more competitively and thereby increase their chance of winning.
2. Involvement in the construction of the NSTF, a flagship UK research infrastructure, provides significant outward marketing material for companies to advertise their capabilities to prospective clients.
3. The construction of the NSTF involves many suppliers of varying size and specialism. It encourages the formation of new links across the supply chain, and this could provide access to markets that may have previously been inaccessible.

Interviewed construction suppliers provided significant evidence for the existence of the first and second mechanism. However, there was limited evidence linking the third mechanism to any new contracts.

How the construction enhanced the ability of suppliers to win new relevant work

Table 7. Quotes provided by construction suppliers on the NSTF's influence on their ability to win new work

Participating in the NSTF's construction enabled suppliers to win new work by...	
Leveraging new knowledge to bid more competitively	Marketing flagship capabilities to prospective clients
"Similar to NSTF's EMC – directly transferable skills and knowledge between the two" - Supplier	"Every project in the science and technology market that we bid, NSTF is on the project profiles that we give clients" - Supplier
"The thing that gave us our USP while bidding that was our experience building NSTF and the transferable skills and knowledge that we gave that team" - Supplier	"When they saw what we could build, NSTF, on that scale – that gives someone real confidence" - Supplier
"Again, we were able to demonstrate our ability to take on unique, bespoke, technically complex projects" - Supplier	"[NSTF is] a prestigious site, it ticks all the boxes as a blue-chip client" - Supplier

The quotes are provided in the context of a range of large (>£100 million) and medium-sized (>£10 million) construction contracts that were won after building the NSTF. The quotes provided in Table 7 are a subset of the evidence base. Across the whole evidence base, there is more evidence for the knowledge development mechanism, reflecting the tendency of construction contracts to be won through competitive bidding process. Suppliers suggested that participation in the NSTF construction enabled them to integrate highly specific knowledge into their bids that could only have been attained by delivering similar work, thereby presenting a convincing capability to potential clients.

Therefore, the analysis attributes suppliers' ability to win new contracts specifically to their participation in the NSTF construction by focusing on contracts closely related to the technical and innovative aspects of the project. By isolating work that leverages the unique knowledge, skills, and experience gained from the NSTF, activities that would not have been developed through standard construction projects, the evaluation reflects impacts that are directly attributable to the programme.

3.1.3.2 The new contracts won due to the NSTF's construction

Suppliers provided seven examples of relevant contracts they have won since delivering the NSTF. In total, at least £180 million of contracts are identified as having high levels of attribution to the NSTF's construction: that is, involvement in the NSTF was instrumental and the supplier was unlikely to have otherwise won that contract. Additionally, £250 million of contracts are identified as having medium levels attribution, where the NSTF's construction had a demonstrable influence on the supplier's success.

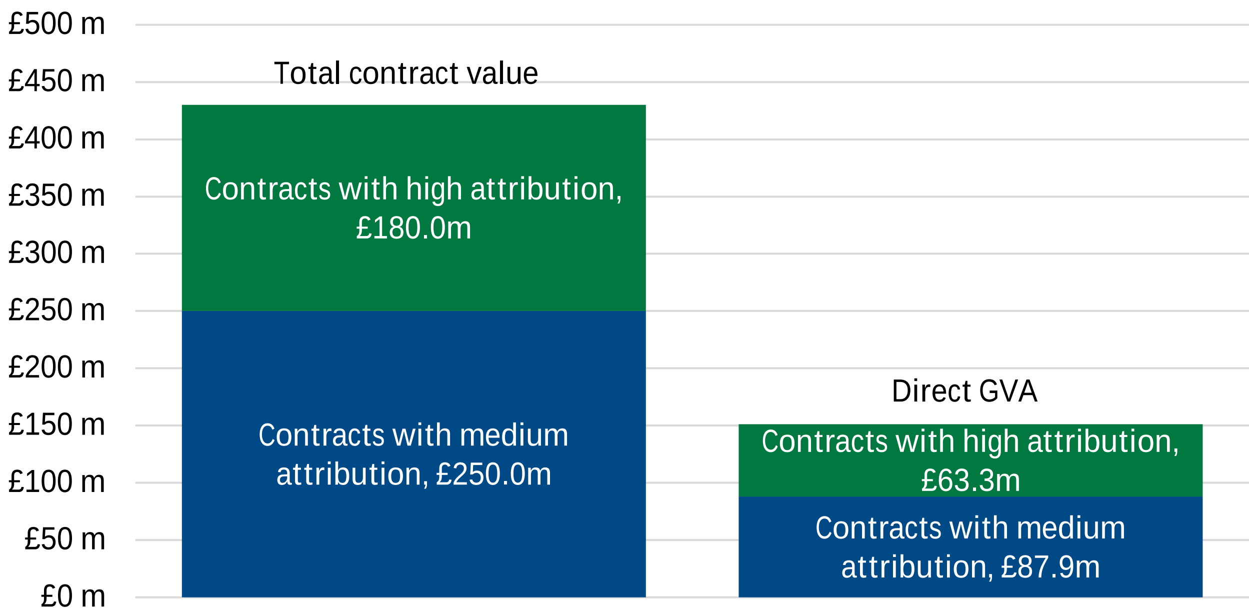


Figure 11. The direct GVA supported by follow-on contracts

The analysis finds the NSTF construction supported suppliers to deliver between £63.3 million and £151.2 million in additional GVA through follow-on work. The lower bound is the set of contracts won with high attribution to the NSTF; those where the NSTF was clearly instrumental in the supplier winning that work. The upper bound also includes those contracts with medium levels of attribution to the NSTF, including where involvement in the NSTF's construction helped to prove a supplier's capability and informed their design and implementation process.

Importantly, the GVA supported by new contracts is not necessarily additional to the UK: UK construction is dominated by UK companies, so it is likely that most of the contracts won would have remained in the UK if not for the NSTF. For this reason, the analysis only features direct GVA impacts (experienced by the supplier), and not indirect and induced impacts (experienced by the wider supply chain, who would have experienced these impacts in any case).

The approximate direct GVA support is associated with an increase in suppliers' tax contributions of between £14.5 million and £34.7 million. Additionally, it supports between 1600 and 3800 job-years within NSTF suppliers. Again, these impacts are not necessarily additional to the UK, but they are additional to the suppliers themselves.

The multiplier effect associated with innovative NSTF construction activity

The NSTF's innovative UK activity amounted to £22 million. Assuming the rates of innovative UK activity are similar for the NSTF and the new contracts won, the NSTF enabled suppliers to deliver between £33.8 million and £80.9 million of new innovative activity.

This represents a GVA multiplier effect of between 1.6 and 3.7. That is, every £1 of NSTF innovative activity generates between £1.60 and £3.70 in additional innovative output for suppliers through new contracts won.

The estimated multiplier aligns with the foundational literature: Castelnovo et al. (2018)'s estimates imply that £1 of technologically advanced CERN procurement is associated with £3.38 in additional technologically advanced revenue for suppliers.[23]

Table 8. Contract 1 – A high-tech testing facility

£100 million	High attribution: Direct influence on the supplier's capability to win and deliver, with the NSTF being the supplier's unique selling point

The supplier led the delivery of a high-tech testing facility, which, like the NSTF, features an EMC chamber. The supplier explicitly described the causal relationship between the NSTF delivery and winning the testing facility work, including examples of valuable knowledge transfer and being able to put forward a team with direct experience working on the NSTF's construction. The supplier produced NSTF-related marketing videos and gave the client a tour of the NSTF to showcase their capability. Their experience building the NSTF also directly informed the design process, enabling them to critically assess the client's requirements and provide detailed advice about potential solutions.

"At the time we were bidding this, we had just produced a big marketing video all about what we've done. So we were able to put that in our bids during the bid process." - Supplier

Table 9. Contract 2 – A pharmaceutical facility

£80 million	High attribution: Direct influence on the supplier's capability to win based on their capability to design complex, first-of-kind, facilities

The supplier described the role of the NSTF, as a first-of-a-kind, highly complex facility, in proving their ability to deliver a construction contract for a pharmaceutical client. It was the client's first design and build project globally, and the supplier was able to showcase their track record in delivering complex and unique projects. The supplier explicitly attributed winning this work to their role on the NSTF's construction.

"The reason that they actually took us on the journey was because it was our first design and build project ever done globally and we were able to demonstrate that we have a track record of delivering the design of complex projects, that were very unique." - Supplier

[23] The estimated impact in operating revenue of 36,975 Euros (from Regression 1 in Table 6 of Castelnovo et al. (2018)) is compared to the operating revenues of the median company of 10,942 Euros (in the corresponding database in Table 1). This provides the increase in firm earnings and relates specifically to the subset of CERN suppliers that are classified as high tech. After excluding estimates that are either not statistically significant at the 1% level or belong to a model that poorly fits the underlying data (by R2 value), the estimated impact of £1 of procurement is estimated to be £3.38. The increase in revenue is experienced by high tech suppliers, so, in the analysis framework of this evaluation, both the original procurement activity and the associated revenue increase are considered as 'innovative activity'

Table 10. Contract 3 – A cleanroom for AR glasses production

Not specified	High attribution: Demonstrable influence on the supplier's ability to win and deliver the work by drawing on the experience gained delivering the NSTF

The supplier built a microelectronics cleanroom for a social media company, building directly on their experience delivering the NSTF's ISO six and seven cleanrooms.[24] The supplier described the NSTF's influence in providing the client with confidence in their ability to deliver the work. Their NSTF experience also informed the way in which the supplier delivered the work, enabling them to apply learning to a contract with the 'same basic fundamentals.'

"When they saw what we could build, NSTF, on that scale, that gives someone real comfort that, wow, if you can build something this big, you can certainly do ours." - Supplier

Table 11. Contract 4 – A neuroscience centre

£200 million	Medium attribution: Clear influence on the supplier's ability to win the work

The NSTF lead supplier took over the construction of a neuroscience centre midway through the project, after the previous main supplier entered administration. The NSTF supplier described two factors that influenced the client to select them as the replacement supplier:

- The team included those that led the delivery of the NSTF, providing concrete evidence of the supplier's capability to deliver complex, technical buildings.
- Some of the process improvements, including the quality forms, were transferred directly to this project.

Table 12. Contract 5 – A pharmaceutical research facility

£25 million	Medium attribution: Relied on the NSTF as the key reference to help win the work

The supplier used the NSTF as a marketing reference to showcase their ability to deliver the pharmaceutical construction. The research facility shares similar challenges to the NSTF, particularly in its requirements to provide tight environmental tolerances. Participation in the NSTF's construction likely played a key role demonstrating the quality of the supplier, although a precise statement on direct attribution was not available.

Table 13. Contract 6 – A research facility

£25 million	Medium attribution: Used the NSTF to demonstrate ability to take on unique, technically complex projects

[24] ISO classes represent the maximum allowable concentration of particles in a space. cleanroom-guide-iso-14644.pdf

Similarly to contract 5, the supplier used the NSTF as a reference to demonstrate their ability to deliver a highly technical facility and resolve unique challenges. Although the facility is smaller than the NSTF, the supplier's experience with first-of-a-kind systems, prefabrication, and temporary works on NSTF was leveraged to build client confidence. The NSTF's reputation as a flagship project in the science and technology sector was also important in positioning the supplier as a capable delivery partner.

"Moving into the research and development space, this is the go-to project, when we're making references in advertising material, bids for future projects, etc. - Supplier

Table 14. Contract 7 – A microelectronics cleanroom

Not specified	Medium attribution: Applied design learnings to and used the NSTF as a key reference, for an overseas client similar to STFC

The supplier delivered a microelectronics cleanroom for an overseas government client with a similar role to that of STFC in the UK. The supplier applied design lessons to inform their bid and the delivery of the project. NSTF's cleanroom construction involved managing large volumes, tight tolerances, and complex airflow dynamics, which are skills that directly transfer to microelectronics environments.

4 Catalysing innovation and technological progress

Key messages

There is strong evidence that the technical complexity of the NSTF's construction drove suppliers to:

- Develop significant specialist knowledge.
- Conduct fundamental research and testing.
- Identify and implement process improvements, including applying new quality assurance procedures and refining their component selection process.

Each of these outcomes is attributable to the NSTF's construction. Suppliers provided evidence that the knowledge, research and process improvements they experienced were highly specific to the NSTF's construction and would not have materialised without it.

Some specialist knowledge has been re-applied by suppliers to improve their capability and enable them to win and deliver further work. Similarly, the process improvements identified by suppliers were applied to future construction projects, demonstrating long-term impact on their capability. There is less evidence that the fundamental research and testing conducted by suppliers was of significant future use, because it is highly specific to the NSTF's environment and requirements and would need to be repeated on any similar different project. However, the R&D-intensive design process had a significant impact on the design of the facility, identifying improvements that could double the number of satellites serviced per year. If this effect does materialise, it represents a significant increase in the NSTF's operational phase's productivity and a large economic return to that R&D spending.

There is no evidence that suppliers have developed or commercialised any new technologies through the NSTF's construction. Some components were rearranged or rescaled to meet the NSTF's specific requirements, but this did not result in any formal intellectual property development.

Table 15 compares the hypothesised impact mechanisms drawn from the Theory of Change to the causal mechanisms in the evidence base. Strength of link conclusions are made using process tracing.

Table 15. Hypothesised impact mechanisms versus evidenced impacts

Mechanism	Hypothesised strength of link	Evidenced strength of link
The NSTF's construction directly encourages technological innovation and IP generation, leading to technology commercialisation	Strong	No evidence, despite some technological adaptation
Specialist knowledge developed constructing the NSTF is leveraged to increase the technical maturity of related	Present but secondary	No evidence

technologies, leading to eventual commercialisation		
Specialist knowledge becomes embedded in suppliers, leading to greater technology-related capability	Present but secondary	Strong evidence across the supply chain
The NSTF's construction prompts suppliers to make sustained improvements to their construction processes	Not explicitly mentioned in the Theory of Change	Strong evidence across the supply chain
The research and development undertaken for the construction results in reusable scientific knowledge	Not explicitly mentioned in the Theory of Change	No substantial evidence, plausible in the future

The Theory of Change provides two possible mechanisms by which suppliers could leverage their involvement in the NSTF's construction to contribute to innovation and technological progress: [25]

1. The NSTF's highly technical requirements encourage suppliers to develop bespoke technical solutions that have potential for reuse beyond the project.
2. The complexity of the NSTF means that robust processes must be adopted to ensure high quality delivery, and these processes are transferrable to other contexts.

4.1 The impact on technological progress

Evidence from suppliers indicates that some targeted technological progress did occur during the NSTF's construction, largely as reusable specialist knowledge and as R&D embedded in the design process. However, there is no evidence that alterations to physical technologies, which were usually highly specific to the NSTF's requirements, were applied within further construction work or commercialised by the supplier.

4.1.1 Transferrable specialist knowledge and know-how

Suppliers reported several examples of the specialist knowledge they accrued during the construction process. In many cases, there is a trade-off between the specificity of the knowledge and how easily it can be reused:

- More specific knowledge offers a larger competitive advantage when bidding for similar contracts, so the incentive for suppliers to embed and build on this knowledge is more significant.

[25] Technology: The practical, especially industrial, use of scientific discoveries. (Cambridge Dictionary, 2025). In this evaluation, we consider physical tools and reusable specialist knowledge to be types of technology. Process improvements are considered a further form of innovation.

- The more specific the knowledge is, the smaller the likely market for the application of that knowledge.

For example, suppliers gained significant expertise in the design of satellite testing apparatus. However, the market for the construction of facilities like the NSTF is small, even globally, so the opportunity to apply this specialised knowledge is limited.

There are several cases, however, in which this limitation does not apply. For example, UK-based suppliers developed expertise in the design and installation of complex mechanical and electronics systems, cleanrooms, and structural components. All these elements are likely to be reapplied on future contracts, enabling this knowledge to become part of the suppliers' business as usual, and thereby becoming embedded within the technical capability of the UK construction sector.

"[The company] now has the knowledge to design complex mechanical and electronics [systems], design complex walls, and a design non-sequential satellite testing procedure in future scenarios." - Supplier

"We had to develop particularly unique fixing methodologies, given that the CLT slab utilised for [the] NSTF was unique to that job" - Supplier

Impact example – design of the NSTF's walls

The NSTF's internal walls are four metres thick, built to isolate the facility from the 146-decibel noise produced in the acoustic testing chamber. The composition of the walls, including layers of air to restrict sound transmission, was developed through a research-intensive design process. This know-how, although potentially not unique, is likely to prove useful in designing a range of other facilities with soundproofing requirements, including other research infrastructures and MRI suites.

Suppliers provided some evidence that the specialised knowledge developed during the NSTF's construction has been applied in further work and is becoming embedded into their capability. Given the innovation lag identified by the foundational literature associated with the LHC, the materialisation of this benefit within two years of the construction's completion is highly encouraging.

"The pre-fabrication expertise, the testing and commissioning in a cleanroom environment – all of those things, the project team have taken on to other projects." - Supplier

"There was an issue with noise and pressure cascade – we overcame that, and we learned a lot – the project we secured for [client] had the same fundamentals so we did apply that learning to that and we will apply it going forward." - Supplier

As should be expected, though, a significant portion of the specialised knowledge developed has not yet been applied in a new context. More time is required to fully understand the extent to which suppliers have retained and reused specialist knowledge, as they win and deliver more relevant contracts that provide the opportunity for this application.

4.1.2 Fundamental research and testing

Suppliers reported several instances in which the unique and challenging conditions presented by the NSTF's construction prompted them to undertake fundamental research to test and develop solutions.

> "What really stands out is all the studies that needed to be undertaken and verified to make sure that [the EMC chamber] functioned correctly…very carefully temperature [and] humidity-controlled environment." - Supplier

> "TVAC (thermal vacuum chamber), the satellite testing area, the shaker room - these are three very unique technical spaces that we have never encountered before." - Supplier

One of the unique complexities of the NSTF's construction was the interaction between the scientific apparatus and the environmental control systems. For example, each feature of the EMC chamber, its significant size, being a Faraday cage, being anechoic (free from echo), being hypoxic (low levels of oxygen), being an Earth-free electrical circuit, was not necessarily challenging in itself, but the combination of all these elements at the same time amounts to significant complexity. As a result, the design and implementation of the chamber required a nuanced approach, with research-intensive design and significant testing to ensure requirements were met.

The lead supplier provided evidence that £1.3 million of its R&D spending qualified for tax credits. The qualifying activity included overcoming design challenges and optimising the NSTF's design to meet operational phase objectives.

> Extract from the R&D tax credit documentation
>
> "After various iterations, [the lead supplier] landed at what is now called the 'hub and spoke solution'. The satellite goes into a central housing area and from there into different test rooms. This non-sequential/parallel design was modelled, and the result was a 50% testing time improvement. [We were] able to double the number of tests carried out within the facility. This has never been done anywhere in the world before."

The documentation reveals a new tangible impact of the construction phase R&D: it increased the potential productivity of the NSTF during its operational phase, thereby increasing the lifetime value for money of the facility. If the estimated productivity increases do materialise, then this will result in highly significant economic gains throughout the NSTF's operation, demonstrating very high returns to the R&D undertaken.

Aside from operational phase benefits, the benefits of fundamental research are more difficult to link to tangible impacts than the specialist industry knowledge that flows from learning-by-doing. There is ample evidence from outside this evaluation that fundamental research and development contributes to positive outcomes in the construction sector. For instance, the Construction Leadership Council linked large increases in R&D effort since the COVID-19 pandemic to improved productivity in the construction sector.[26] Additionally, a 2022 impact evaluation of UKRI's Transforming Construction Challenge (TCC) found that participation in the TCC, which aimed to increase R&D in the construction sector, was linked to:

- profitability, productivity and speed of delivery; and,
- reduced waste and environmental benefits

through survey evidence of self-reported outcomes.[27] However, this evaluation is unable to link research and development effort to any such benefits, because:

- The effects of research and development are difficult to disentangle from other learning-by-doing and process improvement effects.
- No evidence was provided by suppliers on the impact of research on cost- or time-efficiency and productivity for the suppliers themselves, in a way that would be transferrable to other projects and contexts.
- Other impacts, including environmental benefits, are not routinely measured on a project-by-project basis.

4.1.3 Physical technology, intellectual property and patents

Interviews with suppliers revealed no evidence of the invention or commercialisation of physical technology (such as components or tools). Some components were adapted under a novel design to overcome the challenges of the NSTF's construction (notably scale), but these adaptations focused on the arrangement of technologies, rather than the fundamental design of the technologies themselves.

> "Due to site and planning constraints, it was not possible to place traditional [components] outside of the operational areas of the building whilst maintaining the desired test floor areas, requiring [us] to undertake R&D activities to devise a novel solution…By separating the filtering from the pressure requirement, the traditional [component] function was effectively split into two separate operations." - Supplier

Additionally, a search of suppliers' filings with the Intellectual Property Office reveals no evidence of any patents filed in relation to their work on the NSTF's construction.

4.2 The contribution to process improvements

Suppliers indicate that the unique stresses imposed by the NSTF's construction have led to process improvements across two domains:

1. Quality assurance (QA).

[26] Creating a Productive environment for UK Construction (Construction Leadership Council, 2023)
[27] Transforming Construction Challenge Evaluation (Frontier Economics, BMG, 2022)

2. Component selection.

4.2.1 Impact on quality assurance processes

The complexity of the NSTF's construction meant that small mistakes were difficult to find and could have a large impact on the functionality of the facility. This prompted work to be conducted in smaller steps, introducing QA checks every hour. By rolling out this change, the supplier was able to complete the construction of the EMC chamber with less time spent troubleshooting, ultimately accelerating the construction process. This QA methodology is being rolled out more widely following its successful application within the NSTF build.

> "We introduced QA checking every hour…it has proven its worth on NSTF – we are updating our documents and doing 'beta testing' on other jobs." - Supplier

Moreover, this process improvement has been used to demonstrate capability to potential clients, enhancing the UK construction sector's perceived and actual capability. The supplier notes that the level of QA developed under the NSTF construction gave a client confidence that the team was able to build and deliver to its requirements.

> "If you put a screw in and you over-screw it, it creates a short and it nullifies the capabilities of that route…We spent a couple of weeks trying to find where the problem was and that's when we introduced this [hourly] QA checking." - Supplier

4.2.2 Impact on component selection

The physical dimensions and requirements of the NSTF placed stress on components, leading suppliers to conduct stringent tests to ensure solutions were robust. Through this process, suppliers identified flaws in suppliers' products that may otherwise have gone unnoticed, enabling them to make tangible improvements to the design and material composition of their solutions.

> "When you have a job of that scale you do find the weaknesses in [your suppliers'] products." - Supplier

> "There are very bespoke examples of knowledge learning in terms of materials and design features." - Supplier

Limited evidence was provided to suggest these improvements have been carried forward by suppliers into new projects. If the improvements are retained, then this effect has the potential to strengthen the UK supply chain for specialised construction solutions, which would enhance the competitiveness of the UK construction sector.

> "[Our supplier's products] were under more pressure because of the type of facility and the physical dimensions…99 times out of 100 they get away with it." - Supplier

5 Strengthening the local labour supply

Key messages

The NSTF's construction contributed to both the expansion and the upskilling of the local labour force. It resulted in at least 40 new roles across the supply chain and STFC, including those entering the workforce and the hiring of experienced staff. Interview evidence from both STFC and the suppliers suggests that the project also supported skills-building and enabled workers to progress into more advanced positions. Evidence for the existence and attribution of these impacts is strong: the evidence suggests the opportunity and incentive to recruit new talent was a direct result of the requirements of the NSTF's construction. However, the magnitude of the labour supply increase in the supply chain is relatively small, so is likely to make only a marginal difference to suppliers' capacity.

Evidence on diversity-related impacts is limited. While the construction did foster a diverse local skillset, there was no indication that it addressed the existing low levels of diversity in construction, including the participation of women and minority ethnic groups.

compares the hypothesised impact mechanisms drawn from the Theory of Change to the causal mechanisms in the evidence base. Strength of link conclusions are made using process tracing.

Table 16. Hypothesised impact mechanisms versus evidenced impacts

Mechanism	Hypothesised strength of link	Evidenced strength of link
Overcoming the technical challenges associated with the construction provides workers with valuable skills and knowledge	Strong	Strong evidence across the supply chain
The NSTF's construction directly generates new employment opportunities, and these jobs are sustained	Strong	Strong evidence
Working on the NSTF's construction enhances workers' career opportunities and enables workers to get promoted	Present, but secondary	Strong evidence, but counterfactual is unclear
The NSTF's construction makes it easier for STFC to recruit talent by increasing applications to space-related opportunities	Present, but secondary	No evidence, but plausible in the future
The NSTF's construction encourages recruitment from a diverse array of backgrounds, contributing to improvements in construction sector DEI	Present, but secondary	No evidence

5.1 Expansion of specialist teams

The NSTF's construction provided suppliers with the opportunity and motivation to take on eleven new apprentices, two trainees and two graduates throughout the supply chain. In total, these workers dedicated more than 500 weeks (around 10 job-years) of training to the NSTF's construction, as summarised in Table 17.

Table 17. A breakdown of the training of new roles undertaken throughout the supply chain.

Role	Number of roles trained	Total training weeks
Apprentice	11	442
Graduate	2	34
Trainee	2	33

Several of these roles are likely to have encountered the highly innovative aspects of the NSTF's construction. The apprentices included electricians, who worked on complex mechanical-electrical installation; an apprentice who worked on the cleanrooms; and site managers, who were exposed to each aspect of the facility's construction. Other roles included joinery, health and safety and construction assistance roles. While the current role of most of the trained workers could not be identified, of those that could, all either: [28]

- Remained with the company that trained them, in a more advanced role.
- Moved to a company in the same sector, in a more advanced role.

This indicates that the individuals trained under the NSTF's construction derived sustained value that may have helped to advance their careers. Also, the high levels of retention in the construction sector indicate that trained roles contributed to a small but lasting increase in suppliers' labour capacity.

The impact of the NSTF's construction on recruitment in STFC

The NSTF's construction was a catalyst for workforce expansion within STFC's technical teams. The construction's requirement for niche technical expertise led STFC to build an electromagnets group, an entirely new capability. STFC has also invested in training new members of the workforce through degree and degree apprenticeship routes, contributing to the growth of a high-quality local labour supply.

> "On the dynamics team, we've had two, if not three people go through degrees that that we've paid for. On the thermal vacuum group, we've got a couple of people who came through the apprentice HND route." – NSTF programme lead

[28] Only 5 of the 15 apprentices, trainees and graduates could be identified.

5.2 Upskilling, knowledge transfer and spillovers

There is strong evidence that the NSTF's construction contributed to an increase in the quality, as well as quantity, of the local labour supply. The construction phase acted as a platform for upskilling, career progression and the transfer of specialist knowledge.

> "Our consultants – they've been educated, they've come on the journey." - Supplier

The construction process facilitated knowledge transfer across the supply chain from collaboration, education and learning-by-doing. As a result, the project teams have become more effective at designing, implementing and managing complex construction solutions.

> "There's continual upskilling. When money is available, we like to support people." – NSTF programme lead

The increase in the commercial value of these individuals has had a tangible impact on career progression. Both STFC and the construction suppliers report several instances of individuals being promoted in direct relation to their role on the NSTF's construction.

> "There's been a lot of people that, off the back of that job, have been promoted." - Supplier

This implies that participation in the construction serves as a strong signal of an individual's capability, highlighting the significance of the NSTF as a flagship construction project.

> "We have totally upskilled [the EM group] because we didn't have those skills at all, and there have been promotions and people have done reasonably well out of it." – NSTF programme lead

STFC's role as a talent incubator

STFC operates as a publicly funded, highly technical organisation with different incentives to a commercial supplier. It aims to contribute to UKRI's strategic goals, including 'Objective 1: World-class people and careers', and therefore prioritises upskilling and specialisation. While some staff trained under the NSTF's construction have been retained by STFC, boosting its capability, others have moved on to new organisations

> "We're now getting to the point where people have gained some experience with us and they are resigning to go and do better jobs somewhere else. They've been headhunted and poached to go to other places." – NSTF programme lead

Departing members of STFC staff have moved on to other research infrastructures or entered the private sector. This implies that benefits of STFC's upskilling extend beyond the organisation itself, strengthening the national (and sometime local) skills base in science, engineering and specialised construction.

6 Enhancing collaboration across the supply chain

Key messages

The NSTF construction's supply chain has three distinct levels: the primary supplier, with overall responsibility for the contract; specialists that support the construction of a specific element of the facility; and the skilled labour (contractors) and vendors that support the upper levels. There is strong evidence that the third level employed a significant number of local contractors, particularly when the NSTF's construction coincided with the Rosalind Franklin Institute and the Extreme Photonics Applications Centre (EPAC).

The construction supported significant relationship-building throughout the supply chain. There is strong evidence that the upper levels of the supply chain benefited from knowledge spillovers gained by collaboratively working with specialists to resolve the NSTF construction's technical challenges. The lower levels of the supply chain also benefited, being provided with consistent and regular work that familiarised them with primary suppliers' ways of working, standards and technical capabilities.

There is also emerging evidence that the construction enabled the primary supplier to form valuable relationships with specialists, which may increase the speed at which they are able to mobilise on specialist build projects in the future.

Table 18 compares the hypothesised impact mechanisms drawn from the Theory of Change to the causal mechanisms in the evidence base. Strength of link conclusions are made using process tracing.

Table 18. Hypothesised impact mechanisms versus evidenced impacts

Mechanism	Hypothesised strength of link	Evidenced strength of link
The NSTF construction's technical challenges induce suppliers to work collaboratively to find solutions, forming valuable new relationships and facilitating knowledge transfer that strengthens the supply chain	Strong	Strong evidence across the supply chain
The NSTF's construction exposes suppliers to new companies in the supply chain, providing a new route to market	Strong	Some evidence of the benefits of consistent work
The NSTF's construction brings together suppliers with existing relationships, strengthening them through collective capability development	Present, but secondary	Almost all relationships are new due to the novel nature of the NSTF

The NSTF's construction strengthens the UK construction supply chain, and therefore its competitiveness, both by providing economic support (as explored in section 3) and by increasing the quantity and quality of collaboration between suppliers. The Theory of Change identifies several mechanisms by which the NSTF could contribute to enhanced supply chain collaboration:

- By forming new relationships between suppliers, particularly those with different specialisms, the construction facilitates mutually beneficial knowledge transfer.
- The NSTF supply base is composed of large organisations capable of taking full responsibility for a construction (the lead supplier) and small and medium sized enterprises (SMEs) that could deliver specialised support. For an SME, a new relationship with the lead supplier is valuable because it could result in further work that was previously inaccessible.
- The NSTF may strengthen existing relationships in the supply chain, enabling ongoing close collaboration and collective capability development.

6.1 The NSTF supply chain

The NSTF's construction employed at least 48 unique companies registered in the UK, as well as companies from the USA, Germany, Italy and Luxembourg. The companies registered in the UK[29], which account for 91% of directly employed total spend, are mapped to Office for National Statistics (ONS) Standard Industrial Classification (SIC) codes to highlight the industries in which spend was most significant.[30] A detailed work breakdown structure was not available, so the SIC codes are mapped at a company level. Consequently, the analysis carries the implicit assumption a supplier's contribution to the NSTF's construction is in line with their wider business activities.

The analysis considers two layers of the supply chain:

- The suppliers contracted directly by STFC.
- A list of the primary supplier's subcontractors.

> "Any mechanical and electrical supplier will work with 12 to 15 specialist subcontractors and probably another 10 to 15 specialist vendors." - Supplier

Insufficient data is available to assess the next level of the supply chain: those that supplied the primary supplier's subcontractors. However, interviewed subcontractors did provide evidence that this level exists. Figure 12 provides a simplified model of the NSTF construction supply chain.

[29] Note that multinational companies are often register in the UK even if their primary business activity is elsewhere. A small number of the UK-registered companies are primarily from a country other than the UK.
[30] Companies are mapped to ONS SIC codes using Companies House data.

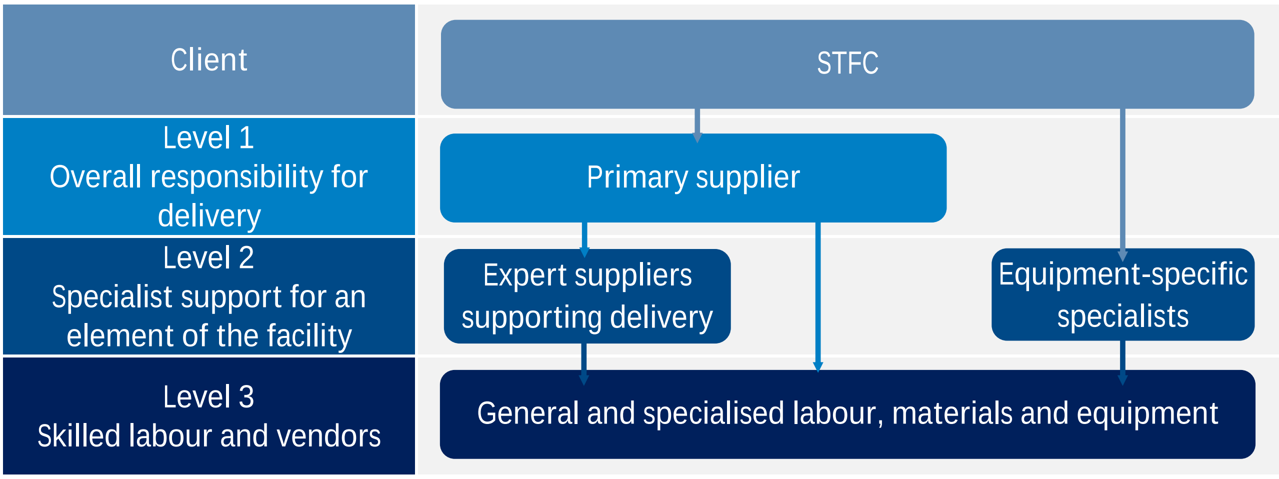
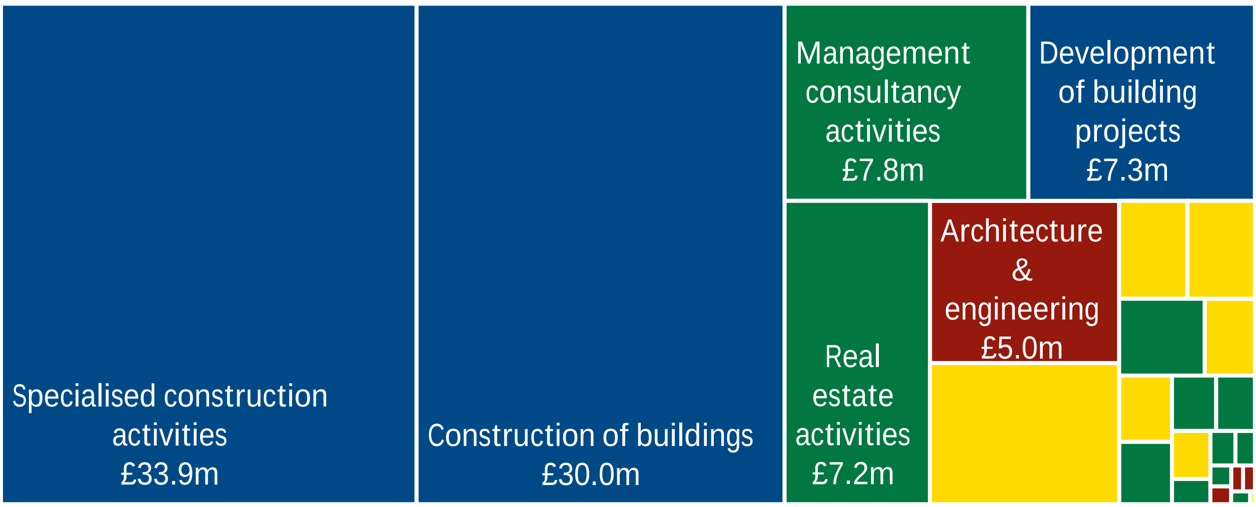


Figure 12. A simplified illustration of the NSTF construction supply chain. Arrows indicate contracting arrangements.

The SIC code analysis divides the (UK-registered) NSTF construction activity into four categories:

- Construction (£73.7 million): Core construction activity
- Support services (18.0 million): Transport, real estate, digital and personnel-related services
- Manufacturing (£8.0 million): Structural elements, machinery and tools
- Design (£5.2 million): Architecture, engineering, testing and analysis

It excludes £10.1 million contracted to non-UK-registered suppliers and another £2 million of miscellaneous labour costs. Figure 13 provides the industry breakdown.



Construction; Support services; Manufacturing; Design

Figure 13. Direct NSTF construction spending by SIC code

The NSTF's construction was delivered by a mix of national companies, multinationals and SMEs. The primary supplier received £76.5m, equivalent to 65% of the total funding. More than 40 suppliers received up to £500k and a further 9 suppliers received between £500k and £13m. However, the number of companies that contributed to the construction of the NSTF far exceeded those employed directly by STFC. It was the responsibility of the suppliers (particularly the primary supplier) to identify and employ (often local) subcontractors with the specialist skills required to deliver the building. For example, the primary supplier employed at least 20 subcontractors to support their delivery, and these subcontractors often employed further specialists to support their package of work. As a result, there was a significant amount of funding that flowed through the different levels of the supply chain.

6.2 Developing the local supply base

Less than £2 million of STFC's direct funding (the first level of the supply chain) was allocated to companies based within 50 miles of the Harwell Campus. The majority of UK-allocated funding was to companies based in London, slightly outside the 50-mile radius.[31] The primary supplier, while based in London, has an established local presence, having delivered both the Rosalind Franklin Institute and the Extreme Photonics Applications Centre (EPAC) on the Harwell Campus around the same time as the NSTF.

> "I'm not aware of a local construction company with its headquarters within 30-40 miles of here that would be big enough to win this contract." – NSTF programme lead

> "The preference is that they're working with relatively local companies, if only because it just means the cost of getting them here on a call out charge [is avoided]." – NSTF programme lead

The second level of the supply chain employed a small number of local companies, particularly for the standard, non-innovative elements of the construction. In general, though, the local community was unlikely to possess the specialist skills required to conduct the innovative elements of the construction, and these were usually contracted to national or multinational companies.

This reflects a broader structural feature of high-tech research infrastructure builds: the most technical work packages tend to be dominated by companies with very specific capabilities, limiting the scope for deep local involvement at the upper levels of the supply chain.

In day-to-day delivery, the suppliers had an incentive to employ local labour to reduce the portion of their budget consumed by travel time and expenses. As a result, the third level of the supply chain (skilled labour and vendors) likely had a much higher proportion of the workforce be local than the upper two levels, although the exact extent of this cannot be quantified with the available information. The NSTF's effect on the local supply base, therefore, was concentrated on this third level.

[31] Location is determined according to the location of a company's main office listed on Companies House.

The largest local impact was driven by the establishment and strengthening of two sets of relationships:

- The primary supplier (level 1) and skilled labour and vendors (level 3)
- Specialist suppliers (level 2) and skilled labour and vendors (level 3)

Interviewed suppliers provided strong evidence that the NSTF, alongside other highly technical constructions taking place at Harwell, has supported these relationships and enabled the cultivation of a strong local supply base. While the primary and specialist suppliers often operate at a national scale, both groups relied heavily on the availability and capability of local labour to deliver work efficiently. As a result, suppliers described making deliberate efforts to integrate local tradespeople into their project teams and to build longer-term partnerships with firms based in the region.

> "We've brought these companies on a journey, giving them regularised work, making sure they feel they have a long-term workstream with us in that area." - Supplier

> "We try to ensure that their project teams include people who live in or near Oxford... we're always trying to cultivate our supply chain." - Supplier

This approach meant that local companies and labour were embedded within the supplier's delivery model, rather than simply fulfilling isolated tasks. Repeated engagement across several Harwell projects enabled some local companies to develop familiarity with the supplier's systems, expectations, and quality standards, which may position them mobilise quickly and effectively in the future and secure further work with the same suppliers.

A further way in which the NSTF shaped the local construction ecosystem was by providing large-scale, continuous activity on the Harwell Campus during the build period. Interviewees emphasised that the three major facilities delivered in parallel (including the NSTF) effectively absorbed a large share of the skilled local tradespeople.

> "[The lead supplier], with the three contracts on site hoovered up pretty much all the local electricians, all the local carpenters, all the local plumbers. And they might have bounced from one site to the next depending on what phase of the project they each of those buildings was in. But they had broadly sucked up everyone who was local." – NSTF programme lead

This absorption effect had two consequences:

- It created a steady pipeline of work for local trades over multiple years, allowing smaller suppliers to plan for consistent income in a way that is not always possible in construction markets characterised by short project cycles.

- It generated spillovers across projects: labour moved between the NSTF, the Rosalind Franklin Institute and EPAC as their construction phases shifted, reinforcing continuity of employment and strengthening worker familiarity with the standards and requirements associated with high-specification research facilities.

The benefits for local companies were not uniform. While some evidence exists that small suppliers benefitted from repeated engagements, the working environment and compliance expectations associated with a lead supplier did not suit all local suppliers. This selectivity suggests that the NSTF construction's contribution to local capacity-building was uneven: it enhanced opportunities for adaptable, well-organised companies but may not have elevated the broader capability of the entire local construction sector.

> "As [the lead supplier] has won other contracts in the Oxfordshire area, the local suppliers that they liked and were happy working with, they have taken with them. But there's no guarantee that they've taken all of them." – NSTF programme lead

> "The local supply chains, they're certainly benefiting the smaller local companies that have the skills and are willing to work under a large corporate organisation with all its rules and regulations…Those that wanted to have probably done well out of the [lead supplier's] presence here on the campus." – NSTF programme lead

Insufficient data is available from the lower levels of the supply chain to assess the magnitude of repeated contracting. However, the qualitative evidence does indicate that the NSTF's construction acted as a gateway for local suppliers to secure future opportunities in the region, and that this effect was strengthened by the clustering of similar projects in location and time.

> "It is built into the initial contract negotiation…[the] corporate sustainability statement and it's implicit: you will look to maximise use of local suppliers in order to grow local supply chains." – NSTF programme lead

6.3 Strengthening relationships at the upper levels of the supply chain

There is strong evidence that the NSTF's construction facilitated meaningful relationship-building and knowledge exchange between the primary supplier and specialist suppliers. The NSTF's construction enabled close collaboration, building capability and forming emerging relationships that may prove valuable in future similar projects.

6.3.1 Developing intelligent customers within the supply chain

The NSTF's construction supported capability-building within the project team and enhanced relationships between the primary supplier and specialist suppliers. The NSTF construction fostered close collaboration between STFC, the lead suppliers and specialists, both in designing the facility and in overcoming issues throughout the project. Several described a working culture in which challenges were approached collectively, reflecting the project's technical complexity and the need for flexible, responsive problem-solving.

"In terms of problem solving… any challenges were taken on as a team." - Supplier

"As a team, ourselves and [the lead supplier], it was very collaborative… especially if things were going wrong." - Supplier

"The specialists had that knowledge – so that knowledge now sits within [our team]." - Supplier

This collaborative dynamic helped to maintain progress during technically demanding phases and, potentially, strengthened mutual trust between partners. It resulted in knowledge spillovers between suppliers. While much of the specialist knowledge initially resided in national-level suppliers, repeated interaction over the construction period transferred some of that knowledge to STFC and the lead supplier.

"We have experience now of working with consultants and specialists in that sphere and we can bring knowledge and understanding… instead of being a passenger." - Supplier

These reflections indicate that close collaboration with specialists strengthened the lead supplier's own technical capability, enabling their teams to absorb elements of specialist expertise and apply them across different aspects of the build. This learning effect is particularly valuable in high-innovation construction contexts, where a supplier's ability to interpret complex technical requirements, anticipate risks and propose robust solutions can significantly influence delivery performance. Over the course of the build, this contributed to the lead supplier becoming a more informed and confident technical partner, increasing their capability to deliver similar contracts in the future. This effect manifested for the lead supplier and the specialist suppliers' ability to win new similar contracts, as outlined in section 3.2.3.

However, the evidence largely reflects the perspectives of direct project teams, and there is limited visibility of whether these spillovers have translated into broader increases in capability across these organisations. The extent to which the knowledge spillovers are retained in the future depends on the effectiveness of the suppliers' information management systems.

6.3.2 Emerging networks at the upper levels of the supply chain

The evaluation did not identify any tangible examples of repeat work between the upper two levels of the supply chain. This finding, however, seems rooted in circumstances as, rather than an unwillingness to collaborate further, such as that:

- insufficient time has passed for a new suitable partnership opportunity to emerge; or
- planned collaborations did not materialise due to budget constraints.

It is common for supply chain arrangements to dissolve after project completion, especially when suppliers work across diverse and highly specialised sectors. Despite this, some interviewed suppliers reported ongoing communication with partners from the NSTF's construction, suggesting that the project helped lay the foundations for future collaboration, even where immediate follow-on work did not materialise.

These interactions indicate that the NSTF's construction has fuelled the emergence of networks at the top of the supply chain by building maintainable familiarity, trust, and mutual understanding. This suggests the construction could reduce transaction costs and improve mobilisation efficiency in future specialist builds on the Harwell Campus or within the wider region. The value of this spillover effect is contingent on the existence of future projects with similar specialist build requirements in the region.

> "We still talk with [lead supplier] ... we haven't done any work with them since." - Supplier

> "We've had a number of conversations [with STFC] ...It didn't go any further because there was a budget problem, but they wanted to use us." - Supplier

7 Boosting the UK space sector's international reputation

Key messages

The NSTF construction site hosted more than 90 recorded stakeholder visits, with a diverse array of guests including:

- Local and national government.
- Space industry primes and industry partners.
- The public.

There is some evidence that the NSTF site served as a hub for engagement, raising the prominence of the space industry in the national policy discussion, encouraging inward investment and commercial engagement, and enhancing the UK space sector’s international reputation. Additionally, there is strong evidence that a significant number of outreach and site visit events have been undertaken to garner public interest in STEM, space and construction and develop local professional skills.

However, it remains difficult to robustly link outcomes to end-impacts, because:

- Many potential impacts - influence on internal policy discussions, inward investment decisions, local attitudes and skills - are unobservable, occur with lags, or cannot be measured with publicly accessible data.
- The counterfactual - the attitudes and decisions of stakeholders if the NSTF did not exist - cannot easily be discerned.

Table 19 compares the hypothesised impact mechanisms drawn from the Theory of Change to the causal mechanisms in the evidence base. Strength of link conclusions are made using process tracing.

Table 19. Hypothesised impact mechanisms versus evidenced impacts

Mechanism	Hypothesised strength of link	Evidenced strength of link
Engagement activities increase awareness of the NSTF and its capabilities, leading to new international partnerships and inward investment	Strong (although with time lags)	Good evidence, difficult to link to end impacts
Activities in the local community increase local engagement with STEM, leading to increased interest in STEM careers	Strong (although with time lags)	Good evidence, difficult to link to end impacts

Engagement activities with government are used to promote investment in space and large-scale science	Not explicitly mentioned in the Theory of Change	Good evidence, difficult to link to end impacts

7.1 The scale of visits to the NSTF

Between 2018 and 2023, the NSTF construction site hosted an extensive and diverse programme of stakeholder visits, with more than 90 formal delegations, public open events and school engagements recorded over the period. Overall, more than 1500 people are documented to have visited the NSTF during the construction period. Visitors represented a significant portion of the UK space ecosystem, including:

- Central government, including UKRI, UK Space Agency, DSIT and other departments.
- International partners, including European Space Agency and partners from Japan and South Korea.
- Space primes.
- Local authorities, parliamentary groups and senior representatives.
- High-profile public figures and media.
- The local community, including school visits.

In total, the construction phase functioned as a major national showcase for UK space capability, reinforcing the UK's reputation for large-scale technical infrastructure, deepening relationships with global space primes, and raising the profile of the Harwell Space Cluster among policymakers, investors and the public. Table 20 provides a detailed breakdown of the visits and their likely impact on the reputation of the UK space industry, noting that actual impacts are largely unobservable.

Table 20. A breakdown of NSTF construction site visits.

Category	Visits	Expected impact
Central government	40+	Strengthened policy awareness of cutting-edge space facilities; reinforced the strategic case for UK space infrastructure; influenced future investment decisions.
International partners	10+	Positioned the Harwell Campus as a globally relevant space cluster; encouraged international collaboration; strengthened the UK's international space diplomacy and technical reputation.
Space primes	35+	Demonstrated UK testing capacity, attracted potential future customers and encouraged inward investment; supported supply-chain collaboration.

Local government and representatives	10-15	Strengthened political awareness of the Harwell Cluster; enhanced local and regional stakeholder alignment.
High-profile public figures and media	4	Broadened national public awareness of UK space excellence; showcased Harwell to non-specialist audiences.
Local community	600+ participants; 5 events	Enhanced STEM inspiration locally; strengthened Harwell's relationship with surrounding communities; supported future skills pipeline development.

7.2 Raising national policy awareness and influencing strategic decision-making

The construction period provided central government officials and with direct exposure to the scale, purpose and emerging capability of the NSTF. Repeated visits served as early-stage demonstrations of capability, enabling policymakers to understand the strategic value of the facility and the role it could play within the UK space ecosystem.

> "We talked to them about that to encourage them to go back to Whitehall and go: here's an idea." – NSTF programme lead

There is some emerging evidence in policy documentation that the NSTF is recognised as a pillar of the UK's space infrastructure offering and an important asset to the local community. However, the NSTF is not mentioned a significant number of times, and mentions of the facility tend to be brief. The most notable mentions in policy documentation are as follows:

- Oxfordshire Local Industrial Strategy (2019): [32] Space is placed as one of Oxfordshire's key growth sectors, citing the Harwell Space Campus and the construction of the NSTF
- National Space Strategy (2021):[33] The NSTF is described as an R&D infrastructure that aims to unleash space sector innovation.
- LaunchUK: Leading the commercial space age (2023): [34] The NSTF is used to evidence the UK's status as a global leader in space science and investment.
- Space Clusters and Infrastructure Fund (SCIF) announcement (2023): [35] The NSTF is used as a reference facility to demonstrate progress in the UK's space infrastructure, which the SCIF aims to build upon.

[32] Oxfordshire Local Industrial Strategy 2019
[33] National Space Strategy (2021)
[34] LaunchUK: Leading the commercial space age (UKSA, 2023)
[35] First dedicated government fund to build space infrastructure launched with £50 million (UKSA, 2023)

- Five distinct mentions of the NSTF in the House of Lords and House of Commons,[36] spanning from 2018 to 2025. The most recent reference highlights the ‘chunky, complex engineering construction opportunities that are opened up in places such as the OxCam corridor’ when infrastructure investment like the NSTF is unlocked. As a comparison, the Rosalind Franklin Institute also had five distinct mentions over the same period, while EPAC had none.

7.3 Completing the Harwell Space Cluster’s offering

There is some evidence that the NSTF’s construction has played an important symbolic and strategic role in strengthening Harwell’s positioning as a leading space cluster, but end impacts remain largely unobservable within the timeframe and data available to this evaluation. Furthermore, this impact is likely to materialise more meaningfully during the NSTF’s operational phase. The NSTF completes a previously missing element of the Campus’ offering, allowing Harwell to present itself as one of the few global locations offering an end-to-end space sector innovation chain, from early-stage R&D through to large-scale environmental testing.

> “It has provided a missing piece of the jigsaw puzzle for the space sector at Harwell.” – Harwell Campus

> “It’s something that doesn’t exist elsewhere in the UK and there are very few in the world with the ecosystem of Harwell.” – Harwell Campus

Construction-phase tours enabled industry, government and international partners to see the NSTF in situ alongside existing Harwell assets, reinforcing perceptions of Harwell as a coherent, high-quality innovation cluster. In principle, this should enhance confidence in the Campus, improve its attractiveness for co-location, collaboration and inward investment, and raise the visibility of the UK’s space capability. However, these effects are difficult to observe and operate primarily at the level of perception and narrative rather than as demonstrable end impacts. The NSTF certainly plays a significant role in the external marketing of RAL Space, with a prominent place on the RAL Space website, its own brochure,[37] and a prominent feature in the 2024 RAL Space highlights.[38]

However, there is currently no robust, attributable evidence of a boost to the space changes in the economic or reputational outcomes of the space cluster or wider Harwell Campus itself. Any such outcomes are difficult to observe, subject to long time lags, are influenced by multiple concurrent investments at Harwell, and are difficult to isolate from wider policy and market trends. The NSTF’s construction has certainly strengthened the space cluster’s positioning and reputation, but the magnitude of this impact cannot yet be stated.

[36] Hansard
[37] National Satellite Test Facility brochure (RAL Space)
[38] RAL Space Highlights 2024

7.4 Stimulating inward investment and commercial engagement

There is also qualitative evidence that the NSTF's construction phase contributed to strengthening the UK's attractiveness to major global space primes and encouraged inward investment into the Harwell Campus. Construction phase visits by several international primes were described by the Harwell Campus as an important mechanism through which the NSTF signalled the UK's capability to host large-scale, high-specification testing. While not concrete, the evidence begins to imply that seeing the facility under construction materially affected primes' perceptions of the UK's testing infrastructure and may have encouraged investment into the space cluster.

Construction-phase visibility allowed primes to inspect the scale, capabilities and co-located expertise at Harwell; update their understanding of the UK's testing offer; and factor the NSTF into future procurement, investment and partnership decisions. It is possible that these visits increased investor confidence and enabled investors to better understand the benefits of being in Harwell. This effect is plausible: it aligns with established literature on the impact on research infrastructures.

"A couple of companies are using NSTF as a 'North Star' for the Campus… this is a really unique place within the UK, within Europe, to set up your business." – Harwell Campus

"Everyone who's come to us asking how they would go about doing it has subsequently gone: 'I think I'll just become a customer of yours'." – NSTF programme lead

"That becomes a really powerful tool when talking to businesses, particularly overseas companies… Harwell is where you can look at the whole pipeline of support." – Harwell Campus

Relevant extract - Reference Framework for Assessing the Scientific and Socio-Economic Impact of Research Infrastructures, (OECD, 2019)[39]

"Research Infrastructures (RIs) offer opportunities for innovation and market development, can attract investments and contribute broadly to socio-economic development. In some cases, they can constitute a focal point for the development of an innovation ecosystem."

These mechanisms might increase the likelihood that firms choose to undertake manufacturing, assembly, testing or programme leadership activities in the UK; increase utilisation of NSTF capacity after commissioning; and expand the commercial pipeline for both RAL Space and the Harwell Campus.

However, these expected effects remain unobservable within the evaluation timeframe. There is no robust, attributable evidence of new inward investment, tenancy decisions, contract awards or long-term commercial commitments that can be linked directly to NSTF construction phase visits or engagement. Commercial decisions of this scale typically operate over multi-year time horizons and are highly sensitive to other factors, like global market conditions, broader space policy and

[39] Framework for assessing the scientific and socio-economic impact of research infrastructures (OECD, 2019)

company strategies. As such, any observed developments in the commercial pipeline during or immediately after construction cannot reliably be attributed to NSTF construction phase-related engagement alone.

7.5 Enhancing international reputation and partnerships

There is some evidence that the NSTF's construction helped enhance the UK's international reputation for high-specification space infrastructure and contributed to strengthening international partnerships during the construction period. Visits by delegations from space agencies and international collaborators were described by the Harwell Campus as influential in demonstrating the scale and ambition of the UK's investment in large environmental test capability.

> "We've engaged through SpaceCom in Colorado… NSTF was described as part of the strength of the Harwell Space Cluster." – Harwell Campus

The NSTF's construction, alongside the release of the National Space Strategy and further infrastructure investment through the SCIF, signalled a long-term national commitment to supporting spacecraft development and testing, helping to position Harwell as a credible international partner.

> "This year we signed a memorandum of understanding in Japan… [NSTF] creates the anchor for this cluster at Harwell." – Harwell Campus

Physical visits allowed overseas partners to assess the UK's emerging capability; global events provided a platform for promoting the NSTF as part of the Harwell offering; and the act of constructing an advanced, world-scale testing facility signalled the UK's readiness to participate in high-value international missions and collaborative programmes. Investment in highly visible research infrastructures like the NSTF is recognised to initiate international collaboration and contribute to science diplomacy objectives.[40] Further engagement at international events and the signing of a memorandum of understanding (MOU) with a Japanese partner strengthens the evidence that NSTF construction phase activities have boosted the UK's global notability.

In the future, these mechanisms may increase the willingness of international organisations to pursue collaborative projects with UK partners; strengthen the UK's position within global supply chains; and make Harwell a more attractive location for joint missions and associated R&D activity. As yet, end outcomes remain unobservable and there are no specific international collaborations or mission partnerships that can be directly attributed to the NSTF's construction phase engagement.

7.6 Increasing public interest in STEM

The NSTF's construction phase generated opportunities to broaden public engagement with space, science and engineering through a combination of media exposure and local science, technology,

[40] International Cooperation in the Research Infrastructure dimension (EU Research and Innovation)

engineering and maths (STEM)-focused activities. Public-facing content, including online videos, articles and coverage on BBC's Click programme, introduced the facility to non-specialist audiences and presented the Harwell Space Cluster as a national centre of technological ambition.[41] Alongside this, local engagement activities such as competitions, and the residents' open evening provided direct opportunities for young people and community members to see large-scale engineering first-hand.

> "Unless you're into your sciences, [science at school] doesn't flick your switch. The kids that come and see what we've got here... go away totally inspired." – NSTF programme lead

Additionally, a significant amount of engagement was undertaken in the community by the primary supplier, in collaboration with local primary schools, secondary schools and youth charities. The activities were designed to leverage the NSTF's construction to generate local interest in construction, engineering and space-related careers, and provide practical career advice to help advance students' skills and knowledge. Table 21 summarises the activity undertaken.

Table 21. A breakdown of local engagement activity conducted by the lead supplier in the construction phase.

Engagement type	Participants	Volunteer hours
Expert talks	552	48
Work experience	375	4
Career advice	354	12
Mentoring	325	45
Student-led projects	290	3
STEM-based workshops	148	4
Science club	6	1

These activities can increase young people's confidence, interest and aspiration in STEM, while strengthening community understanding of the site's purpose. Theoretically, this should contribute to enhanced STEM interest, more positive community perceptions of the Harwell Campus, and support for long-term regional skills development. However, without access to post-event survey data or a similar gauge of community perceptions, it is difficult to robustly link this activity to any observable changes within the local community.

[41] Satellite Testing Centre (BBC, 2025); How are satellites tested for space travel? (BBC, 2025); This Gargantuan Lab Simulates Blasting Satellites Into Space (WIRED, 2024)

8 STFC's specialist knowledge and further investigation needs

Key messages

There is strong evidence that the NSTF's construction developed STFC's technical knowledge by collaboratively overcoming the NSTF's unique challenges alongside suppliers. Some of this knowledge is expected to be used in the procurement of future facilities, which should enable STFC to set detailed and realistic requirements, increasing the chance that future procurements are successful.

Interviewees also raised reflections on the operational and organisational aspects of delivering the NSTF, including resourcing, governance and the capture of learning during the 2017–2023 construction period. These reflections were not investigated as a structured evidence base in this impact evaluation, as such themes fall within the scope of a process evaluation rather than an impact evaluation. STFC has since undertaken substantial changes to its estates and construction function. A separate process evaluation is recommended to robustly assess these themes against current practice.

Table 22 compares the hypothesised impact mechanisms drawn from the Theory of Change to the causal mechanisms in the evidence base. Strength of link conclusions are made using process tracing.

Table 22. Hypothesised impact mechanisms versus evidenced impacts

<table>
<tr><th>Mechanism</th><th>Hypothesised strength of link</th><th>Evidenced strength of link</th></tr>
<tr><td>STFC becomes better prepared for future procurements by gaining specialist knowledge through learning-by-doing</td><td>Strong</td><td>Strong</td></tr>
<tr><td>The NSTF’s construction enables STFC to identify ways in which procurement can be made more efficient and cost effective</td><td>Strong</td><td rowspan="2">Lessons identified but insufficient evidence of consequent action due to scope limitations of the study</td></tr>
<tr><td>The NSTF’s construction prompts the expansion of STFC Estates, enabling STFC to be a more intelligent customer</td><td>Present (an alternative to the above mechanism)</td></tr>
</table>

8.1 Developing STFC's specialist knowledge

> "A one-kilometre-long laser range for instance would require environmental conditioning, but it might not require the soundproofing that we've had." – NSTF programme lead

There is clear evidence that the NSTF's construction generated specialist knowledge within STFC, particularly around vibration damping, environmental control, and maintaining highly stable conditions for precision testing. Much of this expertise is derived from the collective problem solving required by STFC and the suppliers to overcome the highly technical challenges of constructing the facility. Some of STFC's gained knowledge may be applicable to similar future construction projects, enabling STFC to set more detailed and informed requirements and overcome construction issues more quickly. The extent of this benefit depends on the level of similarity between these future facilities and the NSTF.

> "Generally most of these things were NSTF specific, because of the nature of the science that we do... A lot of the lessons learned might be applicable elsewhere, in particular things like vibration damping, the equipment that you need in order to maintain the conditions, things like that can read across to other facilities." – NSTF programme lead

Where future projects share core features with the NSTF, there is scope to re-use design solutions and expertise. However, if future capital investments differ substantially in scale and purpose, the direct applicability of NSTF-specific learning may be limited. The technical learning is most likely to provide value where future facilities share environmental control, vibration, acoustic or precision-conditioning requirements with the NSTF.

At present, much of STFC's specialist knowledge is held in the experience and judgement of long-serving staff rather than in formal systems or documentation. This reflects the significant variance in technical scope of STFC's facilities: detailed technical documentation from previous facilities may not transfer directly to new procurements with substantively different requirements. The extent to which technical learning from the NSTF can be retained and re-used over time is a theme that would benefit from further investigation through the recommended process evaluation (see Section 10.4.3).

8.2 Operational and organisational reflections requiring further investigation

During interviews, STFC stakeholders and suppliers reflected on operational and organisational aspects of delivering the NSTF, including how STFC was resourced and governed as a client of a technically novel research infrastructure during the 2017–2023 construction period.

> "A key lesson learned would be to have a single point of contact with the authority to make decisions." – Supplier

Interview evidence suggests that the NSTF construction exposed limitations in STFC's capability at the outset, particularly around resourcing, technical and project management capacity, reliance on external consultants, and the clarity of governance and decision-making arrangements. Stakeholders identified unclear responsibility boundaries, and the absence of a single authoritative client contact as challenges during delivery.

"It was hard to see where the lines of responsibility stopped and started." – STFC Estates

There is also evidence that STFC recognised and responded to some of these issues, including through growth in the Estates function, targeted recruitment and knowledge transfer from consultants. However, this impact evaluation does not assess the extent to which subsequent changes in STFC's processes, practices and governance arrangements have been embedded, and the effect this has had, as this is contingent on subsequent activity.

"The maturity I think has come through the growth, more people coming on board, people with some experience that that wasn't there before." – NSTF programme lead

The reflections relate to the position of STFC 5–6 years ago when construction was ongoing. A robust assessment of current capability and practice would require fresh evidence collection focused specifically on process and delivery.

Themes raised by interviewees that warrant further investigation include:

- How STFC is resourced to act as a client for complex, technically novel research infrastructure procurements
- The clarity of internal governance and decision-making arrangements during large-scale construction projects
- How learning and knowledge from individual procurements is captured and institutionalised across STFC

A process evaluation is recommended to assess STFC's approach to designing, procuring and delivering complex research infrastructures, drawing on lessons that emerged during the NSTF's construction and reflecting changes implemented since. Such an evaluation would:

- Be conducted in line with the Magenta Book framework for process evaluation
- Provide current evidence on STFC's approach to large-scale capital procurement
- Identify good practice that could be adopted across STFC and the wider research infrastructure community
- Complement this impact evaluation and the recommended operational phase impact and value for money evaluations (see Chapter 10)

9 Looking ahead to the NSTF's operational phase

9.1 The NSTF operational phase

During its operational phase, the NSTF will serve as the UK's one-stop shop for satellite testing. The facility is expected to service multiple clients per year and have an operational lifespan of at least 20 years.[42] The operational phase has four objectives:

- To provide next generation testing capabilities that will allow the UK to construct satellites and deliver payloads into orbit and build a market for UK-based testing services from UK and non-UK customers.
- To enable the growth of the UK space industry through improved access to cost-effective testing services that will encourage other stages of the value chain to locate in the UK.
- To allow the Ministry of Defence to complete the industrial procurement of its future space systems and to test such systems in a secure, UK based facility.
- To drive economic growth locally and in the rest of the UK through the attraction of new inward investment and encouraging business partnerships involving SMEs and academia.

The NSTF has been operational since 2024 and is already making progress towards its operational phase objectives. For instance, the Ministry of Defence used the NSTF to conduct an initial phase of testing on the SKYNET 6A satellite, and this was completed in early 2025.[43] While, detailed analysis of the NSTF's operational phase impacts is outside the scope of this evaluation, a provisional Theory of Change has been developed to frame future evaluative activity.

9.2 The operational phase Theory of Change

The provisional operational phase Theory of Change is summarised in Figure 14. It details the inputs, activities and outputs within the direct scope of the operational phase, and the anticipated outcomes and impacts that are likely to materialise throughout the NSTF's operation.

[42] National Satellite Test Facility Full Business Case (2017)
[43] Military Satellite SKYNET 6A passes initial phase of testing (Strategic Command, 2025)

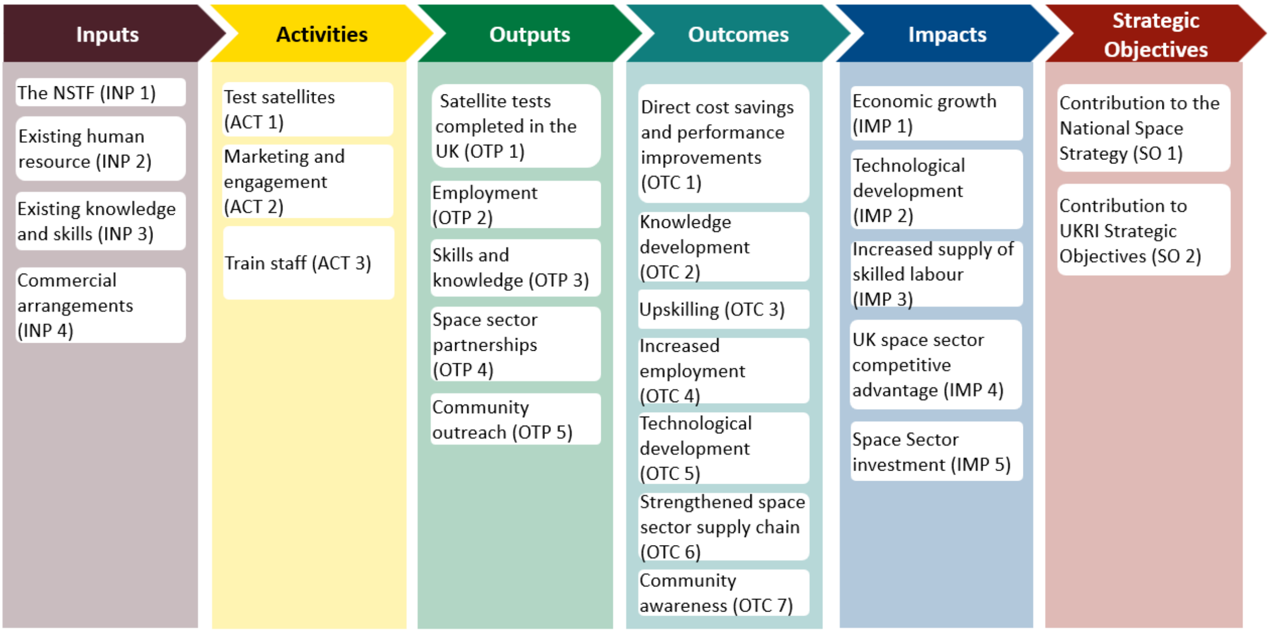


Figure 14. The operational phase Theory of Change

9.2.1 Operational phase inputs and activities

The NSTF, once constructed, serves as the key input for the operational phase. It sits alongside the existing human resource, knowledge and skills of STFC and the existing space sector client base that STFC has access to. These inputs enable the following key activities:

- Satellite testing: Utilising the comprehensive suite of testing apparatus to service client satellites, generating revenue.
- Marketing and engagement: Continuing to advertise the NSTF's and wider Harwell Space Cluster's capability, developing business with domestic and foreign companies and promoting partnership working with agencies.
- Staff training: Continuing to upskill STFC staff to facilitate effective testing.

9.2.2 Operational phase outputs

The operational phase outputs are the direct result of the activities undertaken. The most notable output is the number of satellite tests completed, where the specific contribution of the NSTF to the UK is:

- The number of tests conducted that would have otherwise been conducted outside the UK.
- The number of tests conducted that would have otherwise not been conducted. This reflects the NSTF plays in improving access to testing infrastructure, particularly for SMEs.

The other direct outputs include those employed in satellite testing roles; the skills and knowledge gained and retained in the UK by testing at the NSTF; the partnerships that are formed between STFC and the global space sector, and within the global space sector; and any further outreach events and materials.

9.2.3 Operational phase outcomes

The operational phase outcomes and impacts are not in the direct control of STFC, so they are more speculative than the inputs, activities and outcomes. The outcomes and impacts presented draw on the NSTF full business case:

- Direct cost savings and performance improvements: Testing satellites in a UK-based co-located set of facilities is expected to be cheaper for UK-based space sector clients than testing in a set of foreign facilities. Additionally, the NSTF's status as a state-of-the-art facility may elevate the quality of testing available to the clients, compared to older or potentially lower-specification alternative facilities.
- Knowledge development: The repeated testing of satellites is likely to generate specialist knowledge within STFC and clients, and this knowledge could spillover throughout the UK space sector and upstream and downstream sectors.
- Upskilling: Similarly, repeated testing provides the opportunity for STFC and client staff to gain highly technical skills. This may translate into a productivity gain (e.g. faster testing) as staff learn how to test in a targeted and efficient way.
- Increased employment: The testing activity supports highly skilled jobs throughout the satellite manufacturing supply chain.
- Technological development: The results of tests conducted at the NSTF will help new satellite technologies become closer to commercialisation.
- Strengthened supply chain: The operation of the NSTF may encourage potential clients and adjacent capabilities (e.g. launch) to locate in the UK. The NSTF may act as a hub for satellite manufacturing activity, strengthening supply chain collaboration and, potentially, leading to further expansion of the Harwell Space Cluster.
- Community awareness: Continued outreach and engagement is likely to further enhance local and national participation in STEM and space science and potentially improve the UK space sector's reputation.

9.2.4 Operational phase impacts

Throughout its operational lifetime, the NSTF is expected to contribute to:

- Economic growth, both locally in Harwell and throughout the UK's space sector.
- Technological development across the satellite supply chain.
- An increased supply of skilled labour in Harwell and the space sector
- UK space sector competitive advantage, including fast and efficient satellite testing, a broader satellite ecosystem, increased partnership and Cluster-wide agglomeration benefits.
- Space sector inward investment.

The operational phase impacts are expected to contribute to most of the NSTF's lifetime economic and non-economic benefits. Further evaluation would be required in the future to assess the extent to which these impacts, and any unanticipated impacts, materialise.

10 Conclusions

10.1 Summary of findings

This evaluation set out to explore the evidence for the economic and non-economic impacts of the NSTF's construction phase. It identifies a wide range of impact evidence, including impacts on STFC, the suppliers and their supply chain, concluding that the construction phase has generated significant economic and non-economic value.

The evidence suggests an underlying mechanism for the NSTF construction's impacts that is consistent across most evaluation questions. To overcome the construction's novel technical challenges, STFC and the suppliers had to engage in knowledge-intensive activities, such as:

- In-depth collaboration and collective problem solving across the suppliers and STFC.
- Fundamental research, including the facility design and component testing.

By undertaking these activities, suppliers experienced learning-by-doing benefits, including upskilling, knowledge development and process improvements. The collaboration between suppliers also strengthened the supply chain and enabled contractors to share their specialist knowledge (the spillover effect). Ultimately, this boosted suppliers' capabilities, positioning them to win new construction contracts that they would not otherwise have won. The evaluation finds that £63 million in additional supplier direct GVA is directly attributable to the NSTF's construction, and the construction contributed to a total of £151 million in additional supplier direct GVA. While these figures are not necessarily additional to the UK - another UK supplier could have won that contract - they remain highly significant, and an apt measure of the increase in capability suppliers experienced throughout the construction. The evaluation finds that the innovative construction supply chain was supported by £20.4 million of additional GVA: this figure is additional to the UK, which means this evaluation makes an early contribution to understanding the NSTF's lifetime economic value.

The NSTF's construction also generated several non-economic impacts. Design-stage research activities contributed to improvements that could double the NSTF's annual satellite throughput in its operational phase. No new commercial technologies or IP emerged directly from construction, although several systems were adapted or reconfigured to meet the NSTF's unique requirements.

The construction phase contributed to workforce development by creating at least 40 new roles across the supply chain and STFC, supporting upskilling and progression into more advanced roles, and attracting experienced staff required for technically demanding work. Evidence for diversity-related impacts is limited, mirroring wider construction-sector challenges.

The NSTF's three-tier supply chain benefitted from extensive collaboration, driven by the need to resolve complex engineering challenges:

- The primary supplier strengthened relationships with specialist firms, improving its readiness and mobilisation capability for future technically advanced projects.

- Upper-tier suppliers gained specialist knowledge from collaborative problem-solving with technical subcontractors.
- Lower-tier contractors benefitted from sustained demand, becoming more familiar with prime contractors' standards and systems.

More than 90 stakeholder visits, including government representatives, industry primes and public groups, positioned the NSTF construction as a focal point for engagement. Evidence suggests these visits enhanced the visibility of the UK space sector, encouraged commercial interest and contributed to positive perceptions of UK capability. However, impacts on inward investment, policy decisions and local attitudes are difficult to quantify or attribute with confidence.

Finally, the construction enhanced STFC's technical understanding of advanced research infrastructures through learning-by-doing, supporting more informed requirements-setting for future complex procurements. During evidence collection, interviewees also raised themes relating to the operational and organisational aspects of delivering the NSTF during the 2017–2023 construction period, including resourcing, governance and the capture of learning. These themes were not investigated as a structured line of evidence in this impact evaluation, and STFC has since undertaken substantial changes to its estates and construction function. A separate process evaluation is recommended to robustly assess these themes against current practice (see Section 10.4.3).

10.2 The strength of the evaluation evidence

This evaluation is exploratory in nature and represents the first STFC-commissioned impact evaluation of a construction phase. Table 24 reflects on the strength of evidence obtained for each evaluation question.

Table 23. A breakdown of evidence strength by evaluation question.

Evaluation question	Strength of evidence
Q1: To what extent have learnings from the NSTF's construction been leveraged to win new contracts?	Strong quantitative evidence and attribution
Q2: To what extent has the NSTF's construction contributed to economic growth in the UK construction sector?	Strong quantitative evidence and attribution
Q3: To what extent have learnings from the NSTF's construction been leveraged to invent and commercialise new technologies?	Strong qualitative evidence and attribution, different focus than anticipated
Q4: To what extent has the NSTF's construction improved the quality, quantity and diversity of the labour supply?	Good qualitative and quantitative evidence, small impact magnitudes

Q5: To what extent has the NSTF's construction enabled a more diverse and collaborative supply chain?	Strong qualitative and quantitative evidence and attribution
Q6: How might the NSTF's construction have improved the UK space sector's international reputation?	Good qualitative evidence, difficult to link to end impacts
Q7: To what extent has the NSTF's construction led to specific changes within STFC that make the future procurement of similar facilities easier, cheaper, or more effective?	Good qualitative evidence of specialist technical knowledge, end impacts unobserved and contingent on the future

The utility of the evaluation questions can be categorised as follows:

- Q1 and Q2 provide the main quantitative evidence for the NSTF construction's impacts.
- Q3 and Q5 elucidate the core mechanisms by which these quantitative economic impacts occur.
- Q4, Q6 and Q7 explore complementary evidence and other types of impacts generated by the construction. Q7 captured evidence of technical impacts (specialist knowledge developed within STFC). Additional themes arose during evidence collection that were better suited to assessment through a separate process evaluation.

10.3 The extent to which the construction phase has met its objectives

The evaluation evidence collected also provides an assessment of the NSTF's construction against its objectives. Table 25 summarises this assessment.

Table 24. The NSTF's construction achieved each of its objectives.

NSTF construction phase objective	Assessment	Justification
OBJ 1: Construct the facilities required to provide testing capabilities that will allow the UK to construct more satellites and deliver payloads into orbit	Objective met	The NSTF was successfully constructed and has served its first client
OBJ 2: Develop the skills required to construct a high-quality testing facility complete with specialist testing equipment	Objective met	The construction supported specialist knowledge and skills development across the supply chain and within STFC
OBJ 3: Facilitate the partnerships required to construct the facility	Objective met	The construction supported a significant number of partnerships across the supply chain
OBJ 4: Drive economic growth locally and in the rest of the UK	Objective met	Strong evidence of economic benefits, both in supply chain support and economic spillovers

The construction met all its objectives and, as the evaluation reveals, generated significant economic and non-economic benefits for the UK. This was achieved with a total spend of £117 million, which compares to a total forecasted spend of £99 million in the 2017 full business case.

10.4 Lessons learned for the evaluation of construction phases

10.4.1 The value of construction phase evaluations

Impact evaluations should be undertaken for technically complex research infrastructure constructions. The evaluation demonstrates that it is worthwhile to collect evidence for the impacts of advanced research infrastructure constructions if stakeholders are likely to learn by doing in a way that enhances their future capability. This evidence collection process could take the form of a full impact evaluation, whereby a wide range of impacts pathways are hypothesised, and then corresponding evidence is collected and analysed. This would provide STFC, and UK government more widely, with a better understanding of the value for money of technologically advanced research facilities.

Alternatively, evidence could be collected through a monitoring process, where the client engages with suppliers to collect impact evidence on a regular basis (for example, using a survey). This approach is likely more cost effective, but it requires a strong initial understanding of the construction's impact pathways to ensure the right evidence is collected.

10.4.2 Resources developed in this work for future construction phase evaluations

This evaluation provides useful resources (such as the Theory of Change and evaluation questions) that may should be utilised to support future construction phase evaluations. Each of the evaluation questions studied in this evaluation yield useful evidence for the impact of the NSTF's construction phase. The usefulness of these evaluation questions for a different construction phase evaluation depends on the specific evidence requirements of that evaluation. Some evidence (particularly under Q6, space sector international reputation) is difficult to link to end impacts in this evaluation. Data on the distribution of marketing, events and documentation should be formally tracked to enable structured assessment in future evaluations, enabling a better understanding of the construction's influence on end impacts.

Future evaluations should take note of the causal mechanisms uncovered during this evaluation to develop useful construction phase Theories of Change. This evaluation builds on STFC's preliminary understanding of the mechanisms by which research infrastructure construction phases generate impacts by developing and testing a Theory of Change. The assessment of causal mechanisms shows that most of the mechanisms in the Theory of Change occurred as expected. However, the evaluation also uncovered some unexpected impact mechanisms, and in doing so generated useful learning about how the impacts of the construction phases materialise. Future evaluations should utilise this learning to better understand the pathways by which construction phase impacts materialise, enabling improved assessment of impact and value for money.

10.4.3 Recommended further evaluations of the NSTF

This impact evaluation forms one component of a broader evaluation of the NSTF. To complete the picture in line with the Magenta Book framework, three further evaluations are recommended:

Process evaluation of the construction phase. During this impact evaluation, interviewees raised themes relating to the operational and organisational aspects of delivering the NSTF (see Chapter 8). These were not pursued as a structured line of evidence as they fell outside the scope of an impact evaluation, and STFC has since undertaken substantial changes to its estates and construction function. A process evaluation, conducted in line with Magenta Book guidance, is recommended to robustly assess STFC's approach to designing, procuring and delivering complex research infrastructures, drawing on current evidence and reflecting the changes implemented since the NSTF was constructed.

Operational phase impact evaluation. The majority of the NSTF's impacts are likely to occur during its operational phase. An operational phase impact evaluation should quantify operational economic benefits where possible and explore the range of impacts detailed in the operational phase Theory of Change. It is recommended that this evaluation is conducted approximately ten years into the operational phase to capture a significant portion of the NSTF's operational impact. Monitoring of key outputs and outcomes should take place before this evaluation to maximise its effectiveness.

Value for money evaluation. A value for money (VfM) evaluation should be undertaken alongside the operational phase impact evaluation. Combined with information about the NSTF's lifetime cost, this would enable a full assessment of the facility's lifetime net present value and benefit-cost ratio, providing a comprehensive understanding of the NSTF's lifetime value for money.

10.5 Lessons learned to optimise the impact of similar constructions

The evaluation identifies two key areas that are in direct control of STFC and have a significant effect on the magnitude of impacts generated by the construction phase.

10.5.1 Prioritisation of UK-based procurement where feasible

Where possible, UK-based procurement should be prioritised to maximise UK benefit, particularly for the most innovative aspects of the NSTF. The evaluation finds that 91% of construction phase spending was allocated to UK-based companies. However, only 72% of innovative spending was contracted to UK-based companies. Support to the UK innovative construction supply chain would have increased 46% if all innovative spending was allocated to UK-based companies.

In this case, the allocation of innovative elements to foreign companies likely simply reflects current gaps in the UK construction sector’s capability. Nevertheless, an important lesson remains: identifying the innovative parts of a construction and prioritising UK suppliers for those elements would increase the impact and value for money of a facility.

10.5.2 Implementation of construction lessons learned

There should be a structured process for the review, reporting and dissemination of lessons learned from large-scale construction projects, so that learning is institutionalised. Such a process could identify which technical solutions, project management approaches and supplier interactions should be reused in the future, and develop templates or guidance where applicable.

The technical learning generated through the NSTF's construction includes insights into the design and delivery of soundproofing, vibration damping, cleanrooms, environmental control systems and bespoke scientific apparatus (see Section 4 and Section 8.1). Capturing and institutionalising this learning would support more efficient procurement and delivery of future research infrastructures.

In addition, this impact evaluation surfaced themes relating to the procurement and delivery of the NSTF, including resourcing, governance and the capture of organisational learning, that fall outside its scope. The recommended process evaluation (see Section 10.4.3) would provide the appropriate vehicle to investigate these themes against current practice and identify further lessons to institutionalise.

Report End.

Narrow Quay House
2 Prince Street
Bristol
BS1 4BA

Tel: +44 (0)117 922 6242

fnc.co.uk

Offices at:
Bristol, Burton-on-Trent, Dorchester, Glasgow, Gloucester,
Harwell, Leatherhead, Manchester, Middlesbrough,
Plymouth and Portsmouth