

THE IMPACT OF THE EUROFIGHTER TYPHOON PROGRAMME ON THE UK ECONOMY

AN INDEPENDENT REPORT BY OXFORD
ECONOMICS

JULY 2022

ABOUT OXFORD ECONOMICS

Oxford Economics was founded in 1981 as a commercial venture with Oxford University's business college to provide economic forecasting and modelling to UK companies and financial institutions expanding abroad. Since then, we have become one of the world's foremost independent global advisory firms, providing reports, forecasts and analytical tools on more than 200 countries, 250 industrial sectors, and 7,000 cities and regions. Our best-in-class global economic and industry models and analytical tools give us an unparalleled ability to forecast external market trends and assess their economic, social and business impact.

Headquartered in Oxford, England, with regional centres in New York, London, Frankfurt, and Singapore, Oxford Economics has offices across the globe in Belfast, Boston, Cape Town, Chicago, Dubai, Dublin, Hong Kong, Los Angeles, Melbourne, Mexico City, Milan, Paris, Philadelphia, Stockholm, Sydney, Tokyo, and Toronto. We employ 450 full-time staff, including more than 300 professional economists, industry experts, and business editors—one of the largest teams of macroeconomists and thought leadership specialists. Our global team is highly skilled in a full range of research techniques and thought leadership capabilities from econometric modelling, scenario framing, and economic impact analysis to market surveys, case studies, expert panels, and web analytics.

Oxford Economics is a key adviser to corporate, financial and government decision-makers and thought leaders. Our worldwide client base now comprises over 2,000 international organisations, including leading multinational companies and financial institutions; key government bodies and trade associations; and top universities, consultancies, and think tanks.

July 2022

All data shown in tables and charts are Oxford Economics' own data, except where otherwise stated and cited in footnotes, and are copyright © Oxford Economics Ltd.

This report is confidential to BAE Systems and may not be published or distributed without their prior written permission.

The modelling and results presented here are based on information provided by third parties, upon which Oxford Economics has relied in producing its report and forecasts in good faith. Any subsequent revision or update of those data will affect the assessments and projections shown.

To discuss the report further please contact:

Rob Harbron: rharbron@oxfordeconomics.com

Oxford Economics

4 Millbank, London SW1P 3JA, UK

TABLE OF CONTENTS

Executive summary	1
1. Introduction	4
2. Employment and GDP contributions in 2020	10
3. Employment and GDP contributions, 2018—2022	20
4. Appendix 1 – Economic impact modelling methods	26
5. Appendix 2 – Regional economic impacts	28

EXECUTIVE SUMMARY

THE ECONOMIC IMPACT OF THE EUROFIGHTER TYPHOON PROGRAMME ON UK JOBS AND GDP, 2018—2022

Eurofighter Typhoon is the combat aircraft used by the Royal Air Force (RAF) to protect the UK's airspace. One of the largest collaborative military programmes in Europe, the Eurofighter Typhoon industrial consortium is comprised of BAE Systems, Leonardo, Airbus, Rolls-Royce, and MBDA. Together, these companies represent a European defence and aerospace supply chain providing sovereign combat air capability to the Eurofighter partner nations—the UK, Germany, Spain, and Italy—and to the other nations that have chosen to operate Eurofighter.

In the UK, BAE Systems leads the overall design, development, manufacture, upgrade, and support of the aircraft for the RAF fleet and for a number of government customers in Europe and the Middle East, driving significant value through exports and strategic international relationships. Leonardo UK leads the consortia that provide both the Typhoon's Radar and Defensive Aid Sub-System (DASS) for the UK and export customers.

In this report, we quantify the economic impact of the Typhoon programme on the UK economy over the five-year period from 2018 to 2022. We measure this impact in terms of the number of jobs supported in the country, and the programme's contribution to UK GDP.

The Typhoon programme contributes to the UK economy through three main channels. Firstly, its UK operations directly employ thousands of workers, and contribute hundreds of millions of pounds to GDP through the income it generates. Secondly, the programme indirectly supports further jobs and GDP by procuring goods and services along its UK supply chain. Thirdly, when workers employed by the programme or in its supply chain spend their wages in consumer-facing sectors of the economy, they support thousands more jobs and hundreds of millions of pounds of GDP across the country.

We estimate that, in 2020, the Typhoon programme contributed a total of 20,800 jobs to the UK economy.

Over the five-year period analysed, the programme supported an average of 20,000 jobs in the country.

In 2020, the Typhoon programme directly employed 6,500 workers, located in the North West, Scotland, the East Midlands, and the East of England, where BAE Systems and Leonardo concentrate the Typhoon programme's UK

£1.6bn

GDP contributed by the Typhoon programme to the UK economy in 2020

For every £100 contributed directly by the programme, a further £90 is supported across the economy

20,800

Number of jobs in the UK supported by the Typhoon programme in 2020

For every 100 jobs directly supported by the programme, a further 220 jobs are supported throughout the UK

operations. With just under 60% of such workers in engineering-related roles, the programme's workforce is highly productive—2.3 times more productive than the UK average, and nearly 90% more productive than the average worker in the UK's manufacturing sector. By spending £350m in its UK supply chain in 2020, the programme indirectly supported 6,300 more workers, whose wage spending, along with direct employees' wage spending, supported a further 8,000 jobs. For every job directly supported, the programme supported a further 2.2 jobs.

In 2020, the Typhoon programme contributed an estimated £1.6bn to the UK's GDP. The programme's total GDP contribution also averaged £1.6bn per year, in real terms, over the 2018-2022 period analysed. In 2020, the programme directly generated £840m in GDP through its UK operations. Its UK supply chain supported a £290m GDP contribution, and workers' spending sustained a further GDP contribution of £480m. For every £100 of GDP directly supported by the Typhoon programme, a further £90 was supported across the economy.

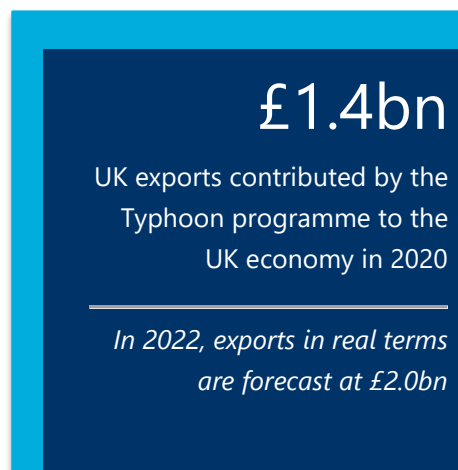
THE WIDER IMPACTS OF THE TYPHOON PROGRAMME ON THE UK

The Typhoon programme contributed £1.4bn to UK exports in 2020. This represents 0.5% of UK total goods

exports for the same year, and is larger than the UK's total gas exports.^{1 2} The programme's UK exports are forecast to increase steadily, in 2020 prices, from £1.1bn in 2018 to £2.0bn in 2022. The programme's net exports in 2020 stood at £980m. Aside from contributing to the UK's economic prosperity, strong international trade under the Typhoon programme strengthens key international partnerships, as defence programmes are typically inter-governmental arrangements.

The programme is helping to build a highly specialised workforce for a thriving UK aerospace and defence sector over the long term. Since 2015, it has trained 320 apprentices in its Engineering Degree Apprenticeship schemes. In addition to around 1,000 apprentices and graduates currently employed by the Air business, 450 apprentices and graduates are scheduled to join BAE Systems' Air business in 2022, many of whom will work on the Typhoon programme. Leonardo has over 500 people on its UK early careers schemes, which include placements, internships, a graduate scheme, and an apprenticeship programme rated "outstanding" by Ofsted—a large percentage of these students are working on Typhoon-related work.

Advanced technologies developed on the Typhoon aircraft through investments in R&D have been applied to and benefitted the aerospace sector, other defence applications, and wider



¹ Office for National Statistics, "[UK trade: October 2021](#)", accessed February 2022.

² This figure for exports represents revenue for BAE Systems, and Leonardo in the UK, in cash terms for the Typhoon programme. This means it is not on the same basis as the £1.6bn total contribution to GDP, which represents the value added through all Typhoon programme revenue.

industry. One example is the advancement of carbon fibre composite technology, which has been adopted by the automotive industry to produce strong and lightweight vehicle structures.

Finally, the Typhoon programme is making strides towards supporting the RAF's environmental targets to reduce the carbon footprint of operating its fleet of combat aircraft. By expanding its virtual pilot-training facilities at its two main RAF bases, it is enhancing its capabilities to train pilots through simulators, reducing the reliance on live training, with the potential to save hundreds of thousands of tonnes of carbon every year. The RAF's Typhoon fleet is also cleared to operate with 50% sustainable fuel as part of its commitment to achieving Net Zero status by 2040.³ In addition, BAE Systems and Leonardo are deploying new digital engineering techniques to boost efficiency in new Typhoon capability development and support. This means fewer test flights will be required before new capability goes into service, reducing the overall carbon footprint of the programme.

³ Gov.uk, "[Sustainable fuels to power RAF jets](#)", accessed April 2022.

1. INTRODUCTION

1.1 THE EUROFIGHTER TYPHOON PROGRAMME: BACKGROUND

Eurofighter Typhoon is a highly sophisticated combat aircraft that performs a number of different air defence and air combat roles. It is regarded as one of the world's most advanced combat aircraft⁴, and one of the two leading fast jet aircraft operated by the UK Royal Air Force. As a long-running consortium between founding nations Germany, Italy, Spain, and the UK, it is also among the largest military programmes in Europe.⁵

The aircraft is operated by nine nations, including the UK, Germany, Spain, Italy, Austria, Oman and Saudi Arabia; Kuwait and Qatar are recent customers, with Typhoons entering service in the near future. The Typhoon aircraft makes up almost a quarter of the combat aircraft fleet of European members of the North Atlantic Treaty Organisation.⁶

The Typhoon aircraft entered into service with the four partner air forces between 2003 and 2005.⁷ The jet became fully operative in 2006, patrolling Italian airspace while the country hosted the Winter Olympics, and first entered combat missions in 2011 in Libya.⁸ There are more than 570 of the aircraft in service today.⁹

1.1 TYPHOON FOR THE UK

The UK is an important contributor to the Typhoon programme, with BAE Systems owning 33% of the consortium—German and Spanish ownership is held through Airbus Defence and Space, and Italian ownership is held through Leonardo. There are over 150 aircraft in the Royal Air Force (RAF) fleet.¹⁰

RAF Typhoons are operated from RAF Coningsby in Lincolnshire (East Midlands) and RAF Lossiemouth in Moray (north-east Scotland). RAF Coningsby and RAF Lossiemouth are the UK's two Quick Reaction Alert stations; here, RAF pilots are on constant standby to deploy their Typhoons and intercept rogue aircraft near UK airspace and the Falklands, and industry teams provide support and readiness for RAF operations.¹¹

BAE Systems leads the production of the Eurofighter Typhoon aircraft for the UK and its international export customers. It also leads the integration and flight testing of capability—such as the new

⁴ Airforce Technology, "[Top 10 advanced fighter aircraft](#)", accessed February 2022.

⁵ Eurofighter Typhoon, "[About Us](#)", accessed February 2022.

⁶ Craig Hoyle, "[The changing balance of NATO's European fighter fleet](#)", FlightGlobal, accessed February 2022.

⁷ Eurofighter Typhoon, "[About Us](#)", accessed February 2022.

⁸ Ibid.

⁹ Eurofighter Typhoon, "[Customers](#)", accessed February 2022.

¹⁰ Armed Forces, "[RAF Aircraft](#)", accessed February 2022.

¹¹ The Royal Air Force, "[Quick Reaction Alert](#)", accessed February 2022.

advanced electronically scanned radar system—and future weapons systems. The UK derives significant value from combat air exports, with programmes such as Typhoon underpinning important strategic international relationships.¹²

BAE Systems' aircraft facilities, where Typhoons are designed, developed, manufactured, flight-tested, upgraded, and integrated are concentrated in the North West of England, at its two sites in Warton and Samlesbury, in Lancashire.

Leonardo in the UK also plays a crucial role in the programme, with the company's onshore research and manufacturing sites supplying the aircraft's main sensors and protective electronics. Specifically, Leonardo leads the development and production of the Typhoon aircraft's existing and future radar at its Edinburgh site, and delivers the aircraft's electronic warfare technologies from Luton, in the East of England.¹³ Leonardo also has a site in Lincoln, in the East Midlands, which provides specialist electronic warfare "mission data" training and support for the UK Armed Forces based at the nearby Air Warfare Centre.

The Typhoon aircraft's primary purpose for the UK RAF is the protection of UK airspace, as part of national security and defence priorities, which helps to protect UK interests and bring the long-term benefits of a stable environment for UK residents and businesses. In addition, the programme also has a large direct economic impact each year in the four regions where its UK industrial operations are concentrated—the North West, Scotland, the East Midlands, and the East of England. Here, the consortium supports thousands of high-productivity jobs, and contributes to local economic prosperity.

On top of this direct impact, the benefits of the programme are felt across the UK through the hundreds of suppliers from which the Eurofighter consortium procures the goods and services needed to develop, build, and maintain the UK's Typhoon fleet—thousands of further jobs are supported by the programme in this way each year. Workers directly employed on the Typhoon programme, and workers employed on the programme's supply chain, also spend their wages in consumer-facing sectors of the economy, such as in food and accommodation, travel, or health care; this spending activity supports further jobs across every region and nation within the UK.

Considering the Typhoon programme's direct economic impact in the UK alongside its multiplier effects through the economy provides a complete picture of the total economic impact of the programme on the UK economy.

Beyond contributing to jobs and GDP in the UK, the Typhoon programme supports the country's economic prosperity by generating revenue from exports that surpass those of entire sectors of the UK economy. The programme also brings a wide set of socioeconomic benefits to the country, from

¹² Gov.uk, "[Britain to take leading role in next-generation air power, as Defence Secretary launches Combat Air Strategy](#)", accessed June 2022.

¹³ Leonardo, "[Eurofighter Typhoon: Effective, proven, trusted](#)", accessed February 2022.

investing in R&D projects that generate technology spillovers into other sectors, to helping to train the next generation of experts in airspace and defence engineering.

1.2 OBJECTIVES AND STRUCTURE OF THE REPORT

This report quantifies the total economic impact of the Eurofighter Typhoon programme on the UK's economy, and relies on data provided by BAE Systems, the consortium's prime contractor in the UK, as well as from Leonardo in the UK.¹⁴

We estimate the economic impact of the Typhoon programme on the UK economy through two metrics: the number of jobs supported, and its contribution to GDP.¹⁵ The analysis presented in this report covers the five-year period between 2018 and 2022.

Chapter 2 presents economic impact estimates of the Typhoon programme in the UK for 2020, the latest year of analysis to rely on confirmed data rather than projections. Economic impact estimates are presented separately by channel of impact, region, and industry.

In chapter 3 we discuss the programme's economic impacts in the UK over the 2018—2022 period. Data inputs on which the results for 2021 and 2022 are based are forecasts provided by the consortium.

Throughout the report we also provide case studies highlighting other channels through which the programme contributes to the UK's long-term prosperity. These are examples of how the Typhoon programme generates socioeconomic benefits to the UK that go beyond jobs and GDP.

¹⁴ While we look specifically at the impact of the Typhoon programme through BAE Systems' and Leonardo in the UK's business activity, the operations of other major suppliers such as MBDA and Rolls-Royce are also included implicitly within our supply chain impact estimates

¹⁵ See our methodology in page 7, and Appendix 1, for more detail.

AN INTRODUCTION TO OUR ECONOMIC IMPACT ANALYSIS

In each section of this report we assess the Typhoon programme’s impact using a standard means of analysis called an economic impact assessment. This involves quantifying the programme’s economic impact across three “core” channels:

- **Direct impact**—relating to its own activities in the UK. This encompasses the economic activity and employment supported directly by the programme.
- **Indirect impact**—the economic activity and employment supported in the UK supply chains of the programme’s UK operations as a result of its procurement of goods and services from other UK firms. This channel includes the impact of the programme’s capital investments, such as on new facilities and IT equipment, as well as that of its day-to-day purchases.
- **Induced impact**—this comprises the wider economic benefits that arise when the programme’s employees in the UK, and those in the programme’s UK supply chains, spend their earnings—for example, in local retail and leisure establishments.

This approach enables us to build a picture of the Typhoon programme’s total contribution to the UK economy across two key metrics:¹⁶

- **GDP**—more specifically, the programme’s “gross value added” (GVA) contribution to GDP. In simple terms, GVA is the sum of income generated by the organisation, in the form of employee compensation and profits, plus some taxes on production such as business property rates. For brevity, we refer to this as the “GDP contribution” throughout the report.
- **Employment**—the number of jobs supported as a result of the programme’s activity.

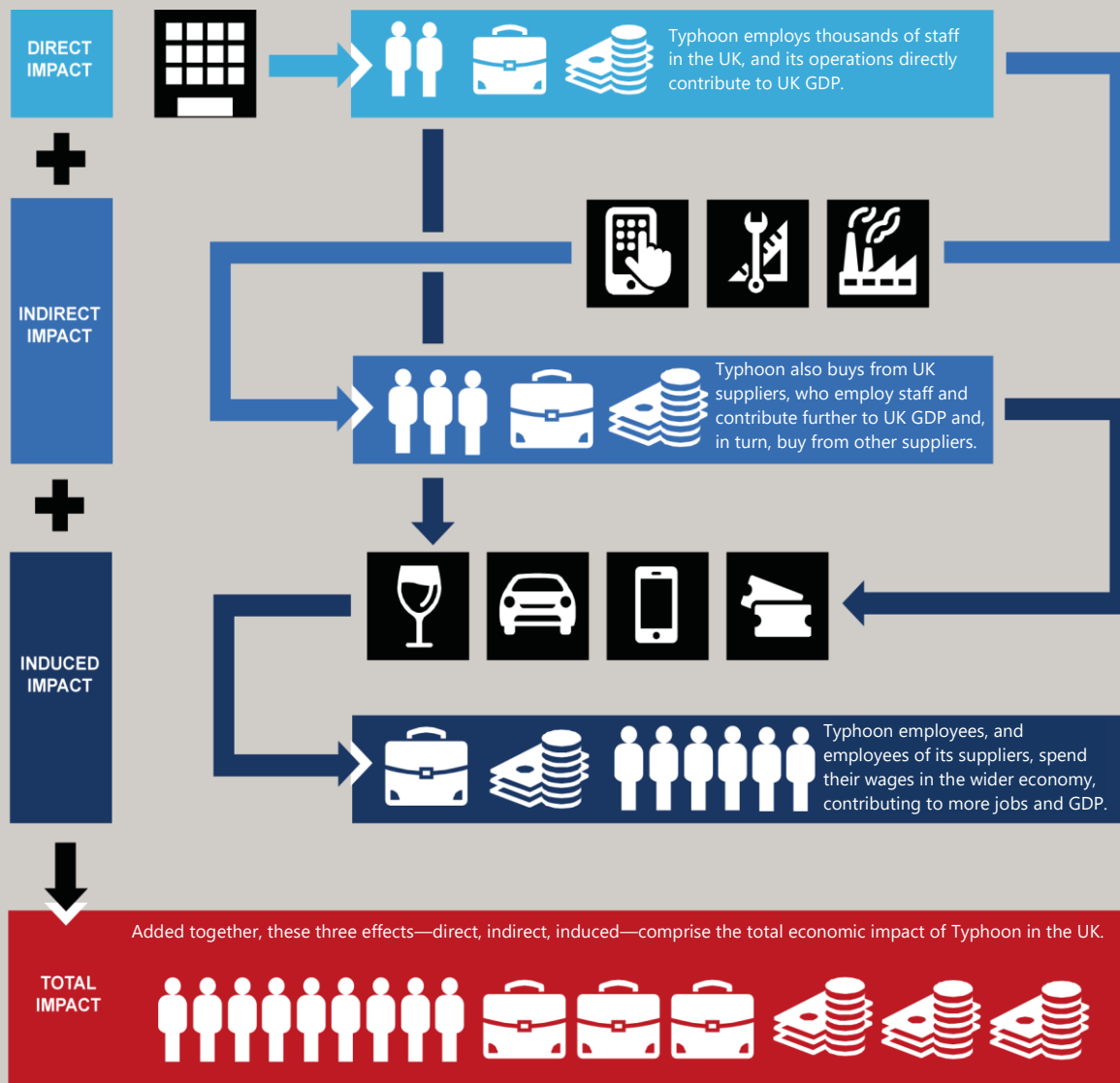
Alongside these core economic impacts, we also consider qualitatively the wider “catalytic” economic impacts through which the programme contributes to the UK’s long-term prosperity. This includes aspects such as skills development and building future capabilities through scientific R&D.

The modelling upon which this report is based computes the economic footprint of the programme in the UK for 2018 to 2022. Our approach uses financial data for these years

¹⁶ The GDP and employment results are presented on a “gross” basis. They ignore any displacement of activity from other organisations. Nor do they consider what the resources currently used by Typhoon or stimulated by its expenditure could alternatively produce in their second-most productive usage. Our economic impact analysis therefore estimates the actual economic footprint of Typhoon in the UK in each year, but does not estimate the extent to which the size of the UK economy might differ if Typhoon’s UK operations did not exist.

from the consortium’s accounts, plus the latest economic data available at the time of writing. Additional information on our modelling approach is provided in Appendix 1.

THE CHANNELS OF ECONOMIC IMPACT IN OUR MODEL



WIDER IMPACT In addition, Typhoon’s activities have wider effects, boosting activity elsewhere in the economy. These—such as R&D investments or exports—represent the wider benefits that governments, consumers, and society derive.

Note: Throughout 2020 and beyond, the global Covid-19 pandemic caused considerable disruption to output, employment, and travel. These exceptional changes to the structure of the global supply chain are dynamic, and continue into 2022 as global economic activity slowly moves back towards a version of normality. Oxford Economics' global modelling framework is based on the latest published structural data, which relate to 2019, and as such can be thought of what the economic impact would be during a "typical" year. However, it is worth noting that

the activity of "essential" industries such as defence manufacturing were less disrupted than other areas of the economy.

2. EMPLOYMENT AND GDP CONTRIBUTIONS IN 2020

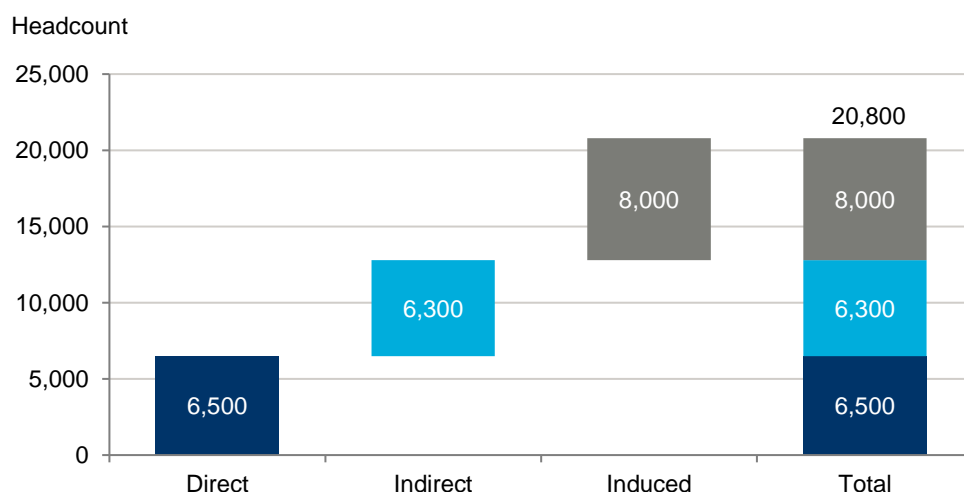
This chapter presents Oxford Economics' estimates of the economic impact of the Typhoon programme in the UK in 2020.

2.1 TOTAL ECONOMIC CONTRIBUTION OF THE TYPHOON PROGRAMME TO THE UK

2.1.1 Total employment contribution

The Typhoon programme supported a total of 20,800 jobs in the UK in 2020.¹⁷ The programme's operations in the UK directly employed 6,500 workers. Supply chain spending supported 6,300 jobs. Wage spending by the programme's employees, and by employees along its UK supply chain, supported a further 8,000 jobs. For every 100 jobs directly generated by the Typhoon programme, a further 220 jobs are supported across the UK economy.

Fig. 1. Total number of workers in the UK supported by the Typhoon programme, 2020



Source: Oxford Economics analysis of BAE Systems and Leonardo data

Almost half (9,280) of all jobs supported by the programme in 2020 were located in the North West of England, where its manufacturing facilities of Samesbury and Warton, in Lancashire, are based. The majority of remaining employment impacts accrued to other regions where the programme's direct operations are based: the East Midlands (1,810), the East of England (1,490), and Scotland (1,410); and to regions which received large proportions of the programme's supply chain spending: the South East (2,230), and the South West (1,590).

¹⁷ All employment figures presented in this report are on a headcount basis.

Fig. 2. Total number of workers in the UK supported by the Typhoon programme, by region, 2020



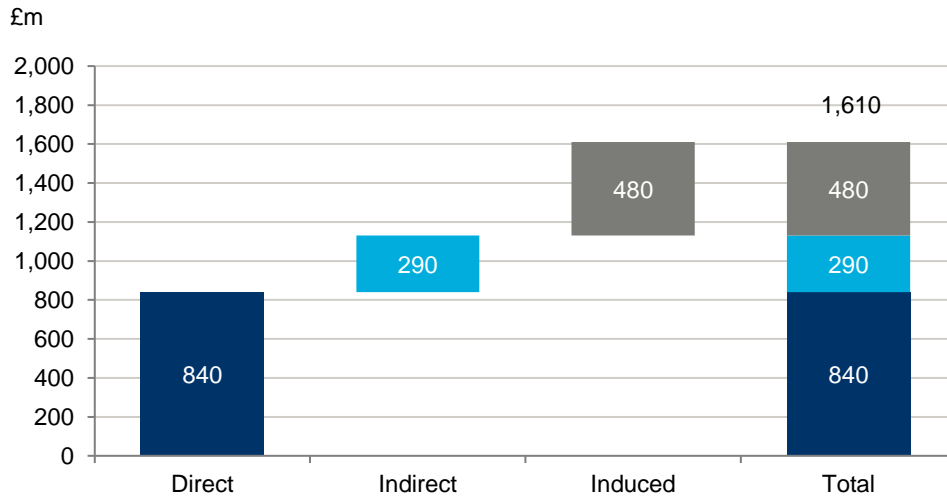
Source: Oxford Economics analysis of BAE Systems and Leonardo data

2.1.2 Total GDP contribution

The Typhoon programme supported a £1.6bn contribution to UK GDP in 2020.¹⁸ Just over half (£840m) of the total GDP impact was directly sustained through the programme's UK operations. Supply chain spending and wage spending supported a further £290m and £480m of GDP, respectively. Consequently, for every £100 of GDP directly generated by the Typhoon programme, the programme supported a further £90 of GDP throughout the economy.

¹⁸ All monetary figures presented in this chapter are expressed in nominal (2020) prices.

Fig. 3. Total GDP in the UK supported by the Typhoon programme, 2020



Source: Oxford Economics analysis of BAE Systems and Leonardo data

The regional distribution of GDP impacts is similar to the distribution of employment impacts. Just over half of total GDP impacts accrued to the North West. The East Midlands, the East of England, the South East, and Scotland each supported over £100m in total GDP to the UK economy.

SUPPORTING THE ROYAL AIR FORCE'S DRIVE TOWARDS NET ZERO

The Royal Air Force (RAF) has committed to achieving net zero carbon emissions by 2040.¹⁹ Reducing the environmental footprint of the fleet of more than 100 Typhoon jets²⁰ through increased use of “synthetic” training simulators is one element of this strategy.

Through a £220m investment by the Ministry of Defence announced in September 2021, BAE Systems is developing new high fidelity, immersive simulation facilities at RAF Coningsby in Lincolnshire (East Midlands), and RAF Lossiemouth in Moray (Scotland) as part of the RAF's Typhoon Future Synthetic Training (TFST) programme. These facilities will enable an expected increase in synthetic training, transforming how Typhoon pilots train, and delivering sustainability, affordability, and security benefits. Tim Colebrooke, Aircrew Advisor at BAE Systems' Air business, says: “The use of synthetic training is so compelling because it is one of those rare technologies with no downside when it's done well. It has the customer benefits of training efficiency, operational security, and lower operating costs, whilst at the same time being significantly better for the environment.”

In 2020, BAE Systems' team of training experts delivered more than 9,000 training events from the synthetic facilities that it currently operates at the RAF's Typhoon main operating bases, representing nearly 13,000 flying hours conducted virtually. The company has estimated that every synthetic flight saves 9.6 tonnes of carbon, and that substituting live training with synthetic training has so far saved about 75 million litres of aviation fuel—equivalent to 184,000 tonnes of carbon.

As part of the RAF's TFST programme, BAE Systems' training experts are now engineering the software and hardware for 10 simulators together with advanced training facilities. The new training environments will be linked together providing an integrated environment for pilots to train and carry out complex combined training exercises using real world mission software and tactics. Eventually, pilots from multiple different locations will be able to fly virtual missions together and provide the ability to “plug into” other assets across air, land, and sea. Mr Colebrooke explains the benefits of this integration: “By hosting this activity synthetically, people join the exercise from their home base, completely reducing the need to travel.”

The RAF is aiming for 80% of all training to be conducted synthetically by 2040.²¹

¹⁹ Royal Air Force, “[A Net Zero RAF by 2040](#)”, accessed February 2021.

²⁰ Royal Air Force, “[TYPHOON FGR4 \(formerly European Fighter Aircraft\)](#)”, accessed February 2022.

²¹ Royal Air Force, “[£274-million training boost for RAF](#)”, accessed March 2022.

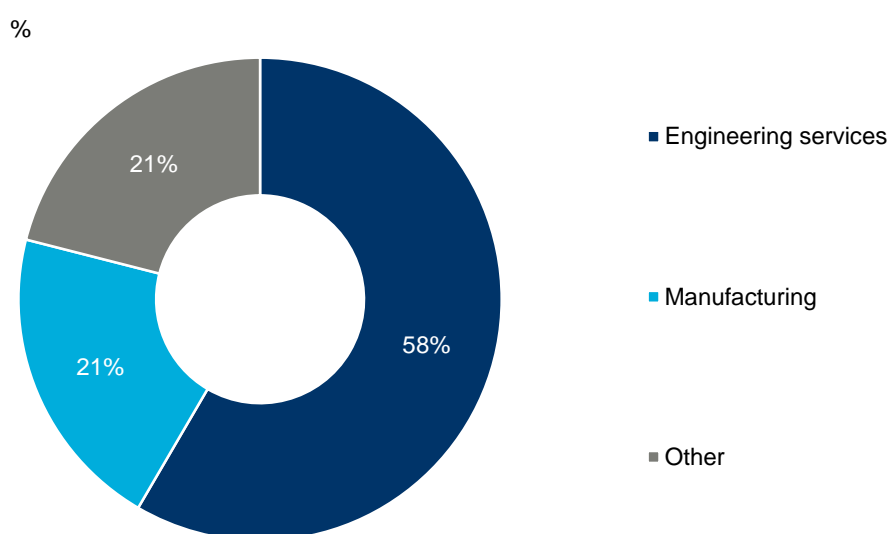
2.2 DIRECT ECONOMIC CONTRIBUTION OF THE TYPHOON PROGRAMME IN THE UK

2.2.1 Direct employment contribution

The Typhoon programme directly employed 6,540 workers in the UK in 2020, including just over 300 contractors. The majority of employees—4,850 workers—were based in the North West.

Approximately 58% of employees are employed in engineering or engineering-related services such as project management, flight operations, and quality control.²² One employee out of every five (21%) held a manufacturing role, while the remainder (21%) held other job functions such as procurement, information management and technology, finance, and human resources.

Fig. 4. Job functions of employees directly employed on the Typhoon programme, 2020



Source: Oxford Economics analysis of BAE Systems data

2.2.2 Direct GDP contribution

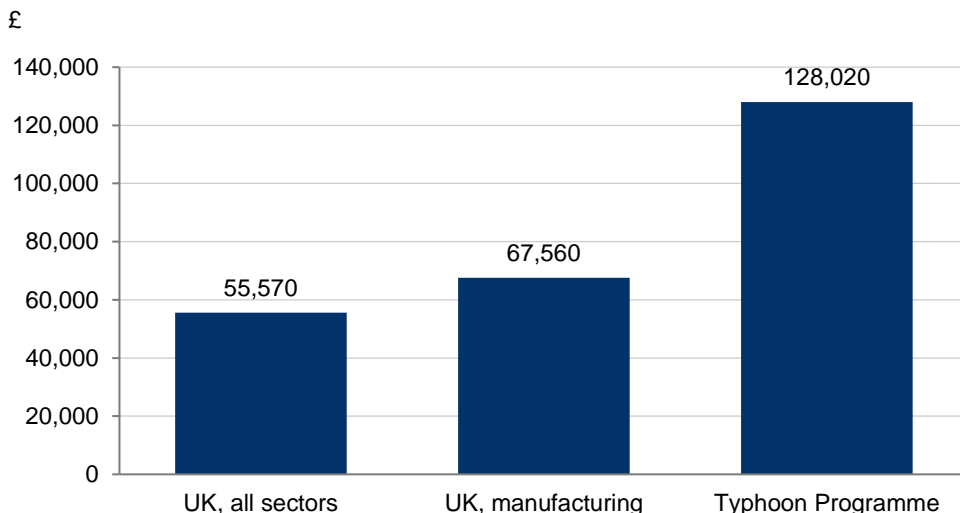
In 2020, the programme's UK operations generated £1.1bn in revenue. The programme directly contributed £840m to UK GDP. This figure was computed by adding total labour costs to the programme's profits—the "income approach".²³

Productivity per worker on the programme in 2020 was 2.3 times higher than the UK average across all sectors, and nearly 90% higher than average productivity in the manufacturing sector.

²² These figures are produced using BAE Systems data on job function splits for 2020.

²³ More specifically, direct GVA was computed as: total labour costs (wages and salaries; employers' pension contributions; employers' national insurance contributions), plus EBITDA (earnings before interest, tax, depreciation and amortisation), plus taxes on production. Some minor adjustments were made to account for the fact that part of contingent workers' labour costs accrue to employment agencies and should not enter the direct GVA calculation (these agency costs instead accrue as procurement spending).

Fig. 5. Productivity per worker on the Typhoon programme, 2020

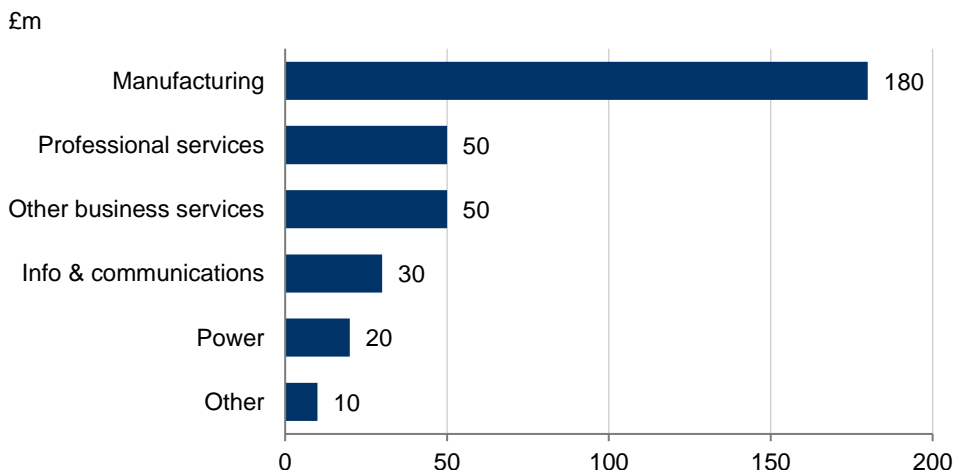


Source: Oxford Economics analysis of BAE Systems, Leonardo, and ONS data

2.3 SUPPLY CHAIN IMPACTS OF THE TYPHOON PROGRAMME IN THE UK

In 2020, the Typhoon programme’s expenditure with domestic suppliers amounted to £350m. Just over half of supply chain spending (£180m) accrued to the UK’s manufacturing sector. Professional and other business services were procured in equal measure and for a total amount of £100m. Total GDP in the UK supported by the programme’s supply chain spending in 2020 is estimated at £290m.

Fig. 6. Procurement spending on the Typhoon programme by sector, 2020²⁴



Source: Oxford Economics analysis of BAE Systems and Leonardo data

²⁴ Totals may not add up due to rounding.

2.3.1 Supply chain employment impact

The employment supported by the supply chain spending of the Typhoon programme reaches into every part of the UK.

For instance, more than 400 workers were supported by the Typhoon programme's supply chain spending in five UK geographies: the North East, North West and East of England, the East Midlands, and Wales. In total, this represents just under 40% of the total employment supported by BAE Systems and Leonardo's supply chain spending in the Typhoon programme. A further 10% of the employment supported was in the West Midlands, Scotland, and Yorkshire and the Humber.

However, over half of total Typhoon programme procurement expenditure in 2020 took place in the South East and South West. As a result, the two regions saw the largest employment support from supply chain spending, with an estimated 1,670 and 1,110 workers respectively providing the programme with the goods and services required to run its domestic operations (see Fig. 14 in Appendix 2). Just under half of employment supported by supply chain spending was in these two regions and London.

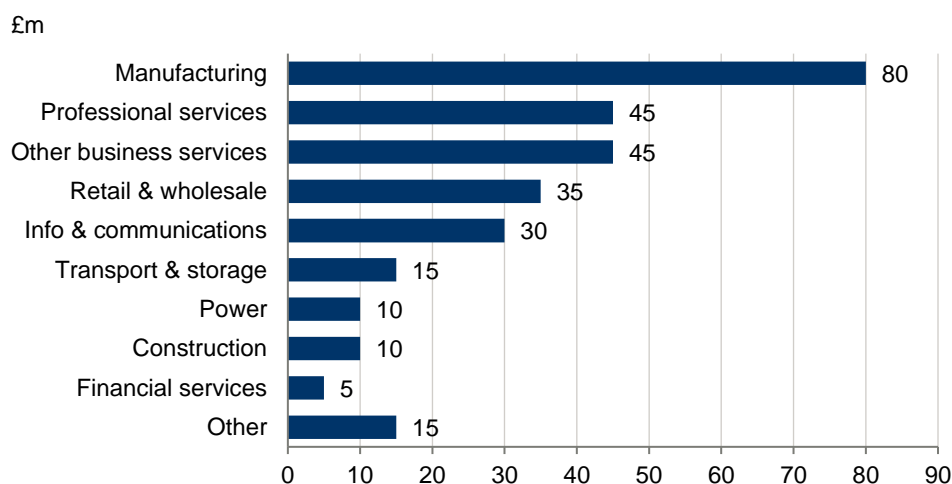
Sectors receiving considerable employment support through the programme's supply chain spending in 2020 were professional and other business services (1,090 and 2,290 jobs, respectively), and manufacturing (1,040 jobs).

2.3.2 Supply chain GDP impact

Though the South East received the largest supply chain GDP impact from the Typhoon programme (£80m), 70% of such impacts accrued elsewhere in the UK. For instance, the South West and the North of England (which includes the North East, the North West, and Yorkshire and the Humber) were both supported with a £50m supply chain GDP contribution (see Fig. 16 in Appendix 2).

The UK's manufacturing sector received the largest GDP contribution from the programme's supply chain activity, estimated at £80m for 2020, or 28% of the programme's indirect GDP contribution. The professional and other business services sectors accounted for a further combined £90m—just under a third of the programme's supply chain GDP contribution.

Fig. 7. GVA in the UK supported by Typhoon programme supply chain spending, by industry, 2020²⁵



Source: Oxford Economics analysis of BAE Systems and Leonardo data

2.4 IMPACTS SUPPORTED BY EMPLOYEE WAGE SPENDING

In 2020, the Typhoon programme’s total labour costs amounted to £440m. As the programme’s 6,540 employees spent their wages in consumer-facing sectors, more jobs and GDP were supported across the country. Further economic stimulus was supported by the wage spending of the 6,260 employees estimated to have been supported by the programme’s supply chain activity.

Combined, jobs and GDP supported by the wage spending of direct and supply chain employees represent the programme’s “induced” impacts.

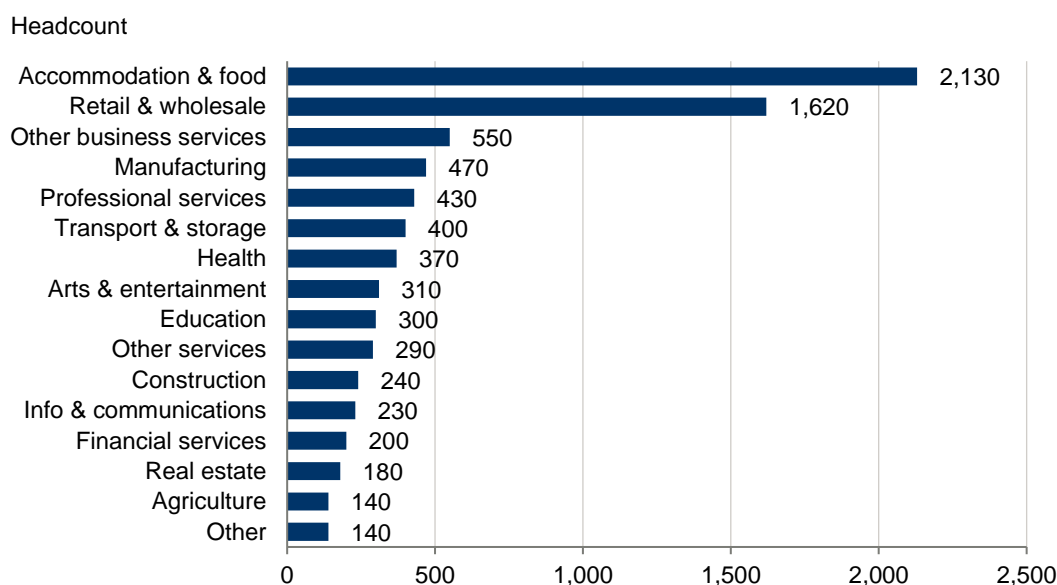
2.4.1 Employment impacts supported by employee wage spending

Typhoon programme employee wage spending in 2020 supported an estimated 7,980 jobs in the UK. These induced impacts clustered in areas where direct and supply chain employees live. Just under half (3,970) of all jobs supported by wage spending were located in the North West (see Fig. 14 in Appendix 2). More than 450 induced jobs are estimated to have been supported in each of the East Midlands, Scotland, the South East, the East of England, and the South West.

The concentration of jobs supported by wage spending is greatest in consumer-facing sectors: a total of 3,750 jobs were supported in the accommodation and food, and retail and wholesale sectors.

²⁵ Totals may not add up due to rounding.

Fig. 8. Number of workers supported by Typhoon programme wage spending, by industry, 2020²⁶



Source: Oxford Economics analysis of BAE Systems and Leonardo data

2.4.2 GDP impacts supported by employee wage spending

Wage spending by Typhoon programme employees and by employees employed along its supply chain supported a total GDP contribution in the UK in 2020 of £480m. Of this, £210m accrued to the North West (see Fig. 16 in Appendix 2).

The real estate sector was supported by a £140m induced GDP contribution, with a further £70m in GDP supported in the retail and wholesale sector.

²⁶ Totals may not add up due to rounding.

DEVELOPING INNOVATIONS THAT BENEFIT OTHER DEFENCE APPLICATIONS AND WIDER INDUSTRY

As well as sustaining the UK's sovereign capabilities to design and develop, manufacture, and upgrade combat aircraft, the Typhoon programme has contributed more broadly to the research and development of advanced technologies in the UK. Expertise refined on the Typhoon programme has driven continued developments and benefits across combat air activities. This in turn has allowed BAE Systems to develop the skills and sustain the roles required to secure further work, and has in some instances resulted in technology spinning-out for the benefit of wider industry.

One example is in carbon fibre composite (CFC) technology. BAE Systems reports that the Typhoon programme has boosted investment in CFC technology over the past two decades, extending into a wider UK supply chain. As a result, the UK has been in a stronger position to drive and support the use of composites in civil aerospace. For instance, BAE Systems secured work in this area on commercial aircraft programmes such as the Airbus A320. The technology has also been adopted more widely in the automotive industry: the development of CFC for Typhoon aircraft has been applied by the Formula 1 racing industry and by the automotive industry to produce strong and lightweight vehicle structures. Other examples of technologies developed on the Typhoon programme and adopted by wider industry include anti-skid braking, global positioning satellite navigation systems, and Heads-Up Display technology.

Technologies developed on the Typhoon programme have also had wider "spillover" benefits within the defence sector. For example, expertise in producing flight control for Typhoon aircraft has been applied in the development of Dreadnought, the UK's next generation submarine programme in Barrow-in-Furness, in Cumbria (North West), also led by BAE Systems. Engineers from the Typhoon programme transferred their skills to directly support BAE Systems' submarines business, developing the electronics that control the heading, pitch, depth, and buoyancy of the Dreadnought class.

The ecosystem of Typhoon programme suppliers has also benefitted from the programme. For instance, BAE Systems' requirement to work within a digital environment on highly complex structural components of the aircraft has spurred its suppliers to invest in this capability. The company reports that this has positioned its suppliers well to secure work out of the civil aerospace sector, and diversify their portfolios into automotive, bio-medical, and other sectors.

Alongside the technology spin-offs from the Typhoon programme, the technical skills required of staff on the Typhoon programme have helped boost a pipeline of expertise in science, technology, engineering, and maths (STEM) skills. These skills have been transferred to other programmes within the company, and support the UK's overall STEM capabilities.

3. EMPLOYMENT AND GDP CONTRIBUTIONS, 2018—2022

This chapter presents economic impact estimates for the Typhoon programme in the UK from 2018 to 2022.²⁷ While 2018 to 2020 estimates are based on actual data inputs from the programme, 2021 and 2022 estimates are based on forecast data provided by the consortium. In this chapter, we present and narrate economic impacts at the UK level; regional economic impact results by year are presented in Appendix 2.

3.1 TOTAL ECONOMIC CONTRIBUTION OF TYPHOON PROGRAMME IN THE UK

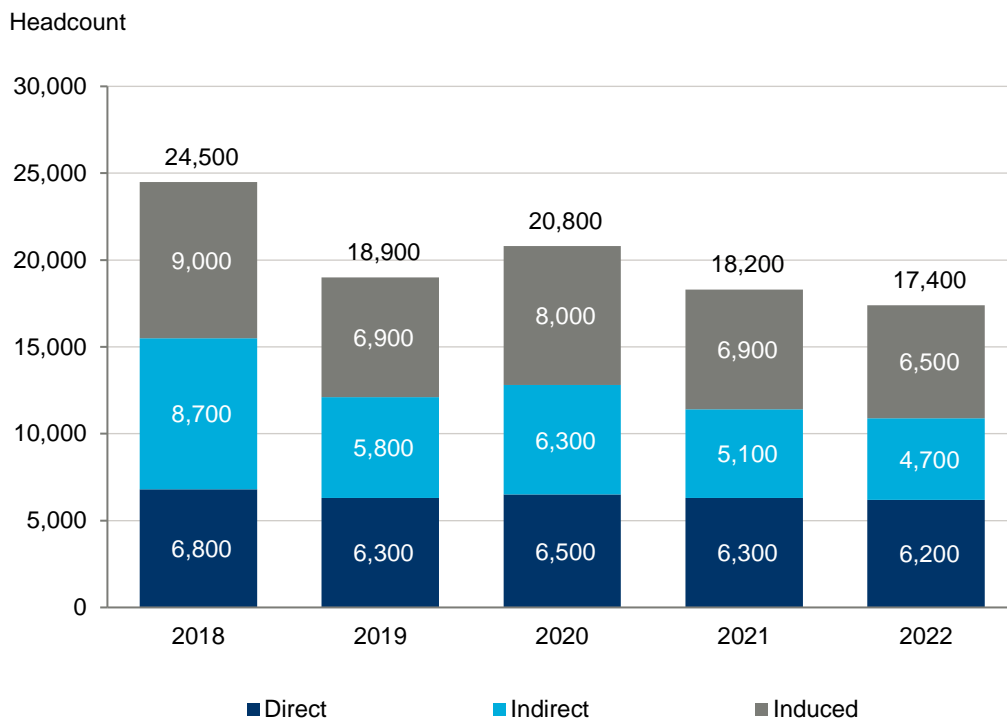
Firstly, we explore the programme's total economic impact over the five-year period, comprising its direct, supply chain (indirect), and wage spending (induced) impact channels.

3.1.1 Total employment contribution

Total employment supported by the programme in the UK over 2018—2022 averaged 20,000. It peaked in 2018, driven by higher supply chain spend which led to more jobs being supported along the programme's supply chain and through the wage spending of supply chain employees.

²⁷ All monetary figures in this chapter are expressed in constant (2020) prices.

Fig. 9. Total number of workers in the UK supported by the Typhoon programme, 2018—2022



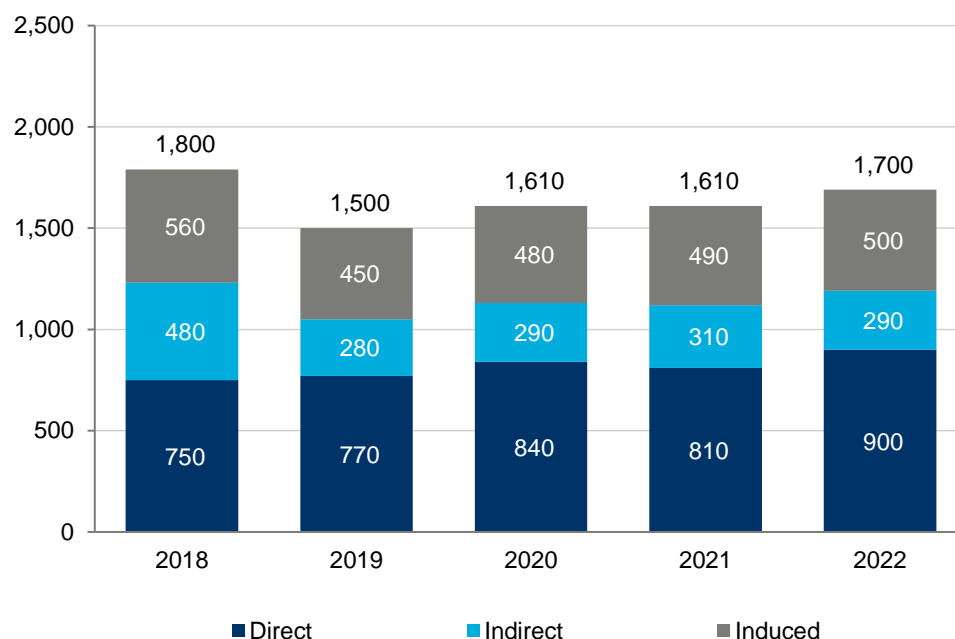
Source: Oxford Economics analysis of BAE Systems and Leonardo data

3.1.2 Total GDP contribution

Total GDP, in 2020 prices, supported by the programme in the UK fell from £1.8bn in 2018 to £1.5bn in 2019—again, due to lower indirect and induced impacts driven by lower procurement spending—before increasing to £1.7bn in 2022.

Fig. 10. Total GVA in the UK supported by the Typhoon programme, 2018—2022

£m, 2020 prices



Source: Oxford Economics analysis of BAE Systems and Leonardo data

3.2 DIRECT ECONOMIC CONTRIBUTION OF TYPHOON PROGRAMME TO THE UK

3.2.1 Direct employment contribution

Between 2018 and 2022, the number of workers directly employed on the Typhoon programme in the UK averaged 6,400, and was at a peak in 2018. Apart from an increase in 2020, direct employment is expected to decline slightly each year until 2022, with 6,200 jobs directly supported by the programme.

3.2.2 Direct GDP contribution

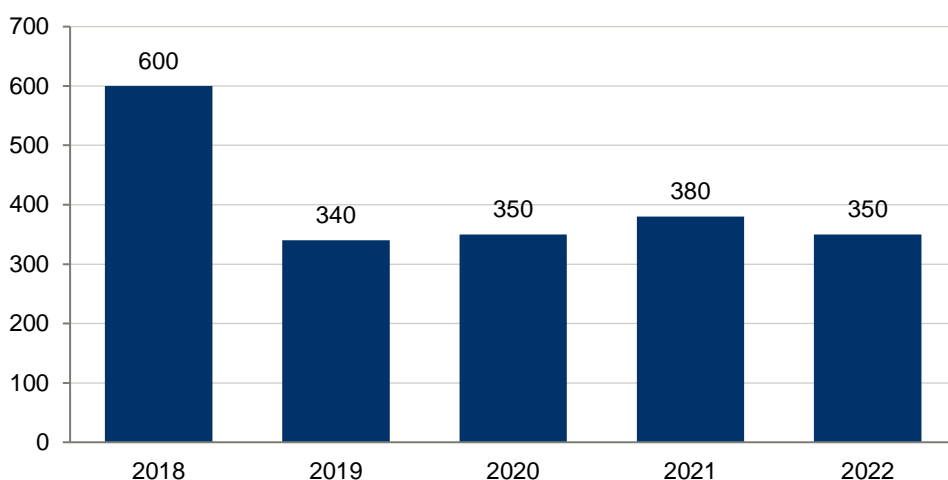
Despite slightly declining direct employment, GDP directly generated by the programme in the UK is expected to increase, in real terms, by £150m, from £750m in 2018 to £900m in 2022.

3.3 SUPPLY CHAIN IMPACTS OF TYPHOON PROGRAMME IN THE UK

Supply chain spending on the programme, in 2020 prices, totalled £600m in 2018, after which it varied between £340m and £380m over the next four years.

Fig. 11. UK supply chain spending on the Typhoon programme, 2018—2022

£m, 2020 prices



Source: Oxford Economics analysis of BAE Systems and Leonardo data

3.3.1 Supply chain employment impact

The programme's supply chain spending supported 8,700 jobs in the UK in 2018, and an average of 5,500 over 2019—2022. Reflecting lower procurement spending, the programme's indirect jobs contribution is forecast to decline to 4,700 by 2022.

3.3.2 Supply chain GDP impact

Following a similar pattern, GDP contributed to the UK economy through the programme's supply chain spending, in real terms, peaked in 2018 at £480m. In the following four years it fluctuated around £300m.

3.4 IMPACTS SUPPORTED BY EMPLOYEE WAGE SPENDING

3.4.1 Employment impacts supported by employee wage spending

Wage spending by the programme's employees and employees along its supply chain spending supported 9,000 jobs in the UK in 2018, and averaged 7,400 jobs over 2018—2022. Despite significantly lower supply chain spending, wage spending is still expected to support 6,500 jobs in 2022.

3.4.2 GDP impacts supported by employee wage spending

Wage spending by workers employed directly or indirectly by the programme supported £560m in GDP, in 2020 prices, to the UK economy in 2018, and is expected to total a robust £500m in 2022.

3.5 WIDER ECONOMIC CONTRIBUTIONS

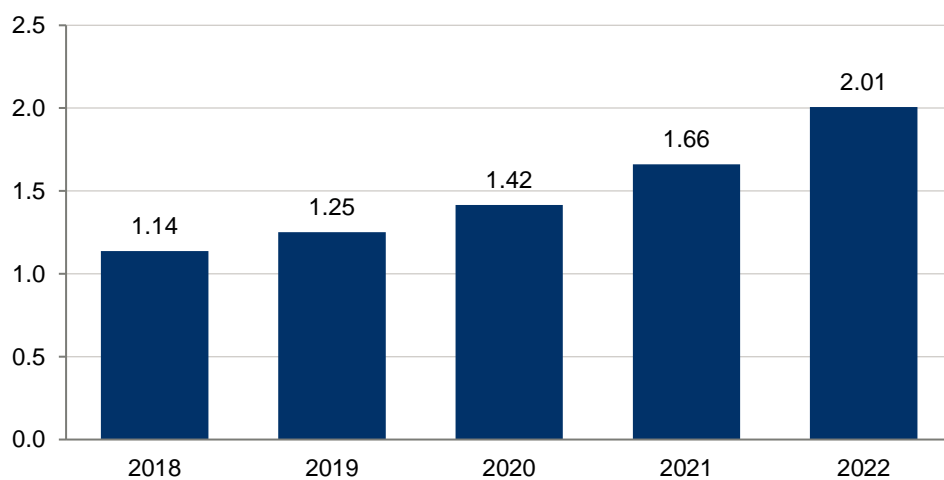
The Typhoon programme further contributes to the UK's economic prosperity by exporting goods and services overseas. The programme's exports consistently increased over 2018—2022, in real terms,

from £1.1bn to £2.0bn. Spend with non-UK suppliers (i.e., the programme’s imports) in 2020 was approximately £430m, including with members of the Eurofighter consortium. The programme contributed more than £980m to the UK’s trade balance in 2020.

Export growth under the Typhoon programme does not only contribute to the UK’s economic prosperity. Defence programmes are typically government-to-government contracts put in place as part of governments’ strategic relationships. Strong international trade therefore strengthens international partnerships.

Fig. 12. Exports from the Typhoon programme, 2018—2022

£bn, 2020 prices



Source: Oxford Economics analysis of BAE Systems and Leonardo data

SKILLS FOR THE FUTURE—SUPPORTING THE CRITICAL SKILLS FOR A THRIVING DEFENCE AND AEROSPACE SECTOR

The Typhoon programme has helped develop the critical skills needed to support the defence and aerospace sector in the UK for the last 20 years. The jet is the first combat aircraft built in the UK to be designed from start to finish in a digital environment, rather than with a more physical design approach. This has resulted in a shift from using traditional, manual methods of manufacturing and engineering to a need for more precision tooling and advanced manufacturing techniques. Consequently, training at BAE Systems has been adapted to include specialist skills in these areas, and a range of new apprenticeship programmes have been introduced to forge the next generation of engineers, helping to support a thriving defence and aerospace sector in the UK.

The company works with regulators and education providers to shape external syllabuses and, in 2015, it created two new apprenticeship schemes reflecting the changing needs of the sector: the Software Engineering Degree Apprenticeship scheme, which has had over 140 starters as of early 2022, and the Aerospace Engineering Degree Apprenticeship scheme, with almost 180 starters as of early 2022.

Under both schemes, students gain experience rotating across the company's departments and earn both a Level 4 Diploma in Engineering and Advanced Manufacturing, and a bachelor's degree in either software engineering or aerospace engineering.^{28 29} Activities covered in the four-year software scheme include developing and testing aircraft displays and interfaces, loading data to the aircraft, and producing the latest training simulators. The five-year aerospace scheme teaches practical and theoretical engineering, with students going on to specialise in a particular area such as airframe, systems, or support engineering.

BAE Systems has also introduced virtual reality (VR) training into their schemes to allow apprentices to learn faster, reduce physical risks, and boost interaction. Through VR training, students can experience working on different areas of the Typhoon aircraft from the classroom, including parts location and identification, cockpit awareness, assembly, and spray painting.

BAE Systems employs around 1,000 apprentices and graduates within its Air business, with a further 450 apprentices and graduates scheduled to join BAE Systems' Air business in 2022, many of whom will be working on the Typhoon programme.

²⁸ BAE Systems, "[Degree Apprentice Air Aerospace Engineering Brough](#)", accessed February 2022.

²⁹ BAE Systems, "[Degree Apprentice Air Software Engineering Brough](#)", accessed February 2022.

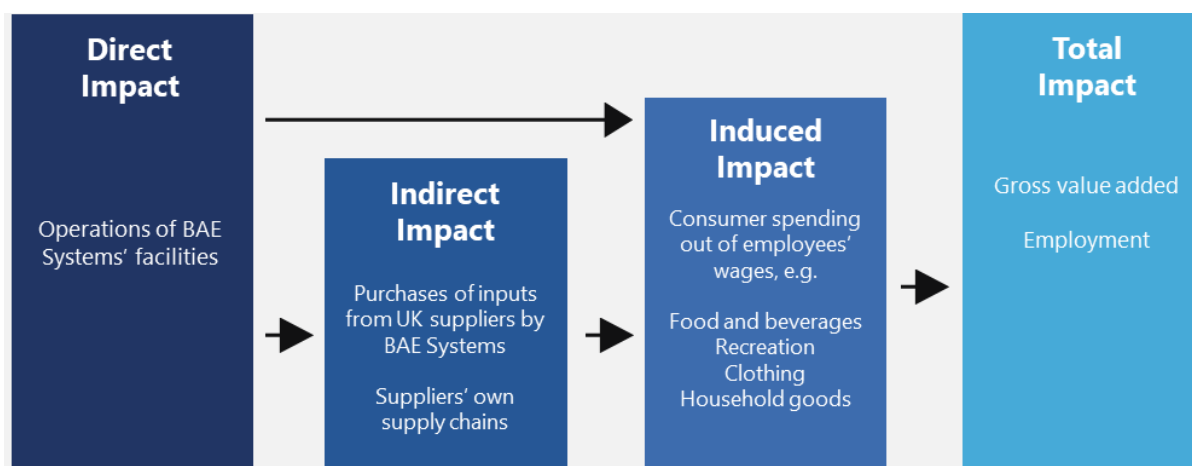
APPENDIX 1—ECONOMIC IMPACT MODELLING METHODS

ECONOMIC IMPACT MODELLING

Economic impact modelling is a standard tool used to quantify the economic contribution of an investment or an organisation. Impact analysis traces the economic contributions through three separate channels:

- **Direct impact:** refers to activity conducted directly by the Typhoon programme in the UK.
- **Indirect impact:** consists of activity that is supported as a result of the procurement of goods and services by the programme in the UK, as well as purchases by suppliers, right down the supply chain.
- **Induced impact:** reflects activity supported by the spending of wage income by direct and indirect employees.

Fig. 13. Direct, indirect, induced, and total economic impacts



Direct impacts

The direct value added of the programme is calculated using the “income approach”. This means that we sum compensation of employees (including employer pension and national insurance contributions); EBITDA; and taxes on production (largely business property rates).

Indirect and induced impacts

Indirect and induced impacts are estimated using an “input-output” model. An input-output model gives a snapshot of an economy at any point in time. The model shows the major spending flows from “final demand” (i.e. consumer spending, government spending investment, and exports to the rest of the world); intermediate spending patterns (i.e. what each sector buys from every other sector—or in other words, the supply chain); how much of that spending stays within the economy; and the

distribution of income between employment and other forms such as corporate profits. As these models measure activity within an economy, the direct impact figures will often not match company annual accounts, which follow accounting standards and rules.

An input-output model uses a matrix representation of a nation's interconnected economy to calculate the effect of changes by consumers, by an industry, or by others, on other industries and therefore on the economy as a whole. These input-output tables ultimately measure "multiplier effects" of an industry by tracing the effects of its inter-industry transactions—that is, the number value of goods and services that are needed (inputs) to produce each dollar of output for the individual sector being studied. These models can be used to measure the relationship between an economic change or "shock," and the final outcome across the whole of the economy.

In summary, an input-output model is a table which shows who buys what, from whom, in the economy.

Oxford Economics used the input-output table for the United Kingdom for 2017, published by the ONS in 2021, for this analysis. This is the most recent input-output table for the United Kingdom.

Direct, indirect, and induced employment figures in this report have been rounded to the nearest 100 jobs, and to the nearest 10 jobs for regional and industry breakdowns. The multipliers quoted in the report represent the additional impacts for each unit of direct impact. For instance, if 10 jobs were directly generated by a company and the impact multiplier is 2, then a total of 30 jobs (i.e., a further 20 jobs) were supported across the economy. These multipliers are calculated from the input-output model results.

Direct jobs are presented including the contingent labour (i.e., external contractors) that BAE Systems hires. The number of these workers was obtained from the consortium, and we assumed that contractors earn the average wage on the programme aggregating direct employees and contingent workers. We then assume that 10% of contractors' wages is retained by employment agencies.

Industry breakdowns

The UK 2017 input-output table is divided into 105 different industry sectors, and the table shows how each sector interacts with the 104 other sectors. For purposes of illustration, to show value added and employment supported across different sectors, the 105 different industries have been pooled into broad industry categories. For example, the professional services industry amalgamates the following sectors:

- Legal services
- Accounting, bookkeeping and auditing services; tax consulting services
- Services of head offices; management consulting services
- Architectural and engineering services; technical testing and analysis services
- Scientific research and development services
- Advertising and market research services
- Other professional, scientific and technical services

APPENDIX 2 – REGIONAL ECONOMIC IMPACTS

Fig. 14. Number of workers in the UK supported by the Typhoon programme, 2020

Employment (Persons)	Direct	Indirect	Induced	Total
North East	0	620	250	880
North West	4,850	460	3,970	9,280
Yorkshire and The Humber	0	180	220	390
East Midlands	670	460	690	1,810
West Midlands	0	240	220	450
East of England	390	550	540	1,490
London	0	340	190	530
South East	10	1,670	560	2,230
South West	0	1,110	480	1,590
England	5,910	5,630	7,120	18,660
Wales	0	400	220	620
Scotland	630	180	590	1,410
Northern Ireland	0	40	50	90
UK	6,540	6,260	7,980	20,780

Fig. 15. Number of workers in the UK supported by the Typhoon programme, 2018—2022

Employment (Persons)	2018		2019		2020		2021		2022	
	Direct	Total	Direct	Total	Direct	Total	Direct	Total	Direct	Total
North East	0	710	0	790	0	880	0	640	0	550
North West	5,170	11,910	4,780	8,410	4,850	9,280	4,510	8,430	4,370	8,910
Yorkshire and The Humber	0	690	0	380	0	390	0	440	0	410
East Midlands	620	1,790	610	1,580	670	1,810	660	1,610	640	1,510
West Midlands	0	690	0	520	0	450	0	460	0	340
East of England	440	2,380	350	1,800	390	1,490	400	1,470	410	1,240
London	0	520	0	740	0	530	0	590	0	480
South East	10	2,960	0	1,850	10	2,230	0	1,940	0	1,480
South West	0	780	0	1,160	0	1,590	0	850	0	720
England	6,240	22,440	5,740	17,220	5,910	18,660	5,590	16,430	5,430	15,640
Wales	0	600	0	390	0	620	0	350	0	240
Scotland	560	1,360	570	1,230	630	1,410	680	1,380	730	1,420
Northern Ireland	0	140	0	80	0	90	0	90	0	80
UK	6,800	24,540	6,310	18,920	6,540	20,780	6,260	18,250	6,150	17,380

Fig. 16. GVA in the UK supported by the Typhoon programme, 2020

GVA (£m)	Direct	Indirect	Induced	Total
North East	0	20	10	40
North West	630	20	210	860
Yorkshire and The Humber	0	10	20	20
East Midlands	90	20	40	140
West Midlands	0	10	20	30
East of England	60	30	40	130
London	0	20	30	50
South East	0	80	40	120
South West	0	50	30	80
England	770	270	430	1,470
Wales	0	10	10	20
Scotland	60	10	30	110
Northern Ireland	0	0	0	10
UK	840	290	480	1,610

Fig. 17. GVA in the UK supported by the Typhoon programme, 2018—2022, 2020 prices

GVA (£m)	2018		2019		2020		2021		2022	
	Direct	Total	Direct	Total	Direct	Total	Direct	Total	Direct	Total
North East	0	40	0	40	0	40	0	40	0	30
North West	560	950	570	780	630	860	590	840	650	950
Yorkshire and The Humber	0	40	0	20	0	20	0	30	0	30
East Midlands	70	130	70	120	90	140	90	140	90	150
West Midlands	0	40	0	30	0	30	0	30	0	30
East of England	50	160	70	150	60	130	60	140	70	140
London	0	50	0	70	0	50	0	60	0	50
South East	0	180	0	110	0	120	0	140	0	110
South West	0	40	0	60	0	80	0	50	0	50
England	680	1,650	710	1,380	770	1,470	730	1,460	810	1,530
Wales	0	30	0	20	0	20	0	20	0	20
Scotland	70	120	60	100	60	110	80	130	90	140
Northern Ireland	0	10	0	10	0	10	0	10	0	10
UK	750	1,800	770	1,500	840	1,610	810	1,610	900	1,700



OXFORD
ECONOMICS

Global headquarters

Oxford Economics Ltd
Abbey House
121 St Aldates
Oxford, OX1 1HB
UK

Tel: +44 (0)1865 268900

London

4 Millbank
London, SW1P 3JA
UK

Tel: +44 (0)203 910 8000

Frankfurt

Marienstr. 15
60329 Frankfurt am Main
Germany

Tel: +49 69 96 758 658

New York

5 Hanover Square, 8th Floor
New York, NY 10004
USA

Tel: +1 (646) 786 1879

Singapore

6 Battery Road
#38-05
Singapore 049909

Tel: +65 6850 0110

**Europe, Middle East
and Africa**

Oxford
London
Belfast
Dublin
Frankfurt
Paris
Milan
Stockholm
Cape Town
Dubai

Americas

New York
Philadelphia
Boston
Chicago
Los Angeles
Toronto
Mexico City

Asia Pacific

Singapore
Hong Kong
Tokyo
Sydney
Melbourne

Email:

mailbox@oxfordeconomics.com

Website:

www.oxfordeconomics.com

Further contact details:

[www.oxfordeconomics.com/
about-us/worldwide-offices](http://www.oxfordeconomics.com/about-us/worldwide-offices)