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Business School

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Restructuring of UK aerospace:

Jobs, skills and high-performance work

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Professor Jonathan Winterton I Professor Chris Forde
Dr Ian Greenwood I Nafisat Olabisi I Dr Andrew Shires

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Foreword

The report summarises a scoping exercise of restructuring in the UK aerospace sector involving a literature review and a series of interviews with industry stakeholders and experts, conducted in 2021 and 2022. The report has been drafted in preparation for a major programme of research into the restructuring of the UK aerospace sector.

The aim of the report is to identify and discuss the factors shaping restructuring in aerospace, and to look at the likely consequences for the industry, primarily business strategy and employment relations. The report concludes by setting out a framework for understanding restructuring in the aerospace sector, which emerges from the literature review and interviews undertaken.

This framework, we argue, can be used to analyse restructuring, and to help forecast job and skill needs in the aerospace sector. It deploys the heuristic restructuring model used in a range of earlier studies of other sectors (including garment manufacture and coal) and sets out key themes and issues that need to be analysed in future research to develop a comprehensive sector change model of UK aerospace.

We are grateful for the participation of industry experts and stakeholders, many of whom have agreed to join a panel to guide our future research work, and to ensure its grounding in the current realities of work, employment and restructuring in the industry. The authors remain responsible for errors and omissions in this work in progress.

Chapter 1: Introduction

The global aerospace sector is experiencing unprecedented turbulence. Air travel collapsed during the pandemic and long-term demand for air travel will remain lower given the urgent need to reduce carbon emissions (Royal Society, 2023). Anticipating reduced passenger air miles, airlines have already downsized operations, causing reduced demand for commercial aircraft.

The focus of this report is on civilian aircraft manufacture, although there is significant cross-over with military aircraft manufacture in long and complex supply chains, encompassing foundation industries and high-tech developers (ADS, 2020a). Whilst still fulfilling orders in progress, most aerospace firms, including Rolls Royce, Magellan, GKN Aerospace, BAe Systems and Airbus announced significant job losses soon after the start of the pandemic, totalling tens of thousands in the UK. These announcements of job losses continued throughout 2021 and much of 2022.

Whilst the sector has experienced some recovery in 2022, demand and orders for aircraft remain lower than pre-pandemic levels. The sector has also experienced acute labour shortages during 2022, affecting airline pilots, cabin crew, airport staff, and staff in various parts of the supply chain. Shortages remain in 2023, and have been attributed to a combination of factors including COVID-19, Brexit, government policy, sectoral level issues around coordination, social dialogue and skills development, and the competitive and HR strategies adopted by individual employers in the sector (Alberti et al, 2022; Forde et al., 2022; Jeffrey and Sposato, 2022; Kazda et al., 2022).

The context of the COVID-19 pandemic and beyond provides a unique opportunity to study the impact of the most significant shock the aerospace sector has experienced in recent times. Air travel has dramatically diminished and only the most optimistic observers expect it to return to former levels, due to the long term need to reduce carbon emissions and expected long-term changes in demand for air travel. Airlines have downsized some operations in anticipation of reduced air travel being a permanent feature of post-COVID economies, and many have cancelled or put on hold orders for new aeroplanes. In this context, aerospace companies are looking closely at working practices, skills development, recruitment, retention and reward of workers in the sector, and considering long-term labour requirements and restructuring processes. These long-term imperatives for restructuring in the sector, and the implications for workers and businesses constitute the core focus of this report.

Throughout the report, we draw evidence from academic literature, along with data from 8 in-depth 'elite' interviews conducted with industry stakeholders, including government, trade unions, employers, academic experts and aerospace sector organisations. These interviews were conducted during 2021 and 2022. Interviews lasted, on average, 1 hour in length and focused on past and current restructuring in the sector, skills development, retention, HRM and high-performance/high involvement working, and sector level dialogue and challenges.

Interviewee	Role
Interviewee 1	Head of Technology Strategy, Public Private Partnership organisation between government and aerospace sector
Interviewee 2	Retired Senior Manager, Large aerospace employer
Interviewee 3	Managing Director, Global Aerospace Industry sector representative
Interviewee 4	Senior official, UK Trade Union representing aerospace sector
Interviewee 5	Aerospace specialist, Government department
Interviewee 6	Aerospace specialist 2, Government department
Interviewee 7	Managing director, public private partnership organization examining skills foresight in aerospace
Interviewee 8	Academic expert on Aerospace, France

The report is organised in five further chapters. In chapter 2, we briefly review the development of the UK aerospace industry and offer an overview of past processes of restructuring in this sector. In Chapter 3, we explore evidence of the extent to which high performance and high involvement work systems have been developed in the sector and the implications for organizations and employees. Chapter 4 considers the impact of COVID-19 on restructuring in the sector, looking at human capital formation, skill deployment, retention and new forms of work organization in the sector during and beyond the pandemic. In Chapter 5, we outline an emerging framework for analysing restructuring, forecasting jobs and skills, deploying the heuristic restructuring model used in earlier studies of other sectors, notably textiles, coal and steel, to identify key themes for a sector change model of UK aerospace. Chapter 6 offers conclusions.

Chapter 2: UK aerospace restructuring

The history of the UK aerospace sector is one of two inter-related sub-sectors: military and civil aerospace, with manufacturers making very different aircraft for quite distinct markets. Both sub-sectors have long supply chains involving thousands of specialist companies, a proportion of which are engaged in both sub-sectors. In the early part of the 20th Century there were already a substantial number of companies involved in building aircraft in the UK but production remained small even with military interest at the start of World War 1. After WW1 the industry struggled (Fearon, 1969) until the approach of World War 2 when aircraft production expanded dramatically (Ritchie, 2013). The British aerospace industry underwent reconstruction and rationalization after WW2 with many market-led mergers and acquisitions (Hartley, 1965) as well as government policies explicitly designed to restructure the sector (Hayward, 1989: 121-132).

The nationalization and subsequent re-privatization of key enterprises demonstrated the important role of industrial policy, and politics, in the industry's fortunes (Hayward, 1989: 133-188). The Labour Government of 1964 had a major impact on the sector, establishing the Plowden Committee of Inquiry to make recommendations on future structure. The Plowden Committee addressed the relationship between aerospace with government, identifying conditions for commercial viability and the need for European collaboration (Plowden, 1965). Whereas the French state focussed on Sud Aviation creating a concentration of aerospace expertise in Toulouse, the UK approach involved spreading contracts around, which maintained the fragmentation of the sector (Lynch and Johnman, 2006).

Nevertheless, by the 1980s the British aerospace industry was seen as relatively successful with the design, development and manufacture of aircraft and engines 'dominated by two firms, British Aerospace (BAe) and Rolls Royce' and supported by 'about 2,000 aircraft-related suppliers and some 15,000 companies' in the supply chain (Hayward, 1989: 1). In contrast with the steady decline of British manufacturing, the British aerospace industry steadily gained an increasing share of the world market between 1960 and 1985 (Hayward, 1989: 201). Industrial policy and politics in the 1960s led to the establishment of a European consortium to build medium range airliners and ultimately the creation of Airbus in 1970 as a GIE (*Groupement d'Intérêt Economique*) involving the UK (20 per cent), France and Germany (each 37.9 per cent) and Spain (4.2 per cent) (Bruce, 1999: 124). The company was subsequently restructured into a single corporate entity as Airbus, with the European Aeronautic Defence and Space Company (EADS) and BAe Systems as stakeholders.

In less than two decades, Airbus grew to capture 30 per cent of the world market, hitherto dominated by US manufacturers, to become the second biggest manufacturer after Boeing, which had merged with McDonnell Douglas in 1967 (Bieler, 1999). Braddon (1999: 82) argued that the US aerospace industry used its' defence linkages, underpinned by extensive government-funded research and development to reduce costs and risks to civil aerospace manufacturers. Indeed, Lawrence (1999: 27) has argued that despite numerous US complaints in the 1980s and 1990s about the role of the state (or rather, states) in the European aircraft industry, the US effectively 'subsidizes commercial aerospace manufacturing.' Lawrence and Braddon (2001: 114) subsequently elaborated this claim with a systematic analysis of US data sources on contracts to conclude the large commercial aircraft sector received annual subsidies in the 1990s of more than one billion dollars. Indeed, a trade dispute between Boeing and Airbus and arguments over respective subsidies has run for more than two decades. During the 2021 G7 meeting, the EU, UK and US agreed to suspend their disagreement for 5 years, and make efforts to end the tariff war over the Airbus and Boeing dispute (Agence France-Presse, 2021; Smout and Hepher, 2021).

Since 2019 Airbus has been the world's largest aerospace manufacturer but in terms of net orders, Boeing had an almost identical market share in 2021. The duopoly between Boeing in the US and Airbus in Europe is the most obvious defining market characteristic of the manufacture of large civil aircraft. In contrast with the US, there is extensive multinational collaboration in European aerospace, both civil and military, which has contributed to the relative competitive success of the sector in Europe (Hartley and Braddon, 2014). Notwithstanding the dominant role of these two companies, there are many more manufacturers of smaller aircraft with niche markets. An equally important feature of the sector is the length of supply chains and the large number of companies involved. The complexity of the production process and long lead time from design to delivery, coupled with the fragmented nature of supply chains, makes aerospace manufacture one of the most difficult sectors to study, and to anticipate and manage restructuring, something recognised by interviewees:

Interviewee 5, Aerospace Specialist, Government Department

‘I don't think industry is very good at setting out the demand signal for the future … trying to get that sort of demand signal from industry has been really, really hard there. As I say, there's been several attempts to do it, but no one’s kind of really cracked it. And at the other end the supply side is really slow to change, so you got this sort of you got this challenge…..We are in effect saying to companies now, if you want …lots of R&D funding from us, we need to see more evidence that you're doing more to help the UK supply chain grow’

The aerospace sector has experienced periodic restructuring emanating from economic, geopolitical and environmental events. As noted above, there was rationalization immediately after WW2 and again during the 1960s. Major restructuring of UK aerospace was also prompted in the 1980s when the military sector moved from ‘cost-plus’ contracting to competitive and fixed price contracting. Drastic cuts in defence spending led to diversification into civil aerospace (Bishop, 1995). Crises such as the Gulf war, 9/11, the global financial crisis of 2008/9 have all affected sector actors globally (Danford *et al.,* 2005; Fry, 2020; Landoni and Ogilvie, 2019; McLachlan *et al.,* 2019; Richardson *et al.,* 2010; Upchurch and Danford, 2001). Restructuring in UK aerospace has also arisen from strategies to improve competitiveness and cost efficiency (Danford *et al.,* 2002; Smith and Tranfield, 2005).

The anticipation and management of restructuring in aerospace has varied from country to country. The 1990s recession put significant pressure on civil aerospace companies in both France and the UK. However, French firms avoided redundancies, explaining ‘*solidarité*’ as the reason for preferring to reduce working hours, help individuals start their own business, allow training leave for up to two years, and granting unpaid leave to retain employees (Lloyd, 1999). Such efforts were viewed as forward looking in terms of firm recovery and performance, with companies that showed concern for employees’ wellbeing during the recession expecting to enjoy employee trust, loyalty and commitment after the crisis. By contrast, UK aerospace firms focussed on reducing costs through redundancy and compulsory early retirement, something which has continued to be a hallmark of the management of restructuring in aerospace and it might be added, across the UK economy, since this time. While the UK approach was seen as demonstrating efficiency to shareholders, many firms incurred higher costs through having to poach workers when the recession ended (Lloyd, 1999).

Different labour market regulatory frameworks limit the options available to employers, which explains why European transnational companies like Petroplus closed UK plants before those on the continent in restructurings during the previous decade (Winterton and Forde, 2013).

‘I think it's just the way that our you know we have a much more violent labour market when it comes to hiring people firing people very forward that...It's compounded by the fact that we have a very unequal approach to payroll support in different European countries.....you look at something like the job support schemes in Spain and in compared with the UK in Spain, you cannot make redundancies (in the way the UK does) within the sector’

Interviewee 4,
Senior official,
Trade Union
representing
aerospace sector

Braddorn and Hartley (2007) made a pessimistic prognosis for the future of UK aerospace when benchmarking its competitiveness against the US, despite significant improvements in productivity and competitiveness between 1980 and 2000, noting the need for new R&D that would require government funding (IGT, 2003). The drive to maintain competitiveness and attain cost efficiency in the face of strong international competition is also constantly driving restructuring in the sector (Landoni and Ogilvie, 2019).

Interviewee 5,
Aerospace Specialist,
Government
Department

‘There are opportunities both in maintaining strengths in the sort of areas that we've got at the moment around kind of wings, propulsion, advanced systems, but you know, increasingly we need to turn our eye to new technologies which will bring in, you know, new players, new entrants and companies that hitherto haven't been regarded as kind of aerospace companies at the top level. That's how I see it...’

‘OK, well I think [from] 2008.....what we have seen is the demand at the front end of the aircraft - the premium demands - essentially never came back to the level that it was previously. And there was (sic) intense cuts.....There was further and more intense competition for that that that demand, so that in terms of European airlines, you saw, they didn't have the money to invest in that product. So, they're in a very competitive market. They've got far more players in the market than any of their counterparts, and they are not awash with cash. And if they were to spend their cash, they would usually be spending it on consolidation

Interviewee 4,
Senior official,
Trade Union representing
aerospace sector

Airbus, for example, announced a significant restructuring and cost-cutting plan in late 2016, which was aimed at offsetting costs originating from delays in the company's aircraft programmes and minimizing losses on its A380 'superjumbo' (Hollinger, 2016). Some 1,164 job losses were spread across Germany, France, Spain and Britain during this restructuring (Agence France-Presse, 2016; Tran, 2016). In 2018, Rolls-Royce similarly announced fundamental restructuring. The restructuring involved creating three customer-focused business units to improve business performance, simultaneously reducing the workforce by 4,600 jobs over three years, with the aim of producing a 'leaner, more agile organisation' (Rolls-Royce, 2018).

'They [Legacy Carriers] have a history of restructuring and outsourcing. So, they start looking at well, what's our core business? What do we need to restructure? Newer terms and conditions are coming in and a two-tier workforce is breaking up historic bargaining structures and developing new ones.'

Interviewee 4, Senior official, Trade Union representing aerospace sector

In summary, there have been periodic bouts of restructuring in aerospace, driven by economic and political crises and events, as well as government policy. Approaches to restructuring vary from country to country, with UK aerospace focusing largely on the management of redundancy, rather than the anticipation of change. In the following section, we focus more closely on work systems and processes in aerospace, to develop an understanding of the nature of work and HRM, and the context in which decisions around restructuring are taken.

Chapter 3: High performance and high involvement work in aerospace

As a concept, high performance work systems (HPWS), popularised by Appelbaum *et al.* (2000) and others, relate to a range of attempts to improve performance, usually with associated bundles of HR practices, but there are many versions, which vary according to different institutional settings (Paauwe and Boselie, 2003). As Boxall and Huo (2019: 99) note, the work and employment practices associated with HPWS 'are subject to a confusing array of definitions and assertions.' Like lean production systems, HPWS have been associated with work intensification and employee burnout since they became widespread (Ramsay *et al.,* 2000) and negative effects for workers have been consistently reconfirmed even if there are often positive performance outcomes (Han *et al.,* 2020). There is also substantial evidence to support the conclusion that different groups of workers react differently to HPWS (Andersén and Andersén, 2019; Heffernan and Dundon, 2016).

Advocates of HPWS argue that involving employees in decisions regarding job tasks and the organization in general leads to greater employee trust in management, job satisfaction, commitment to work and organizational objectives, and higher discretionary effort without causing work intensification (Danford *et al*., 2004; 2005; Felstead *et al.,* 2019; Stewart *et al.,* 2010). Organizations adopting such practices provide employees with training and development to increase productivity and organizational performance (Felstead *et al.,* 2019; Stewart *et al*, 2010). Felstead *et al*. (2019) found team working could facilitate employee involvement, but could equally lead to increased work effort, work intensity, and job strain, negatively affecting employee wellbeing, results that are echoed in other studies (Danford *et al*., 2005; Richardson *et al.,* 2010; Sterling and Boxall, 2013; Stewart *et al*., 2010).

Like broader partnership initiatives (Stuart and Martinez Lucio, 2005), the rhetoric of HPWS stresses a win-win outcome but empirical studies suggest that such systems are primarily directed at improving performance. Management strategies are not intentionally interested in increasing employee participation in decision making (Danford *et al.,* 2005; Lloyd, 2002; Richardson *et al.,* 2010; Stewart *et al.,* 2010). Profit maximization and shareholder interests have always been paramount, even before the 'financialization' of manufacturing (Thompson, 2013). One of the consequences of prioritizing shareholder interests is that management are likely to delimit employee involvement to organizational practices that improve productivity, rather than empowering them to participate in organizational decision-making.

The differences between HPWS and high-involvement work 'processes' (HIWP) are fundamental, the latter characteristically providing workers with a high degree of task discretion and influence over work procedures that are widely associated with higher job quality and employee satisfaction (Boxall and Winterton, 2018). High involvement work, like anthropocentric work organization (Winterton and Winterton, 1987), demands higher competencies but also gives employees greater opportunity to develop and deploy skills (Boxall *et al*., 2019a). Many analyses of high involvement work have confirmed the importance of autonomy and skill utilization (Boxall *et al.,* 2019b).

More differentiated approaches to managing people at work focus high *involvement* initiatives on those employees with high strategic value to the organization and skills that are difficult to obtain in the labour market (Lepak and Snell, 2002). There is an inherent paradox in HIWP, analogous to the 'Matthias Principle' (McCracken and Winterton, 2000) often cited in relation to training, that only those with a high level of competence are able fully to utilize their skills and experience. Reviewing the evidence in relation to high involvement work processes, Boxall and Winterton (2018) concluded that high involvement work is positively associated with higher skills utilization and career advancement, greater employee job satisfaction and organizational commitment, and lower labour turnover.

HPWS and HIWS in aerospace

Boxall and Winterton (2018) argued that HIWP are appropriate in capital intensive industries where quality and safety are paramount and the workforce is highly skilled. Prima facie, aerospace offers an ideal setting for developing both HPWS and HIWP (Hobday 1998): the workforce is highly skilled; production is capital intensive; and the cost of error is extremely high. However, several studies have raised doubts about high performance work in aerospace (Danford *et al.,* 2004; 2005; Stewart *et al.,* 2010) and some have questioned the effectiveness of skill development (Lloyd 1999; 2002).

‘Skills have always been part of the kind of national aerospace strategy is to kind of set a bit of a high-level framework and then allow regional bodies and regional authorities to - you know - to do their thing, but hopefully shaped by what the behavioural framework sets. So, this is, this is what we're kind of looking to achieve at national level…. But I have to say the skills agenda has been, is always been the most challenging and difficult….I just think most of industry is just not very good at thinking beyond a near-term horizon on what its skills needs and if you look, most of the skills stuff gets done by the HR department’

Interviewee 5, Aerospace Specialist, Government Department

‘Due to the economic impact of Brexit and COVID, in the UK, the demand for high skilled employees such as pilots and air traffic management has diminished. BALPA is of the view that for the next five years there will be no new pilots trained. Engineering apprenticeships have ‘dried up’ and those coming out of their time have often been let go.’

Interviewee 4, Senior official, Trade Union representing aerospace sector

‘The situation where you know an employer led skill system is basically populated by training managers, is not one that's going to take us forward. An employer led training system which is populated by engineering and strategic directors is a far better bet….So, one of the interesting balancing points in this is working with employers at a very senior level who understand they will need this. This foresighting process works with the technologists from Centres of innovation universities who have an understanding about how the organization structures will need to change in their capabilities will need to change how businesses will need to change. So, we've injected this important step around organizations, which hasn't been, I think, talked about before this. I don't think the work that I did was about included the organization piece. It went straight to the skills activity, so that's been the missing link in this’

Interviewee 7, Managing director, Aerospace Skills Foresight Organisation

Stewart *et al*. (2010) reject any association between HPWS and skill increases in aerospace, suggesting that employees who reported skill increases based this on technological changes, including computer technology, new equipment, and increased product complexity. This phenomenon of self-reported skill increases is reminiscent of work in coal mining, where evidence of systematic deskilling (Burns *et al.,* 1983) was contested by Penn and Simpson (1986) based on mineworkers' perspectives, rather than detailed analysis of work and technological changes (Winterton, 1994). At Airframes, employee effort was intensified with new multi-project responsibilities, combined with task specialization as the organization pursued a cost cutting agenda and sought to reduce lead times between design and production. Similarly, at Jetco task accretion in specialized units and staff cuts was used to push technical labour to work harder for fear of being laid off (Danford *et al.,* 2005).

Restructuring and work reorganization through the adoption of HPWS in UK aerospace has been driven by competitive and efficiency seeking motives (Danford *et al.,* 2005). One of the requirements for successful use of HPWS is job security so employees will make discretionary effort and show commitment to work (Angelis and Thompson, 2007). The adoption of HPWS in the UK aerospace industry was accompanied with downsizing and outsourcing as a competitive strategy, putting stress on retained employees and increasing and enforcing efforts with fear of job losses.

Some employers used 'small is beautiful' rhetoric in adopting both lean and mean systems (Danford *et al.,* 2005). Trade unions have attempted to reduce adverse impacts on employees (Danford *et al.,* 2005; Richardson et al., 2010; Upchurch and Danford, 2001), but have had little success in improving job security, employee voice, and skills utilization (Danford *et al*, 2005; Stewart *et al*., 2010). Danford *et al*. (2005) concluded HPWS were simply another management strategy for gaining employee commitment to organization objectives serving the interests of employers. Unions were only involved in decisions when it improved firm performance and efficiency (Danford *et al*., 2005).

> 'Firms in the aerospace sector that manufacture (engines for example) are less constrained in their attempts to bypass unions than their counterparts who are fixed to a geographical location. ……… So, I think aviation is sufficiently unionized that it is difficult to avoid it and the resistance there is is very significant, but they would try and get away with it if they could, and as I said, there are still some entities that we're chasing down for collective bargaining rights.'

Interviewee 4, Senior official, Trade Union representing aerospace sector

The type of involvement employees have within an organization, shapes how well they are able to deal with stress, develop and utilize skills, and influence decision making, which should be evident in employee outcomes such as job satisfaction and commitment. The extent of employee involvement varies substantially, however, with the European Working Conditions Survey' (EWCS) suggesting that 38 per cent of European workers experienced low involvement work organization (with low task discretion and influence over work process), 27 per cent were involved in high-involvement work (with high task discretion and influence over work process), 20 per cent had high task discretion, but low influence; and 15 per cent had low task discretion but high influence over work processes (Eurofound, 2013: 23).

Human capital and skills management

There is evidence of sophisticated competence management in the aerospace sector, particularly in France (Winterton and Turnbow, 2020) and Italy (Corallo, Lazoi and Margherita, 2010) which offer benchmarks for competence forecasting and management. Turnbow (2011) developed a comprehensive competence management and forecasting system, drawing on European research into competence frameworks (Le Deist and Winterton, 2005; Winterton, 2009). Unlike many large employers in France (Le Deist, 2009), Airbus did not use the jobs and skills forecasting technique of GPEC (*Gestion Prévisionnelle de l'Emploi et des Compétences*) but developed in-house the Airbus Skills Optimization Programme, and ultimately the EADS Competence Management System.

Aerospace Composite Technologies (ACT), a UK company supplying the sector with aircraft windshields, had an innovative skill development and deployment strategy (Lewis, 1997) and was one of the companies studied for its apparent good practice in relation to collective bargaining over continuing vocational training (Winterton and Winterton, 1994). The company was revisited as an ideal-typical case study exploring the extent to which work organization facilitated and necessitated continuous training, characterizing this as 'anthropocentric work organization' (Winterton and Winterton, 1997).

Danford *et al.* (2005) note that systemic skills, training and career progression are all important for the development of human capital in aerospace. Lifelong learning and opportunities for personal development provided through skills acquisitions continue to be important for partnership in the workplace and organizational performance. In a technology-intensive sector like aerospace workforce skills are highly significant particularly when there is rapid technological change (Lloyd, 2002). The UK aerospace sector is the fourth largest in the world and has a global reputation for design and manufacture of aircraft wings and engines. A decade ago, 50 per cent of all large aircraft wings and 25 per cent of aircraft engines globally were produced by British firms (Lewis, 2012).

The skills-intensive aerospace sector is, however, operating in a notoriously low skills UK economy (Finegold and Soskice, 1988; Mayhew and Keep1999). Skills shortages at technician and operator levels have been noted in UK aerospace, shortages that are largely accommodated through outsourcing (Brown, 2020; Hooper, 2021; Smet et al., 2020). Companies like Airbus continue to compensate for knowledge gaps by outsourcing to suppliers (Cooke and Ehret, 2009). UK aerospace employers provide more on-the-job training than their Italian counterparts (Stewart et al, 2010), but this reflects the lack of initial vocational training in the UK and employer training tends to be highly job specific (Lloyd, 1999). In addition to anticipated shortages of pilots, more than 42 per cent of leaders in aerospace and aviation reported shortages of maintenance technicians that would demand attention in the next five years (Abbot, 2020). Although increasing workforce skills is a central tenet of the UK Government's strategy, skills shortages are a recurrent feature of the UK economy and many have called for greater sector level coordination, at a regional and national level to develop skills across the aerospace sector (Lewis, 2012; Lloyd, 1999).

'It will become important to retain connections with people. Because of their aptitudes, not their technical talents. I think contrast that with opportunities that individuals will have. So, the tension is going to between individuals seeking opportunities and employers seeking individuals that fit an agile system'

Interviewee 7, Managing director, Aerospace Skills Foresight Organisation

Interviewee 5, Aerospace Specialist, Government Department

'I would say some of the better things that happen in skills do happen at a regional level because you get that regional engagement between businesses and universities, businesses and colleges and businesses and schools…Strong relationships being formed and then things just evolving out of them. So, I think I think at regional level you know that that sort of regular engagement. And there's probably more flexibility at regional level as well for local authorities and LEPS to adapt'

'The companies tend to have this sort of sense of responsibility as well to their local areas, and you know want to do the right thing for bringing people into the company, so we see a lot of the companies doing outreach programs to encourage youngsters into the sector'

Interviewee 6, Aerospace specialist 2, Government department

Chapter 4: The impact of COVID-19 on aerospace

Job losses in aerospace during COVID-19

The COVID-19 pandemic was an unanticipated and unprecedented crisis for the aerospace sector. The immediate impact of COVID-19 brought compulsory lockdowns and travel bans, leading airlines to ground their fleets. In the first four months of 2020, global international passenger capacity fell by 80 per cent, according to the international civil aviation organization, while Berkshire Hathaway divested of more than £4.6bn stock in American Airlines, Delta, Southwest Airlines, and United Airlines (Fry, 2020). There was a 68 per cent decline in passenger travel in 2020 compared with 2019, a 52 per cent decline in bookings, and aircraft were flying at 60 per cent capacity (Szondy, 2020). US carriers lost over 95 per cent of domestic travel passenger revenue to COVID-19, with 17,000 aircraft grounded due to travel restrictions (Aerospace Industries Association, 2021b).

Several airlines declared bankruptcy, British Airways grounded its 747 fleet in premature retirement, Delta and Lufthansa each cut their fleets by 100 aircraft, and many workers were laid off (Statista, 2021; Szondy, 2020; Tyrrell, 2021; 2020). The Welsh Minister for Economy, Transport and North Wales, Ken Skates, in a written statement on the impact of COVID-19 on the air transport sector, reported that the pandemic had already reduced sector demand by 40 per cent, causing significant loss of passenger revenue, and rendering 33,500 employees redundant across the sector (Skates, 2020). The report by the House of Commons Transport Committee (2021) noted 12,000 job cuts and downgrade of about 35,000 employees' terms and conditions in British Airways, while Ryanair and Virgin Atlantic each announced about 3,000 job losses and Easyjet 4,500.

Jobs were lost despite the furlough scheme (see Stuart et al., 2021; Spencer et al, 2022) offered by the UK Government to companies affected by the pandemic, prompting criticism in Parliament and suggestions that the restructuring by British Airways was opportunistic. The British Airline Pilots Association (BALPA) claimed airline downsizing was unnecessary, and that the COVID-19 pandemic had provided an excuse for firms to restructure for increased profitability. There was some agreement amongst stakeholders that demand for some skilled workers had reduced and was unlikely to return, however, there was also widespread recognition that decisions around redundancies were being made too quickly, with little attention being paid to the long-term skills and labour needs of the sector.

> 'Due to the economic impact of Brexit and COVID, in the UK, the demand for high skilled employees such as pilots and air traffic management has diminished… Engineering apprenticeships have 'dried up' and those coming out of their time have often been let go'

Interviewee 4, Senior official, Trade Union representing the aerospace sector

Unions in British Airways showed strong opposition to significant job cuts and adjustments to terms and conditions, prompting threats from management that they would replace the existing workforce if the actions were not supported by the unions. Key unions representing workers in the sector nonetheless accepted job losses were inevitable given the financial consequences of the pandemic and the insignificant support offered by the Government compared with Continental Europe (Aero, 2021; Unite, 2020). The short-term perspective adopted by employers and unions in the aerospace sector, and deep restructuring and heavy redundancies announced, particularly in the context of the job retention (furlough) scheme available to support workers during the pandemic is likely to have significant effects upon long-term retention, skill development and HRM in the sector, with many workers not returning to the sector after COVID-19.

‘In terms of the industry itself, again, there is no cohesive industry body. … And you don't have a stakeholder forum. You've got different stakeholders, so the airport operators association and the airlines UK. One represents the airlines, the other the airports. you didn't even have a stakeholder for the ground handlers and 3rd party providers. They (needed to) create one during COVID to lobby.’

Interviewee 4, Senior official, Trade Union representing the aerospace sector

The aerospace sector in other countries were also hit heavily by the pandemic. Aircraft manufacturers globally faced declining orders, deferrals and cancellations, prompting restructuring across the aerospace industry globally (Aso and Bouchard, 2020; Basu, 2020a; Skates, 2020). In the US, about 20,000 workers at Raytheon Technology (Waltham, Massachusetts) engine and aircraft parts division were laid off and two other companies in the Raytheon group were affected: Collins Aerospace experienced a 34 per cent drop in sales in the third quarter of 2020, while Pratt and Whitney, Connecticut-based jet engine manufacturer, also lost sales because of COVID-19. Globally, another 16,000 jobs (10 per cent of the workforce) were lost from GE Aviation (IndustriALL Union, 2020), whilst Boeing, which already had its 737 max grounded for safety reasons, was hit even harder by the pandemic and laid off about 30,000 of its global workforce (Gregg, 2020).

The order books of Airbus looked promising at the start of 2020 with 7,482 commercial aircraft and a forecast rise in demand, but this was quickly eroded. Airbus announced resizing and adapting its global workforce, which was expected to result in 1,700 job losses in the UK, and 15,000 job losses in total across its global operations. In the wake of the pandemic, restructuring and thousands of job losses were announced, mainly in the civil aerospace industry.

Airbus CEO Guillaume Faury described the pandemic as the gravest crisis the industry has ever experienced, a view shared by other industry experts (KPMG, 2020; Szondy, 2020) and a number of interviewees in our research:

Interviewee 5,
Aerospace Specialist,
Government
Department

‘It's going to be a three to five well from now. Another two to four years, I think before we back to pre-COVID levels of growth. So, you know the challenges facing the industry is changed and our strategy in working with industry is sort of changed … our focus previously has been on the large commercial aircraft … potentially there's opportunities around kind of new regional sized aircraft.’

Rolls-Royce also undertook significant restructuring, with at least 9,000 job losses in 2020, despite having undertaken another restructuring programme as recently as 2018 (Maurya, 2020). Early in 2021, Rolls-Royce announced it would suspend aircraft engine production for two weeks and would sustain cost efficiencies through reducing staff salaries (McCulloch, 2021). This affected 12,500 employees working on jet engines and all 19,000 employees in the international civil aerospace segment of the company. A significant share of Rolls-Royce’s revenue comes from per hour engine flights, and with aircraft grounded the company’s revenue plunged with losses of around £21 billion expected by the end of 2021, double the original forecast. The company considered relocating engine production from its historic factory in Barnoldswick, Lancashire, to Singapore, but this was prevented by strike action of Unite members in 2020 (McCulloch, 2021).

The fragility of the ‘per hour’ model of generating income from engines, along with a reliance on maintenance contrasts has been exposed during the pandemic. As industry experts noted:

‘(Firms are) losing money because in their contracts they still have to maintain those engines. They have to ensure that they are ready for when they are used….you have less maintenance because the aircraft are not flying as much, but you still have to maintain and run the aircraft and keep it up to date’

Interviewee 1,
Head of Technology
Strategy, aerospace-government
partnership
organisation

Interviewee 2, Retired
Senior Manager, Large
aerospace employer

‘The moment those engines stopped flying, income dried up so you know if you just not got the money coming in, you can't afford to keep all those people.’

The unions had some success in moderating compulsory redundancies in aerospace, negotiating a voluntary severance scheme for 3,000 job losses announced by Rolls-Royce in June 2020. Similarly with GE Aviation at several sites, redundancy was avoided by agreeing to a shorter working week and a pro-rata cut in income (Sumner, 2020), though the unions failed to prevent 140 jobs being lost with the closure of the Bournemouth site of Magellan Aerospace (Noble, 2020). In September

2020, Unite and devolved authorities jointly demanded that the UK Government create a UK Aerospace Taskforce to combat the impact of the pandemic on the sector (Unite, 2020). Unite argued that support like the furlough and job retention schemes were only short-term measures and called for more significant long-term support comparable with support offered in France and Germany.

The long-term implications of the short-termist outlook adopted in the UK is likely to be significant. Stakeholders pointed to the permanent loss of skills that the severe bout of restructuring undertaken during the pandemic had had on skills in the sector:

Interviewee 2, Retired Senior Manager, Large aerospace employer

'You know [employer X] had to show the financial markets that it was prepared to be quite brutal,. And when it announced the scale of layoffs, it had to ask for volunteers… You know that whole generation (age 55+) just decided to vote with their feet, not that we were particularly fed up. Not that we got any gripes with the company, but you know, we did the mathematics'

'All of that knowledge, all of that experience is out the door… it's going to take years to recover. You're losing technical skills now, whereas before you were losing coordination…You know marketing support staff in in the back office and things like that. Now you're losing a lot of real expertise, which you cannot get back up, you know Chief engineers'

Interviewee 1, Head of Technology Strategy, aerospace-government partnership organisation

Interviewee 3, Managing Director, Global Aerospace Industry sector representative organisation

'It's very important that those skill sets are retained because soon as they are lost, that's it. You can't immediately just snap your fingers….you know you need to deliver to a very high standard, very high-quality standard in a highly regulated industry. So you need those experience, those skill sets'.

The sector has begun to recover in 2022, but demand and orders for aircraft remain lower than pre-pandemic levels. Alongside this, acute labour shortages have impacted on the UK industry in 2022, affecting airline pilots, cabin crew, airport staff, and staff in various parts of the supply chain. These shortages remain in 2023, and have been attributed to a combination of factors including COVID-19, Brexit, government policy, sectoral level issues around coordination, dialogue and skills evelopment, and the competitive and HR strategies adopted by individual employers in the sector (Alberti *et al*, 2022; Forde *et al.,* 2022; Jeffrey and Sposato, 2022; Kazda *et al.,* 2022).

Suppliers and Maintenance, Repair and Overhaul Organizations (MRO)

With long and complicated supply chains, suppliers and MROs within civil aerospace were inevitably affected by the pandemic (Aso and Bouchard, 2020; Basu, 2020a; Deloitte, 2021; Michaels, 2020; MAA, 2020; Sadler, 2021; Szondy, 2020). The UK has a growing MRO sector that provides services to both the defence and civil aerospace sector (UK Country Commercial Guide, 2020). Although not all suppliers are identified as aerospace companies, the turnover for many depends on aerospace demand. The large aerospace supply chain cluster in the Midlands has over 300 companies (MAA, 2020). The cluster has contributed significantly to the UK economy due to the growing global demand for high tech aero engines, precision engineered components and complex aircrafts systems for industry manufacturing giants like Airbus and Boeing (MAA, 2021).

Much activity in the aerospace supply chain has been consolidated over the last decade, with transactional type activities being increasingly outsourced. Efforts to gather and capture knowledge across the supply chain had been undertaken, often led by the largest employers in the sector. However, that work was still incomplete, with the result that much knowledge within supply chains had been lost as restructuring took hold:

Interviewee 2, Retired Senior Manager, Large aerospace employer

‘The whole of the aerospace supply chain was trying to do was to proceduralize to capture that knowledge…. the whole idea was to try and capture that knowledge such that you were no longer relied upon an individual or a whole generation of individuals….when the pandemic hit that journey wasn't complete. It is looking to the supply chain to plug that gap now…through the recruitment of ex-(large aerospace employer) engineers. Now my criticism of that is it's short term..It isn’t sustainable’

Reed and Walsh (2002) suggested that large aerospace firms tend to keep designs in house and rely on in-house scientists and engineers for design technologies. With the evolving manufacturing sector, the priority of these large firms is to keep core competencies by outsourcing sub-assemblies and sub-systems to suppliers, shifting technology responsibility to the suppliers.

The drastic impact of COVID-19 on consumption of airline services and aerospace manufacturers had a ripple effect on suppliers, exacerbating the suspension of Boeing’s 737 max programme (MAA, 2020). UK suppliers needed to stock aircraft parts to avoid supply interruptions due to Brexit. Michaels (2020) argued that suppliers will have to adjust to the new realities and shed non-core and under-performing assets acquired and developed over the previous two decades by Original Equipment Manufacturers (OEMs) and Tier 1 suppliers. Rolls-Royce for instance announced the closure of some of its facilities in the UK, Singapore and Germany. Airbus also stopped its planned in-sourcing of A330neo nacelles (which contribute to propulsion performance, reduce engine noise and perform a braking function on landing) with a loss of 350 jobs. Likewise, Spirit AeroSystems scrapped its plan to acquire Asco, a component supplier company. Secondly, there is the possibility of consolidations among smaller built-to-print manufacturers and tier 3 suppliers, due to the impact of the pandemic combined with new technological capacities and efficiencies.

Tyrrell (2021) reported a fall in wide-body orders of 81 per cent and a decline of 54 per cent in wide-body deliveries in 2020, while single-aisle aircraft had a 35 per cent decline in deliveries. There has been some recovery in 2021 and 2022, although this has been slower than anticipated (PWC, 2021; RSM, 2022). RSM (2022) point to some recovery in demand for aircrafts over 2022, with 728 global aircraft orders placed in the first half of 2022, and 513 aircraft deliveries, the most since 2019 and an overall increase of 13.2% on the same period in 2021, indicating some easing in supply chain issues. Basu (2020b) notes that 75 per cent of the global air passenger market is now dominated by single aisle jets and companies like Rolls-Royce do not manufacture the small engines, focussing on engines for wide-body aircraft. Before the pandemic, Boeing expected that single-aisle aircraft like the 737 max would form the dominant proportion of the 32,000 aeroplanes expected to be built in the following two decades because people were increasingly opting for point-to-point flights (Szondy, 2020). Suppliers were affected both by sharp decline in demand across the sector and pressure to develop technological capacity to improve efficiency (Michaels, 2020).

Long recovery time for wide-body aircraft manufacturers is expected to have a serious effect on the financial well-being of suppliers in this segment, with weak suppliers likely to be side-lined in favour of those with more secure finances (Aso and Bouchard, 2020). Aerospace manufacturers are aiming to simplify supply chains through global alliances with suppliers, which may reduce opportunities and retard supplier recovery (UK Country Commercial Guide, 2020). Civil aerospace has been worst affected by the pandemic, but civil and defence aerospace share the same supply chains, so civil aerospace issues also impact supply chains in the defence sector (AIA, 2021). In April 2020, KPMG (2020: 1) anticipated ‘significant consolidation’ in aerospace, and forecast that financially sound companies would ‘take advantage of undervalued assets or bail out suppliers to safeguard supply chains.’

Sector Level Support and Dialogue

There was some support provided to the aerospace sector during COVID-19 although this was relatively small scale compared to that offered to other sectors. The aerospace supply chain was supported with a £500 million fund and long-term investment (Sadler, 2021). In partnership with the aerospace industry, the UK Government also provided a £400million ‘go green’ fund for high performance engines, wing designs and ultra-lightweight materials to reduce fuel consumption (Waddington, 2020). Beneficiaries of the fund included Airbus for wings design and manufacturing towards efficient assembly, installation, design processes and innovation; Rolls-Royce for Ultrafan engine technology development, and ultra-lightweight seat structures by Oxford (Waddington, 2020). Alok Sharma, Secretary of State for Business, Energy and Industrial strategy claimed the support would help the UK secure its position as the world leader in the development of safer and greener flight technology and reinstated the state’s commitment towards zero-carbon emission with the FlyZero initiative aimed at promoting design and development of zero-emission commercial aircraft.

The UK Government also provided £8 million funding to encourage investment in the sector and its supply chain, with a particular focus on projects aimed at providing disruptive solutions to the challenges faced by the civil aerospace.

Interviewee 5, Aerospace Specialist, Government Department

‘Back in 2016 industry itself came up with a thing called the Supply Chain Competitive Charter. It was at the heart of the refreshed industrial strategy that's on the AGP [Aerospace Growth Partnership] kind of website. If you look at it. And. Essentially, it was a sort of two-way deal where it was the larger companies signing up for working more closely with their suppliers to give them more opportunity to compete. And in return the suppliers were signing up to continuous performance improvement. … the absolute clear remit was for companies to kind of change their behaviours a bit and be more cooperative with UK suppliers…We are in effect saying to companies now, if you want …lots of R&D funding from us, we need to see more evidence that you're doing more to help the UK supply chain grow.’

However, compared with countries such as US, France and Germany, the UK Government offered less support for the aerospace sector’s response to, and recovery from, the pandemic (Hollinger and Pfeifer, 2021). The Aerospace Technology Institute (ATI) in Britain announced the suspension of bids for new research projects, reflecting Government failure to set clear plans for reaching its net zero greenhouse gas emission targets by 2050. Moreover, while European governments cover 70 per cent of aviation regulation costs under the European aviation regime, the new aviation regime in the UK leaves 100 per cent of the costs to the industry (*The Loadster*, 2020). Whiteman (2021) claims that with travel restrictions, the impact of the pandemic and relatively low government support, the UK experienced the slowest rate of growth in the aerospace sector of anywhere in the world.

The lack of sector level coordination in aerospace in the UK was a theme highlight by a range of industry stakeholders interviewed:

> ‘I don't think it is coordinated at all…there is the aerospace growth partnership…a skills working group, but I haven't engaged with them too much other than knowing who they are… I think they've attempted to do some mapping of skills requirements more than to attract new talent to develop existing talent, but I'm not too sure what they're doing. But I don't think it is coordinated at all…there’s pockets of things’

Interviewee 1, Head of Technology Strategy, aerospace-government partnership organisation

There was a perception that this was a long-standing issue, and that dialogue and coordination at a sectoral level, particularly around long-term skills development was informal and reactive, as a union respondent noted:

Interviewee 8, Academic expert on Aerospace, France

> ‘I know a number of companies and I can have a strategic conversation with them and they might have strategic conversations with each other, but it will all be based on who you know. Sadly I've been knocking around the industry quite a while, so I know people who will have that discussion with me…but it's not guaranteed…..There's very little attention to skill strategy’

> ‘The national aerospace strategy is to kind of set a bit of a high-level framework and then allow regional bodies and regional authorities to you know to do their thing, but hopefully shaped by what behavioural framework kind of sets. So, this is, this is what we're kind of looking to achieve at national level …. But I have to say the skills agenda has been, is always been the most challenging and difficult…So, for government, sparking more joined up [thinking] around the skills agenda (is important) … Industry is just not very good at thinking beyond a an immediate near-term horizon on what its skills needs are’

Interviewee 5, Aerospace Specialist, Government Department

Recovery Actions

Early in the pandemic, it was suggested that the aerospace sectors in the Asia Pacific region would recover faster than North America, which in turn would recover faster than Europe (Gudmundsson, Cattaneo and Redondi, 2020). Having fallen behind France and Germany, the UK aerospace sector is expected to recover even more slowly. Basu (2020a) noted that the sector's slow response, stakeholders' actions in terms of higher job losses in the UK relative to France and Germany, and the isolated investments in environmentally sustainable products (relating to zero emissions) are all likely to hold back recovery in the sector in the UK, as will a lack of coordination of activity at a sectoral level.

> 'The German system is very latent, but it's also loose, so things can change without having to. We think of as being very controlled, but its actually got looseness in it…This is where I do think our institutions in the sense of our educational institutions are behind. Their model is predicated on long programs, not short incremental courses. Singapore is guiding their sector to be much more flexible by way of funding for upskilling people to sit in the same units as undergraduates and undertake the same program at their own time'.

Interviewee 5, Aerospace Specialist, Government Department

Interviewee 4, Senior official, Trade Union representing the aerospace sector

> 'You've got airlines and the aviation industry saying we're piling up debt. To such a level that we just simply haven't got any case for investment that we could make, which you know isn't going to have a direct impact on our bottom line. So, all of that disappears…………….[A] whole cycle of aircraft retirement and renewal has just been wiped out. So, I would think a five-year cycle of aircraft renewal and investment has just disappeared.'

> 'There is just a clear absence of any strategic view of the industry……. Now, in terms of the industry itself, again, there is no cohesive industry body'

Interviewee 4, Senior official, Trade Union representing the aerospace sector

The competitiveness of aerospace companies will be determined by first mover initiatives towards recovery, and individual aerospace companies are already working towards this. Airbus, for example, resumed work on modernizing the A320 final assembly line in Toulouse. By contrast, production of the A380, the world's largest airliner, was halted by Airbus in 2021 after Emirates, the airline with the most A380s in service, cut further orders. The decision to end the A380 raised questions over the future of the Airbus Broughton plant, where wings were built and flown to the A380 assembly line in Toulouse. As bigger aerospace companies are at risk, smaller companies and clusters are becoming more important. For example, the South-West (UK) aerospace cluster (West of England Aerospace Forum), allegedly the biggest in Europe, is leading the race to develop the first all-electric vertical take-off and landing (eVTOL) aircraft (Baker, 2021).

While industry players have taken actions towards recovery from COVID-19, UK Government actions are less clear than in the US, where according to the Aerospace Industries Association (2021b), the industry and US Government have each clearly outlined recovery actions. Significant parts of the industry's recovery actions involve strengthening the resilience of the supply base and improving communications throughout supply chains, giving suppliers reliable information about upcoming demand so they can plan more effectively.

The role of the UK Government in aerospace recovery from COVID-19

The UK Government appeared not to acknowledge the urgency for the need for a recovery plan for aerospace, responding to the Transport Committee's recommendations towards travel during the summer of 2021 that a recovery framework would be published later that year (House of Commons, 2021).

In 2019, 21 million summer travellers flew into Heathrow Airport from the US. Travel restrictions dramatically reduced the number of passengers with airlines expressing concerns that summer travel losses incurred in 2020 could be a recurrent problem with continued travel restrictions. The UK Government was accused of being opaque, unpredictable and confusing with a system of international travel restrictions (Houghton, 2021). The so-called 'traffic light' system, classifying countries as green (not requiring isolation upon return/arrival), amber (requiring isolation after visiting), and red (not allowed) came in for particular criticism (Pengelly, 2021; Reed, 2021; Sharma and Young, 2021; Smout and Hepher, 2021). Travel to and from the US was restricted for almost two years and impeded the recovery of aerospace manufacturers (Canning, 2021). The ending of COVID travel restrictions between the EU and US was announced at the 2021 G7 meeting, but post-Brexit the UK had to negotiate a bilateral agreement (Reed, 2021). Travel into the UK from the US was allowed from 28 July 2021, but it only became possible in the opposite direction from 8 November 2021.

The UK aerospace sector wanted more coherent and effective action from government to support faster recovery and return to pre-COVID levels of production, as well as to meet green emissions targets. Companies including Airbus and Easyjet benefited from government grants or loans during the pandemic, but in the recovery, their efforts towards reducing carbon emissions and the absence of government direction in this regard is only too evident. The future of the UK aerospace sector depends crucially on low emission technology, which might require greater integration between aerospace firms like Airbus and organizations such as the UK Electrification of Aerospace Propulsion Facility (UKEAPF) funded to develop zero-emission technology. Similar emphasis on innovation to drive de-carbonization has been noted in US aerospace (Deloitte, 2022).

As a sector, UK aerospace has also been ill-prepared to deal with skills challenges resulting from the COVID-19 crisis. During the pandemic, apprentices were unable to complete final assessments because of lockdown and distance learning (ADS, 2020b), further widening the skills gap. Brown (2020) noted that the pandemic caused a 70 per cent nationwide decline in the number of engineering apprentices expected to start in September 2020 and claimed many of the tertiary education institutions serving the sector were underfunded, with some colleges that provided training for apprentices closing. With massive job cuts, existing skills shortages prior to COVID and the skills gap created by the incapacity of employers to recruit as many apprentices as they had in previous periods, the retained workforce had to cover for vacant roles and to acquire new skills in using future technology (ADS, 2020b; Hooper, 2021).

Potential solutions to the impact of the pandemic on skills in aerospace include training to develop agile and transferable skills, and collaboration with sectors having similar occupational families such as automotive, marine engineering and energy (Abbot, 2020; Hooper, 2021; MAA, 2020). Skills shortages could be mitigated through increasing apprenticeships or collaboration with schools, although continuing training, funding of training institutions and assessment completion are already beginning to address skills gaps. The ADS (2020b) report on the impact of COVID-19 on skills in aerospace noted future opportunities for the sector, including the UK target of zero carbon emissions and the establishment of JetZero and FlyZero programmes. Career opportunities are anticipated in low-carbon emission technologies and sustainable fuels.

Yet, in this uncertain and rapidly changing environment, changes in notions of 'careers' and work within a defined sector of aerospace are also set to change. As one stakeholder noted:

> 'The occupation is merely your starting point. Your life long journey is incremental in terms of the skills….It's about having the right modular skillsets gained incrementally, which relate to your starting point, but give you opportunities'

Interviewee 7, Managing director, Skills Foresight Organisation

The importance of skills and training has also been acknowledged with the roll out of funding by the UK Government, the aerospace industry and individual firms. In March 2021, the Government announced a £90 million boost to aerospace manufacturing. With the aim of securing 1,400 jobs across the UK, approximately £40 million of the funding was assigned to ASCEND (Aerospace and Aviation Supply Chain Enabled Development) to increase skills that will support the goal of zero carbon emissions. The Minister for Economy, Transport and North Wales, Ken Skates, reiterated the Ministry's plans to partner with suppliers in the aerospace sector, and provide funding to help recovery. The Scottish Government also published its training support to aerospace companies through the launch of the National Training Transition Fund (NTTF).

However, in the low-skills equilibrium environment of the UK, government support and coordination to address the challenges being faced by aerospace employers and workers remains limited. As one government representative, with expertise in the aerospace sector noted:

Interviewee 6,
Aerospace specialist 2,
Government
department

'The skills agenda has been, is always been the most challenging and difficult. And I think part of the problem is that you know the responsibilities (within government). Its been with Department X, then Department Y....There have been several attempts to try and map it an and work with industry to get a better understanding of skills...'

A much longer-term perspective on skills needs and challenges is needed, as another government aerospace representative outlined:

'I just think most of industry is just not very good at thinking beyond the immediate near term horizon on what its skills needs are....You know most of the skills stuff gets done by the HR Department. They're looking at recruitment over the next year, next two years. And probably maximum the next sort of four or five years. Not what we're going to be needing in 10, 12 or 15 years time. I think that's the that's biggest challenge'.

Interviewee 5,
Aerospace Specialist,
Government
Department

The financial capacity of companies in aerospace supply chains remains a concern and few have the liquidity or solvency to expand into new fields after having suffered diminishing revenues with the drastic decline in aircraft orders and a halt to operations under lockdown. With 70 per cent of aircraft value in the supply chains these companies are under pressure to upskill (ADS, 2020b) especially as core competencies have been pushed to the suppliers (Reed and Walsh, 2002). Many aerospace manufacturers have identified skills shortages and are investing in skills, but outsourcing of core competencies, including sub-assemblies and sub-systems, has shifted responsibility for the development of technological capability to suppliers (Beaudry, 2001; Cooke and Ehret, 2009; Reed and Walsh, 2002). There is also the need for greater connection between employer-level, sectoral level and industrial strategies, as one stakeholder pointed out:

> 'What if we could properly and effectively connect our technology strategies with our workforce strategy? Then we would have a source of competitive advantage because we would not be working in a lagging and latent system. An employer led skill system basically populated by training managers, is not one that's going to take us forward. An employer LED training system which is populated by engineering and strategic directors is a far better bet.'

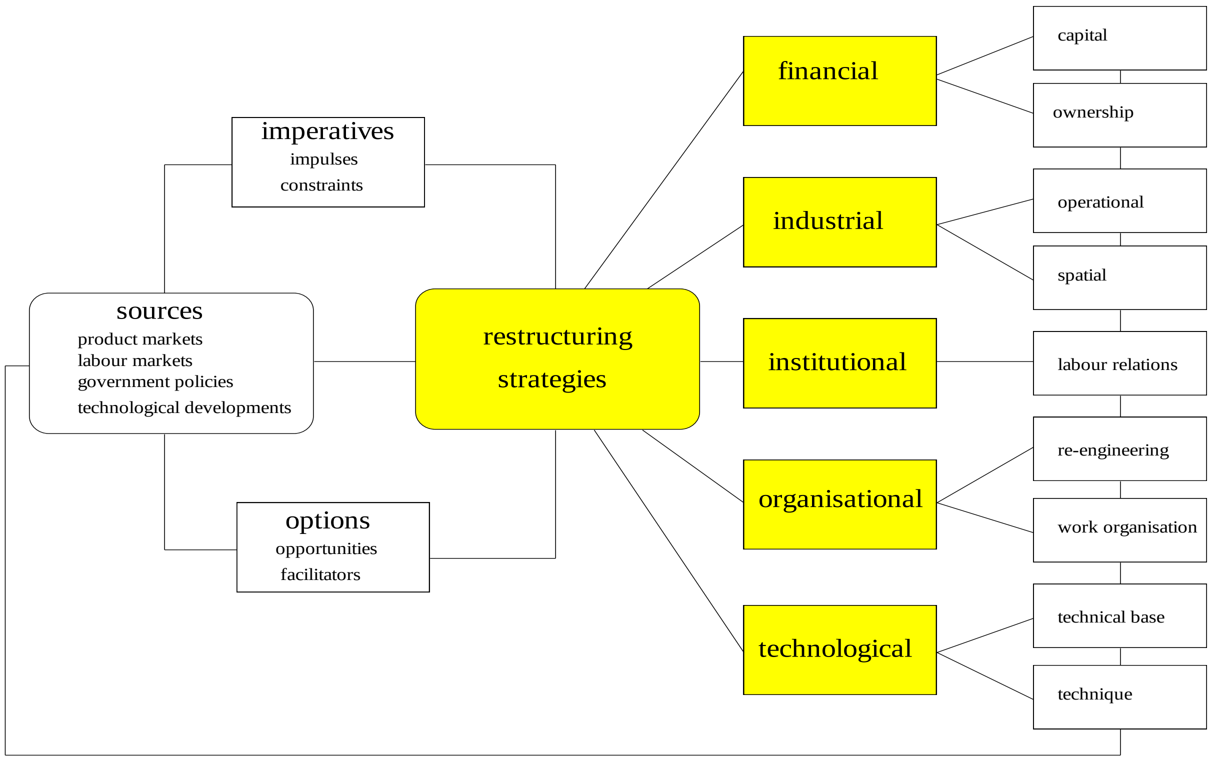
Interviewee 7, Managing director, Skills Foresight Organisation

Chapter 5: Towards a heuristic model for researching and understanding aerospace restructuring

Sector change models have been widely used to map and forecast restructuring and its effect on jobs and skills. The model we are developing to study aerospace restructuring draws on our earlier research on restructuring in the coal mining sector (Burns, Newby and Winterton,1985; (Winterton and Winterton, 1989), garment manufacturing industries of high wage economies (Taplin and Winterton, 1995; 1997) and steel (Mackenzie et al, 2006; McLachlan et al, 2018).

The original heuristic restructuring model (Figure 1, below) was engineered retrospectively from the coal mining research which had emerged organically based on information provided by miners working at the coalface and analysis of technical papers by mining engineers employed by the National Coal Board (Winterton, 1985). That model accurately predicted job losses in coal mining, acknowledged in a series of Parliamentary committees (Winterton, 1988; 1990; 1992a; 1992b), and was systematically updated to incorporate demand side changes as well as the supply-side effects of new mining technologies (Winterton and Winterton, 1989). Coal mining restructuring was intimately associated with the adoption of new technologies that involved deskilling, reduced task discretion and increased management control, which together brought work intensification and productivity increases. In a context of falling market demand for coal, the cumulative effect of these factors, was rapid and profound job loss.

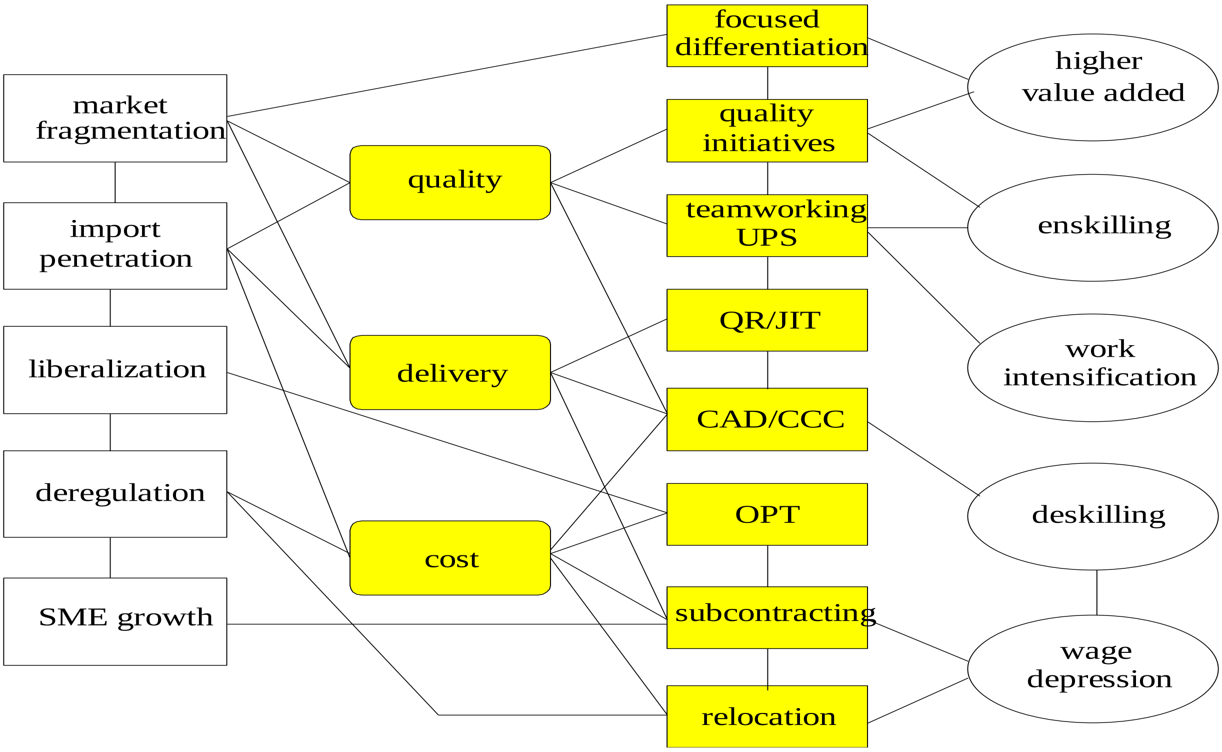
Figure 1. A heuristic model of restructuring



Source: J. Winterton & I. M. Taplin (1997).

The heuristic model was subsequently used as a lens to analyse contemporary change in the garment manufacturing industries of high wage economies (Taplin and Winterton, 1995; 1997). When applied to clothing manufacture the model looked quite different because of the different drivers of change and imperatives in clothing manufacture, as shown in Figure 2. The key drivers of change included market liberalization and deregulation that facilitated imports and the growth of small and medium enterprises, coupled with market fragmentation reflected in the increased number of 'seasons' and smaller production runs. The range of restructuring responses created a vertically segmented and polarized industry structure with higher value-added approaches at one end and sweat shops at the other. The model formed the basis for the sector change model used in the Skills Foresight for the Clothing Industry undertaken for the Department of Trade and Industry (Winterton and Winterton, 2001; 2002).

Figure 2. Restructuring of the clothing industries of high-wage economies



Source: J. Winterton & I. M. Taplin (1997)

The heuristic model was also used to analyse some major European restructurings (Winterton and Forde, 2013) and systematically to explore the impact of these on workers (Le Deist and Winterton, 2013). Although the model was not employed in the steel industry studies, researchers found parallels with the coal mining restructuring. Skill formation initiatives associated with changes in work organization (Leisink and Greenwood, 2007) and restructuring involving the introduction of team working had major implications for skills and work intensification (Greenwood and Randle, 2007). Restructuring in the steel industry also had profound and negative effects on workers made redundant (Gardiner *et al.,* 2007; 2009), with implications for class identity (MacKenzie et al., 2006) and occupational communities (McLachan *et al.,* 2019).

Given the generic nature of the heuristic model, it must be contextualized for analysing restructuring in a specific sector. What would such a model look like in the aerospace sector? A contextualized model for aerospace will need to identify the drivers of restructuring, strategies adopted by companies and outcomes relevant to this sector. Our report has highlighted many of the key drivers and mechanisms of restructuring in aerospace and the supply chain. Some elements of an aerospace sector change model can be developed a priori, but ongoing dialogue and discussion with industry stakeholders and experts using Foresight methodologies (Leman, Winterton and Winterton, 2000). Our interviews and literature review point to the following key drivers of change and associated restructuring strategies below in Table 2 overleaf.

Based on our analysis and research so far, we identify 7 main drivers of change in the sector. These are associated with a number of imperatives and options for actors in the aerospace sector, which connect to a range of possible restructuring strategies. Many of these drivers, imperatives/options, and restructuring strategies are multi-faceted and connected. These are summarised in Table 2, and described below.

The climate agenda and the energy crisis are exerting considerable pressure for change on the aerospace sector. As we have outlined in this report, there are pressures on aerospace firms to move towards cleaner fuels, carbon neutral technologies. Some requirements are already written into targets for the sector, with more regulation and targets likely in the medium term. Alongside this, demand for travel is changing, as a result of climate and environmental imperatives, with a long-term decline in demand for air travel likely. The energy crisis and the rising cost of fuel is also exerting short-term cost pressures on air travel companies, and manufacturers. Employers, and sector level bodies have begun to restructure activities in response to some of these changes. Our interviewees highlighted that the sector will undergo significant change over the next decade, with the adoption of significant new propulsion technologies, the use of biofuels, and engine efficiencies which will help with the achievement of climate goals.

Skills and labour shortages have been highlighted by a number of interviewees as a particular source of pressure for change in the sector. Many skills shortages are observed at a sectoral level, raising questions about the current ability of the sector to collectively deliver the appropriate long-term skills needed by individual firms. Particular issues related to an ageing workforce, a lack of apprenticeships, the continued adoption of 'low-road' approaches to competitiveness being adopted by individual aerospace employers, a lack of integration of HRM policies, and the challenges of developing sector level dialogue, strategies and solutions.

Relatedly, our report has highlighted how current HR strategies in the sector may be problematic in terms of their ability to deliver high-commitment, high involvement, high performance working in the sector. The need for a focus on the development of high-skills amongst workers, and on long-term retention of staff is being undermined by restructuring strategies which are often adopting a short-term outlook, particularly during the COVID-19 pandemic. Layoffs made by many firms during the pandemic have resulted in a permanent loss of skilled workers, as many of the workers laid off have permanently left the workforce or moved to other sectors.

COVID-19 has exerted, and continues to exert, an impact on the sector. The pandemic had a huge impact on the sector, with imposed restrictions on travel and huge falls in demand for travel resulting in restructuring and significant reductions in workforce levels. As lockdown eased, many firms were unprepared for an upturn in demand, with the sector facing significant labour shortages in 2021 and into 2022.

The state as an actor also impacts upon the sector through labour market regulation and strategies. Specific impacts on the sector have come from the furlough/Coronavirus Job Retention Scheme, climate targets, industrial strategy, Brexit, along with specific sector level supports and initiatives. Finally, product market competition is another factor to consider in terms of its impact upon the sector, with competition in aerospace manufacture increasing. Important to consider here are the HR approaches, skills ecosystems and regulatory regimes in different countries, in terms of how these may encourage the development of skills in the sector, or create challenges for the development of high-involvement working.

Table 2 - Towards a heuristic model of restructuring in UK aerospace

Sources and drivers of change	**Imperatives and options**	**Restructuring strategies**
Climate change and energy crisis	Declining long-term demand Meet climate goals Carbon neutrality	Development of new propulsion technologies engine efficiencies, biofuels new materials for lighter aircraft
Skills/labour shortages	Address labour shortages Address long-term skills gaps Develop sector dialogue	Development of regional aerospace clusters Collaboration networks Knowledge transfer from other sectors More strategic approaches to HRM Sector coordination
Approaches to HRM	Embed HPWS/HIWS Improve retention/skills	Redeployment Retention and skills development Quality/innovation strategies Integration of HRM practices Management of change rather than anticipation Reward systems
Brexit	Address decline in EU labour Changes in market/competition/ Regulation	Work design Supply chain rationalization Transfer of risk Changing mix of workers (UK, EU, non-EU) Development of new talent pipelines Automation
The COVID-19 Pandemic	Changing demand for travel Changing demands for work	More flexible forms of working Changes in working time Hybrid working Automation Truncation of internal labour markets, outsourcing, Transfer of risk to suppliers

		Sector level co-ordination to manage restructuring use of government support (Furlough scheme, ongoing sector level support)
The state/sector level actors	Industrial strategy Climate strategy Develop sector voice	Dialogue and engagement with policy, regional networks, unions Co-ordination of training and education Sector level recruitment, retention, training Challenges of ‘low skill equilibrium
Product market Competition	Increased competition	New competitive strategies (rather than cost minimisation) Flexibility Consolidation/mergers

Chapter 6: Conclusion

Our report has provided an initial summary of a scoping exercise of restructuring in the UK aerospace sector. The report has been drafted in preparation for a major programme of research into the restructuring of the UK aerospace sector. Conducted in 2021 and 2022 our scoping exercise has involved a literature review and a series of interviews with industry stakeholders and experts.

We have identified the factors shaping restructuring in aerospace, and to look at the likely consequences for the industry, and we have considered how the UK aerospace sector has been impacted by, and responded to, the COVID-19 pandemic. The report ends with developing a preliminary model for understanding restructuring in the aerospace sector.

The heuristic model, which builds on models used in other sectors, sets out key themes and issues that need to be analysed in future research to develop a comprehensive sector change model of UK aerospace. We will use the model to help inform and guide our future research on in the sector and argue that the model can be used to analyse restructuring, and to help forecast job and skill needs in the aerospace sector.

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CONTACT

Centre for Employment Relations, Innovation and Change
Leeds University Business School, University of Leeds, Leeds, LS2 9JT

business.leeds.ac.uk/ceric
ceric@leeds.ac.uk
Twitter: @CERIC_LUBS
LinkedIn: #CERIC_LUBS
Podcast: https://soundcloud.com/leedsunibschool

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