

Article

Royalties, Patents and Sub-Contracting: The Curious Case of the Hawker Hart

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Abstract: Aircraft procurement by the Air Ministry in the inter-war period was beset by various problems, with numerous solutions proposed in an attempt to resolve them. One such potential solution was the proposal to sub-contract the production to other aircraft manufacturers within the Air Ministry's ring of firms who were allocated firm orders. This action by the Air Ministry, it was believed, would spread the technical knowledge of aircraft production to a wider base that could be built upon in a time of national emergency or war. This approach was also a way of 'artificially' keeping firms alive where they had been unsuccessful in being awarded contracts. Such a scheme would, from the industry's perspective, however, lead to less orders for firms successful in aircraft design and allow the potential sharing of industry secrets amongst direct competitors.

Disclaimer: The views expressed are those of the authors concerned, not necessarily the MOD.

Introduction

The Air Ministry found itself under increasing pressure from several sides regarding its expenditure on new aircraft in the early 1930s. The aircraft industry felt that the sparsity of orders threatened their individual existence as going concerns, politicians were starting to murmur at the outlay of public money and many believed that the Royal Air Force (RAF) was not receiving value for money when it placed orders.¹ There were also rumours spreading that aircraft firms were inflating the prices charged in order to maximise profits. Politicians felt that they were in fact exploiting the relationship between the Air Ministry and the private firms in order to make excessive profits as the RAF was reliant on these firms for all aircraft as well as for implementing the new technologies that were emerging in the field of aircraft design. Whilst no Parliamentary debate on the issue had yet been forthcoming, those at the Air Ministry who worked under the Air Member for Supply and Research (AMSR) (Air Marshal Sir Hugh Dowding) believed that such an action was imminent, and that evidence had to be provided to demonstrate that steps were being taken to reduce the cost of new aircraft and ensure greater value for money.² The Air Ministry has been portrayed as a conservative organisation that did not look to implement major changes, save for the development of doctrine surrounding strategic bombing.³ The reality is somewhat more nuanced than this.

This article will use the case study of the Hawker Hart aircraft to demonstrate how the Air Ministry looked to implement this new ordering system as this was the aircraft designated for the first experiment of the procedure. It will argue that facing huge pressure from bodies such as the Public Accounts Committee and the Treasury, the Air Ministry faced little option in altering the ordering system for new aircraft but had to tread a very fine line when doing so to retain the support of the Society of British Aircraft Constructors (SBAC) and the aircraft industry who believed their very existence was threatened by the proposed changes.⁴ It will further demonstrate that the Air Ministry was a forward-looking organisation that sought to introduce a system of procurement, even by limited experimental means, which would be widely implemented if a major war was to break out. This system was that of sub-contracting orders for airframes away from the aircraft firm that had designed it and to other manufacturers who had demonstrated themselves to be more efficient at production or could offer to construct the aircraft as a whole for a cheaper price.⁵ The ordering system employed by the Air Ministry had been in place since 1920 and was based around the concept that, provided the quoted price of a successful aircraft design was deemed fair and reasonable within the wider market, the designing firm would receive the full production contract.⁶

These discussions over how best to interact with the suppliers of aircraft echo what is happening today. Military spending is generally unpopular with the wider public who prioritise other areas of public outlay such as health and education. The quest for value for money is seemingly unending. This article can provide guidance to policy makers today as to how private industry may try to ensure that they have the advantage those involved in

procurement, both militarily and in general, by resisting attempts to change procurement processes and efficiency drives. With a better understanding of how these interactions worked in the past, decision makers can forge better arguments and ensure changes occur. This has the potential to ensure public money is spent better and delays and overspends are reduced to the minimum necessary.

Whilst the Air Ministry and RAF were naturally relatively conservative in outlook, their reliance on developing technologies and technical expertise meant that they had to also be forward-looking and anticipate major changes in both aircraft design and procurement techniques. With the increasing pace of technological development in airframe design and construction the Air Ministry had to be cautious in what was adopted as failure may lead to aircraft incapable of competing in the event of war. A force of aircraft not technologically capable also had the potential to harm British foreign policy and diplomatic efforts as policy could not be backed up by the theoretical or actual threat of force. The SBAC also looked to allow its members to take control of the sub-contracting process, attempting to establish the principle that it should be down to the original designing firm to decide whether the whole aircraft or certain component parts should be subcontracted.⁷ To place these ideas within their modern context, many 'tier one' manufacturing firms 'subcontract' out the manufacture of components to 'tier two' suppliers with very few manufactured by the tier one firm.⁸ For the SBAC, the sub-contracting out of entire aircraft would mean unnecessary duplication of jigs, tools and gauges.⁹ This demonstrates that the SBAC and Air Ministry had differing perspectives. The duplication of jigs, tools and gauges, as well as an aircraft industry that was capable of producing aircraft from engineering drawings, was seen by the Air Ministry to be a necessary precaution, which would be vital in any future war. For their purposes, they required an aircraft industry that was as flexible as possible. Through the SBAC's eyes, whilst they were not, in principle at least, against an aircraft industry that was capable of reacting to an unpredictable and increasingly unstable global situation, their interest was principally concerned with the survival of their members as going concerns and so would defend the status quo.¹⁰ The system that had to be navigated by aircraft firms was far from ideal, but better than some of the ideas that were being proposed. The ordering system, combined with the creation of the ring of approved Air Ministry suppliers in 1924, provided firms with some degree of stability and allowed them to make small profits on the relatively small number of aircraft that the Air Ministry could order given the constrictions in budgets.¹¹

Sub-contracting had been employed during the First World War where firms were under greater government control in terms of production requirements. Successful designs in this period were often produced *en masse* by other firms as it was the quantity of aircraft that was crucial to supporting the British Expeditionary Force on the Western Front as well as other subsidiary theatres.¹² Naturally enough, given their different perspectives, the Air Ministry and the SBAC failed to see eye-to-eye on this issue. The 1931 Report into the aircraft industry, conducted by the Air Ministry, as well as the discussions that followed its publication,

will be used to demonstrate the precarious position the Air Ministry found itself in with the industry as well as how they sought to modify their ordering procedures without causing the collapse of the entire industry.¹³

In order to facilitate any necessary change to Air Ministry ordering procedures, a report was commissioned to look at the state of the aircraft industry in 1930. This report not only investigated the aircraft industry, but the Commission also looked to provide advice and new ideas that had the potential to transform how aircraft were purchased for military means. Some of the more radical changes suggested would, if implemented wholesale, have had a profound effect on the individual firms of the aircraft industry. What was suggested was the implementation of relatively wider-scale sub-contracting of successful aircraft designs, utilising open tendering to gain better pricing of aircraft and send a wider message to industry as a whole that the time of high aircraft prices was at an end.¹⁴

The Hawker Hart was not the first instance of compulsory sub-contracting directed by the Air Ministry within the aircraft industry. It had been introduced as a temporary expedient in 1924 and was considered again in 1927-28.¹⁵ Sub-contracting was considered for the Hawker Hart as it was a versatile aircraft that was produced in many variants.¹⁶ In an attempt to wrest some control of the process with regards to compulsory sub-contracting, the SBAC suggested that the majority of decisions with regards to what aspects of production and construction should be sub-contracted should be left to individual firms.¹⁷ On the one hand, such a move would make the lives of individual construction firms easier as they would be able to adjust the sub-contracting system to best suit themselves on an individual basis. On the other hand, however, this would lead to potential chaos within the Air Ministry, as there would not be standard procedures for ensuring consistency of sub-contracting and losing a general overview of what was sub-contracted out at any time. The only way for sub-contracting to function effectively when required was for the Air Ministry to retain overall control of the process and procedures as well as what was sub-contracted out by individual firms and when. This would naturally put them at odds with the SBAC and individual firms who would want complete control in order to shape the system to their economic and production benefit and not that of the Air Ministry which would ultimately have to take responsibility for any failings in aircraft production and procurement. The SBAC continued to argue for the widespread adoption of sub-contracting as a basis on which to control prices, as costs could only be lowered 'by the continued manufacture of a standard article'.¹⁸

Open tendering would mean that a firm that was successful in designing an aircraft that met or exceeded Air Ministry requirements were not guaranteed to be awarded the full production contract, if it was deemed that their prices were over-excessive and better value with similar quality could be obtained elsewhere.¹⁹ Such an idea was an anathema to the SBAC who foresaw the potential collapse of many sound manufacturers and expressed this opinion vigorously and with great menace.²⁰

The aircraft industry in Britain suffered from two major issues that prevented it from being as efficient as it could have been in the 1920s and 1930s. The first major issue was the relative lack of orders. Due to the restrictions in defence spending in the wake of the end of the First World War, aircraft firms faced financial hardship, surviving on limited orders from the Air Ministry.²¹ This in turn led to decreased profits, a situation not helped by the imposition of an Excess Profits Tax levied to assuage public concerns that arms manufacturers had taken advantage of the death and suffering during the war to make money.²² This almost put several firms out of business, and it was only through the extensions and continuation of overdrafts that many of the firms who became household names during the Second World War survived the so-called lean years.²³ Whilst the declinist view of the likes of Corelli Barnett has been largely dismissed by more modern scholarship in this area, the situation was not quite as rosy as has been painted by David Edgerton.²⁴ The industry was not as underfunded as has been claimed, but this did not mean that it was in a healthy position when rearmament commenced in 1936. The industry had survived, but it was not in a position where mass production could begin on any scale, as the sparsity of orders had left little incentive to change production methods. The second issue, largely related to the first, was that with the limited number of orders available to firms, they were unable to invest in new manufacturing technologies such as machine tools, jigs and presses to increase their output.²⁵ They were also unable to find the necessary capital to invest in increased factory floor space that would increase their output capacity. This inability to invest would mean that when demand for aircraft increased the industry would find it difficult to increase their overall production capacity in the event of a diplomatic crisis or international emergency.²⁶

The Air Ministry had looked intensively at the current and potential future capacity of the aircraft industry through the work of Air Commodore L E O Charlton. Charlton sought to work with the industry both on the level of individual firms and the SBAC to increase the potential for expansion. Through his work and negotiations with the industry, Charlton highlighted several areas where the capacity of the industry could be expanded without increasing any public funding or the amount of orders that individual firms received. These changes would require a massive overhaul of the system of procurement from the Air Ministry, the spreading of orders amongst the firms, and a change in the general attitude of the firms and SBAC to the increased spreading of orders amongst the industry. The most contentious of Charlton's ideas was to increase the extended use of sub-contracting for aircraft orders.²⁷ Through the sub-contracting of orders to construction firms which were not the original designers of the aircraft, the Air Ministry sought to achieve two distinct aims.²⁸ The first was to increase the capabilities of individual aircraft firms so that they would be up-to-date with latest production techniques and able to construct a variety of different aircraft if a diplomatic emergency or sudden outbreak of war required a quick and unexpected upturn in production levels.²⁹ This demonstrates that the Air Ministry was seeking to develop within the industry a strategic capacity that could be utilised when required. With the rapid development of new aircraft materials, it was also vital that every firm within the Air Ministry's network of constructors was able to produce the variety of aircraft that were being ordered. Sub-contracting would allow

them to spread the orders amongst the various firms to give them the necessary experience of working in metal as opposed to wood. This had already been employed when sub-contracting had been resorted to previously. The Air Ministry's second ambition for sub-contracting was to drive the price of aircraft down by assigning contracts to the firm which could produce them for the lowest price. This was potentially a radical overhaul of the purchasing system in Britain, and such a dramatic shift in procurement policy was sure to be met with resistance by the SBAC. Traditionally, the Air Ministry's procurement policy had been based around a full development and production contract award. The contractor was expected to design the aircraft and execute extensive trials, against competitor's aircraft, to meet the minimum requirements specification. The firm who designed and produced the aircraft, which met the specifications and delivered the best value for money, were awarded the contract.³⁰ This system, it was believed by certain members of the Air Ministry, but also, and potentially more importantly, Members of Parliament, allowed firms to overcharge for aircraft and so recoup losses made on other aircraft designed and built to Air Ministry specifications and entered, unsuccessfully, into previous design competitions.³¹ There is little evidence to suggest that firms were doing this to a large and widespread degree, but, given the precarious financial position of the majority of aircraft firms, it is not beyond the realms of possibility that firms were overcharging to a certain degree to bolster their bank balance and to see them through any future lean period. It must be borne in mind that without a successful aircraft design to produce for the Air Ministry, individual firms had to bear most of the cost of successful aircraft whilst they were in the design, prototype and initial production phases. If an aircraft did not meet specification or did not succeed in proving itself against other designs, there was no recompense for the firm and any costs had to be absorbed either by past profits or through overdrafts with the bank.

By moving to a procurement system closer to that employed by both France and the United States (US), it was hoped that the cost of aircraft could be driven down, the quality of aircraft design maintained and driven upwards and improvements in the construction capability of the industry as a whole enhanced.³² There were, however, several issues that presented themselves in this aim. A position prevailed in Britain where those firms with the best design teams were often also poor in planning production meaning delays in delivery programmes. These firms were often at the forefront of technological developments in design and capability and so provided a qualitative edge over potential opponents. In order to maintain these design teams, production orders were required but at the cost of efficient delivery.

Decisions had to be made as to whether these design teams had to be artificially supported, despite the weakness of their construction skills, through the assigning of full production orders despite potential delays in delivery dates previously agreed. The firms with the best design teams generally had greater costs associated with manufacture, increasing the price of each individual aircraft. Without sufficient orders for new aircraft or the reconditioning of aircraft already in service, these firms would simply collapse and there was no guarantee that the design teams would be employed with other firms. The system of procurement did,

however, in the opinion of the aircraft firms and the SBAC, increase the standard of design through competition within the industry, as achieving the best design would likely lead to orders and a continuation of the business; failure would lead to financial problems.³³ The SBAC was able to provide convincing evidence to the Air Ministry about the effects of widespread open tendering and sub-contracting. The aircraft industries of both the US and France had adopted such a system of procurement and found that their design capabilities had diminished at an alarming rate as firms competed against each other on price instead of the capability of the aircraft.³⁴

Increasing the capabilities of the industry as a whole had been attempted with the sub-contracting out of the Siskin all-metal aircraft to give greater experience to manufacturers of working in the new material and the associated techniques and processes.³⁵ This demonstrates that the Air Ministry was seeking to develop within the industry a strategic capacity that could be utilised when required. With the rapid development of new aircraft materials, it was also vital that every firm within the Air Ministry's family of constructors was able to produce the variety of aircraft that were being ordered. Sub-contracting would allow them to spread the orders amongst the various firms to give them the necessary experience of working in metal as opposed to wood.

The second ambition for sub-contracting from the Air Ministry's point of view was that sub-contracting could be used as a tool to drive the price of aircraft lower by assigning contracts to the firm which could produce them for the lowest price. This was potentially a radical overhaul of the purchasing system in Britain, and such a dramatic shift in procurement policy was sure to be met with resistance by the SBAC.

Whilst discussions were taking place over the reintroduction of sub-contracting in 1927, the SBAC fought as hard as possible to prevent it, as it had the potential to cause serious financial hardship to several of its members which, whilst extremely capable aircraft designers, were not the most efficient production firms. The SBAC argued that, due to the disruption of having to learn how to produce a new and unfamiliar aircraft, the sub-contracting firms' costs would escalate, and their production processes and flow would be hindered.³⁶

The Hawker Hart presented several unique problems in terms of sub-contracting. One of the biggest issues that presented itself concerned the use of patents. The Hawker Engineering Company, in their design and development of the Hart, had developed certain new rivets and the tools required to manufacture them had been developed to produce the aircraft. Through sub-contracting the manufacture of the Hart away from Hawker, the Air Ministry was actively encouraging the breaking of patent law and so ways and means of indemnifying the firms who were given sub-contracted orders had to be found in order to allow them to fulfil the orders according to the engineering drawings.³⁷ The Air Ministry's position in negotiations with Hawker was made all the more difficult as Hawker had spare production capacity, and the Air Ministry had decided that in order to improve the capability of the wider

industry, it was the Hart that should be sub-contracted out.³⁸ A further reason for the Air Ministry to sub-contract out a large proportion of the Hart procurement was the sheer cost. Sub-contracting within the aircraft industry had been previously considered as a way of controlling prices within the industry. The Hart was chosen partly as a result of the ease of manufacture that the design presented, and this was demonstrated by the fact that it was possible to sub-contract out at a very early stage of its development life.³⁹ Hawker also raised the important question of safety and inspection of individual aircraft and who would be held responsible for a failure of an aircraft on trials or in the field. The question was not settled as to whether Hawker would have to provide its own staff to inspect the work of other firms and ensure that it was in line with the drawings. With a variety of tooling and gauges made available for various firms there could be no guarantee that tooling and gauges were as accurate as they were required to be.⁴⁰

In order to ensure that Hawker was suitably rewarded for its success in the open competition utilised by the Air Ministry to find the best designs for each aircraft type and encourage both risk taking and ensure that aircraft designed remained cutting edge, a system was negotiated for the payment of royalties. These negotiations demonstrated an almost entirely predictable difference of opinion between Hawker and the Air Ministry over the maximum that should be paid by the Ministry to Hawker in royalties for each aircraft produced by a sub-contractor. To Hawker, the Hart represented the culmination of twenty-one years of trial, error and development, and the drawings that resulted were in the possession of nine different aircraft firms. This also meant that trade secrets known only to Hawker were now available to a large proportion of the industry and, in any future competition, Hawker would face a more level playing field. In order to compensate for this and the fact that Hawker would not receive the full income from producing the Hart, the Air Ministry offered to pay royalties to Hawker up to a maximum of £40,000. This was deemed inadequate, as Hawker's directors felt that the Hart design was worth £100,000 and that the Air Ministry's offer would not even cover the firm's expenses. The Air Ministry felt that their offer had been fair and reasonable and in line with the guidelines set down by the Royal Commission on Awards to Inventors.⁴¹ Hawker believed that not only were the royalties being offered unsatisfactory, they were lower than in other cases where sub-contracting had been resorted to.⁴²

In an attempt to placate Hawker and to ensure their good will in terms of mentoring and training the other aircraft constructors selected to manufacture the Hart, the Air Ministry proposed to pay 7.5% royalties to Hawker of the first £250,000 of sales, 6.5% on the next £250,000 and 5.5% on the remainder of sales.⁴³ These payments would be in addition to those made to firms constructing the aircraft and so represented an additional burden on public expenditure that the Air Ministry was keen to reduce as much as possible. An agreement was reached with Hawker on the basis described above for royalty payments in November 1931 but was conditional on Hawker providing the agreed tuition and support to other aircraft firms and an agreement not to proceed against firms utilising patents registered by Hawker as the firms had been indemnified by the Air Ministry to utilise them.⁴⁴

The Air Ministry's experience with sub-contracting out the Hart made them wary of repeating the process. Whilst it was a useful tool in an attempt to influence the prices charged by aircraft firms which to a certain degree, did look to exploit the closed nature of the market that they were working within.⁴⁵ With the Air Ministry having an almost complete monopoly as the only major customer for the inter-war period and had great influence over the industry, it was also reliant on a small number of firms to provide them with the aircraft to enable the RAF to provide the military and political support required by the United Kingdom. This allowed them to artificially raise prices to a certain degree, safe in the knowledge that the Air Ministry had to pay those prices provided they could be justified as fair and reasonable.

The Hart was one of the few aircraft to be sub-contracted out during the inter-war period, and certainly one of the few where price was an overriding factor in the decision.⁴⁶ The Air Ministry was fully aware that any widespread attempt to introduce sub-contracting as a means of controlling prices would see a reduction in the design abilities of certain firms.⁴⁷ It would simply not be cost-effective to maintain expensive design teams and drawing shops if orders were then placed with other firms and small revenues ultimately made. The Air Ministry was fully aware that whilst production capacity would be important in the next war, the ability to design aircraft that were at the cutting edge of technology was more important and this had to be fostered.⁴⁸ By adopting this policy of keeping firms employed by providing them with work despite their production difficulties, to maintain design teams the Air Ministry had to relinquish to some degree their ability to influence the price of aircraft purchased.

Another major problem that presented itself was the capability of each individual aircraft firm and was an issue that was tackled by industry together through representations by the SBAC to the Air Ministry. Each firm had differing production capabilities and looked to gain technical production advantages over rival firms and were loath to allow other firms to become aware of their individual production methods that gave them a potential competitive advantage. Any attempts to bring widespread sub-contracting would require firms to divulge these trade secrets to rivals, thereby negating any competitive advantage they may have.⁴⁹ This would level the playing field and increase the amount of competition within the industry as a whole. Those firms whose production techniques were not as up to date as others could potentially have their fortunes transformed through the awarding of a subcontract that utilised new secret production methods. The successful firm would have to be supervised by the designing firm and so must divulge their secrets. Whilst this may have been acceptable in publicly owned armaments works such as the Royal Ordnance Factories, it could never work in the completely private aircraft industry. The Air Ministry did not have the same powers of mandated compliance and direction over the aircraft firms, as they were private entities. A different relationship was required as compared to that which existed between the factories in public ownership that could be directed to a much greater degree.

Firms were simply unwilling to give up any advantage they had over their competitors as it could mean the end of them as going concerns. Throughout the entirety of the inter-war

period, the Air Ministry and the aircraft industry had to find a way to bridge the exceptionally large gap in perceptions that existed between the two and the way they saw the world and their place in it. The Air Ministry looked to the long-term strategic security of the country through the creation of an aircraft industry that could respond to the vagaries and complexities of the post-1918 world. The aircraft industry, on the other hand, looked to survive until the end of the next financial year. These were perceptions that were almost impossible to marry up, as they viewed the world in two different and almost polar opposite contexts.⁵⁰

There was also entrenched disagreement with regards to the level of responsibility that the successful design firms should take for aircraft produced by another firm. This was not a new problem, as it had first been encountered during the First World War.⁵¹ Firms were, quite understandably, not keen on having to take responsibility for the products manufactured by a different firm over which they had no control in terms of quality control and production standards. The division of responsibility was a difficult concept to overcome as the firm chosen to undertake the sub-contracting would not be overly willing to take the responsibility for aircraft that they had not designed themselves. They would not be fully versed in the intricacies of production gained through the design, development and production of prototypes and the experience of how to overcome difficulties in production specific to that aircraft.⁵² There would also be the question of responsibility if an aircraft failed, and any attempt to attribute liability would be fraught with difficulty.

The SBAC fought hard against the introduction of sub-contracting in general, and if the Air Ministry was to develop this new form of procurement, it would have to provide incentives to successful designing (but inefficient manufacturing) firms to abrogate and reduce the risks they perceived through the loss of orders and the revelation of industrial secrets. In an attempt to bring individual firms on board and also to split the support within the SBAC, the Air Ministry offered a series of incentives if aircraft were to be sub-contracted out. The designing firm were to be offered a royalty of at least 5% of the agreed purchase price for each individual aircraft not produced by themselves.⁵³ This cost was an additional charge for the Air Ministry on top of that for each aircraft. This was, in the opinion of the Air Ministry, a cost worth bearing if it helped reduce the overall amount spent on new aircraft as well as increasing the strategic capability of the industry as a whole. In order to ensure that firms did not reduce or remove their design departments and simply focus on upscaling and upgrading their production facilities, (and this was a very real risk), the Air Ministry was willing, for a fair price, to give a reasonable percentage of the manufacture of aircraft to be ordered to the designing firm.⁵⁴

One way in which the Air Ministry could influence and adopt sub-contracting on a wider basis was to utilise the existing capacity of the aircraft industry. Each firm had a limited construction capacity and if it was successful in developing a new type would face the possibility of not being able to meet Air Ministry requirements for previous models of aircraft, as well as the new type. A decision would have to be made between the firm and the Air Ministry over whether the old type was still required for Service purposes and how both could be produced

if necessary. It was possible for negotiations to take place between the firm and the Air Ministry over which of the two aircraft the firm would be willing to produce, and the other would then be sub-contracted out with the firm receiving compensation in the form of royalty payments on each sub-contracted aircraft ordered from a different firm.⁵⁵ It was expected that, given the developments of technology and manufacturing processes, the firm would be more interested in producing their latest type due to the greater profits to be made. This would allow the Air Ministry to adopt a greater degree of sub-contracting in the aircraft industry whilst keeping the firms and the SBAC on side, as such an approach would be more in their interests. It would keep firms employed on producing aircraft providing the income and potential profits to keep their design teams in being. It would also increase the overall construction capacity and capability by giving various firms the experience of constructing aircraft that they had not designed.

The Air Ministry had to tread a careful and difficult line when trying to modify the nature of how they ordered aircraft from a completely privately owned aircraft industry that was able to act in unison to protect its collective interest in a far more effective manner than the Air Ministry was able to exploit its position as almost sole customer for the entire industry. The Air Ministry had to have concern not only for the functioning of the aircraft industry at that moment, but also how it would function and work to the best of its collective ability in the event of a diplomatic crisis or a sudden declaration of war. Sub-contracting orders was one way of achieving radical change within the aircraft industry but fell down on the fact that the economic and strategic position Britain found itself in after the First World War meant that there were not sufficient orders within the system at any one time to allow firms to survive whilst other firms took up the slack. Whilst the principle of sub-contracting was a sound one, the practicalities and implementation were not possible within the wider position the Air Ministry was in during much of the inter-war period. It was only with the development of the shadow factory system and the pressing need for an increase in the production capacity of the aircraft industry that large-scale sub-contracting was required.

This was not, however, the same sub-contracting system that the Air Ministry had sought to introduce with the Hawker Hart. This form of sub-contracting involved the introduction of new engineering firms into the aircraft industry working under the supervision of the aircraft firms in shadow factories.

Notes

¹ The National Archives (TNA) AIR 2/1322, Aircraft Supply Committee Report, Air Ministry 1931.

² TNA AIR 2/619, Letter from Air Ministry to SBAC, 1 April 1927.

³ Corelli Barnett, *The Audit of War: The Illusion of Britain as a Great Nation* (London: Pan Books, 1996), p.130. Scot Robertson, *The Development of British Strategic Bombing Doctrine, 1919-1939* (Westport Connecticut and London: Praeger, 1995).

⁴ TNA AIR 2/619, Letter from A.F. Nicholson (Air Ministry) to SBAC, 1 April 1927.

⁵ TNA AIR 2/619, Letter from F. Handley Page to Air Vice-Marshal Hugh Dowding,

6 December 1930.

⁶ TNA AIR 2/619, Letter from Handley Page to Dowding, 29 December 1930: Extract from Air Ministry Letter 10 May 1920.

⁷ TNA AIR 2/619, Memorandum by SBAC on Sub-contracting 2 March 1927.

⁸ Douglas M. Lambert and Martha C. Cooper, 'Issues in Supply Chain Management', *Industrial Marketing Management* 29: 1 (January 2000), 68.

⁹ TNA AIR 2/619, Letter from Fairey to Dowding 6 November 1930.

¹⁰ TNA AIR 2/619, Letter from SBAC to Air Ministry, 2 March 1927.

¹¹ Keith Hayward, *The British Aircraft Industry* (Manchester: Manchester University Press, 1989), 12. P. Fearon, 'Aircraft Manufacturing' in Neil K. Buxton and Derek H. Aldcroft, *British Industry between the Wars: Instability and Industrial Development 1919-1939* (London: Scholar Press, 1979), 222. Adrian Smith, *The Man Who Built the Swordfish: The Life of Sir Richard Fairey* (London and New York: I.B. Tauris, 2018), 107.

¹² Peter Dye, *The Bridge to Airpower: Logistics Support for the Royal Flying Corps on the Western Front, 1914-18* (Naval Institute Press: Annapolis, Maryland, 2015), 60.

¹³ TNA AIR 2/1322, Aircraft Supply Committee Report, 1931.

¹⁴ TNA AIR 2/1322, Aircraft Supply Committee Report, 1931.

¹⁵ TNA AIR 2/619, Memorandum by the SBAC on Sub-contracting, 2 March 1927.

¹⁶ Francis K. Mason, *Hawker Aircraft since 1920* (London: Putnam, 1961), 26-9.

¹⁷ TNA AIR 2/619, Memo by SBAC on Sub-contracting, 2 March 1927.

¹⁸ TNA AIR Memorandum on Sub-contracting by SBAC, 8 December 1930.

¹⁹ TNA AIR 2/619, Letter from F. Handley Page to Dowding, 6 December 1930, Extract from Air Ministry Letter 10 May 1920.

²⁰ TNA AIR 2/619, Letter from Fairey to Dowding, 6 November 1930.

²¹ Sebastian Ritchie, *Industry and Air Power: The Expansion of British Aircraft Production, 1935-1941* (London and New York: Routledge, 1997), 7-8.

²² Anthony J. Arnold, "A Paradise for Profiteers"? The Importance and Treatment of Profits during the First World War', *Accounting History Review* 24, 2-3, (2014), 69.

²³ *Ibid.*, 8.

²⁴ David Edgerton, *Warfare State: Britain 1920-1970* (Cambridge: Cambridge University Press, 2006), 42-5.

²⁵ TNA AIR 2/619, Memorandum by SBAC on Sub-contracting, 8 December 1930.

²⁶ TNA AIR 2/266, Minutes of a Meeting held at SBAC, 23 April 1925.

²⁷ TNA AIR 2/266, Meeting between Charlton and Management Committee of the SBAC, 4 February 1925.

²⁸ TNA AIR 2/619, Letter from Handley Page to Air Vice-Marshal Hugh Dowding, 6 December 1930.

²⁹ TNA AIR 2/619, Letter from Air Ministry to SBAC, 1 April 1927. TNA AIR 2/266, Loose Minute from Lieutenant-Colonel H.W.S. Outram to Air Commodore L.E.O. Charlton, 22 December 1924.

³⁰ TNA AIR 2/1322, Aircraft Supply Report, 1931.

³¹ Fearon, 'Aircraft Manufacturing', 228.

³² TNA AIR 2/1322, Aircraft Supply Committee Report, 1931. TNA AIR 2/619, Letter from Handley

Page to Dowding, 29 December 1930.

³³ TNA AIR 2/619, Letter from Handley Page to Dowding, 29 December 1930. Memorandum by SBAC on Sub-contracting, 8 December 1930.

³⁴ TNA AIR 2/619, Letter from Fairey to Dowding, 6 November 1930.

³⁵ TNA AVIA 8/158, Notes of a Meeting held regarding the Payment of Royalties to Messrs Hawker in Respect of the use of the Hart Design, 29 July 1931.

³⁶ TNA AIR 2/619, Memorandum by the Society of British Aircraft Constructors – Sub-contracting, 2 March 1927.

³⁷ TNA AVIA 8/158, Letter from S.W. Hiscocks (ATS Co.Ltd.) to the Secretary of State for Air, 14 July 1931.

³⁸ TNA AVIA 8/158, Notes of a meeting on the Payment of Royalties to Messrs Hawker in Respect of the Use of the Hart Design, 29 July 1931.

³⁹ TNA AVIA 8/158, Memorandum from Frank G. Cowlan to Air Ministry – Original Request for Information, 26 November 1931.

⁴⁰ TNA AIR 2/619, Letter from Fairey to Dowding, 6 November 1930.

⁴¹ TNA AVIA 8/158, Notes of a Meeting on the Payment of Royalties to Messrs Hawker in Respect of the Use of the Hart Design, 29 July 1931.

⁴² Ibid. Letter from General Manager Hawker to Secretary of the Air Ministry, 17 August 1931.

⁴³ Ibid., Letter from General Manager Hawker to Secretary of the Air Ministry, 17 August 1931.

⁴⁴ AVIA 8/158, Letter from C.L. Bullock to Hawker, 2 November 1931.

⁴⁵ TNA AIR 2/619, Extract from Air Council Minutes 143rd Meeting, 7 May 1931.

⁴⁶ TNA AIR 2/714, Loose Minute from Dowding to Chief of the Air Staff and Secretary of the Air Ministry, 5 October 1934.

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⁵⁰ Matthew Powell, 'Capacity for War: Preparing the British Aviation Industry in the 1920s', *Journal of the Royal United Services Institute*, 163: 3 (June/July 2018), 28-35.

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⁵⁵ TNA AIR 2/1213, Loose Minute from AMSR to Chief of the Air Staff, Secretary of the Air Ministry and Secretary of State for Air, 2 July 1926.

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