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**"Shadow factories, shallow skills ?
an analysis of work organisation in the aircraft industry in WW2"**

Little S.E.¹ & Grieco M.S.²

Abstract

The relationship between design and the determination of social and skill practices has been under-considered within the literature. This paper investigates the relationship between design and skill transmission in the context of the WWII "Shadow Factory" programme. The Shadow Factory programme formed an integral part of the WW2 re-armament strategy of the British Government. The term came into widespread use to describe both a) duplicated facilities under the direct control of the parent company and b) distributed facilities managed by other companies with appropriate skills. This paper examines the Shadow Factory component of the wartime expansion of manufacturing production in Britain, and its implications for skill formation and gender in the workplace.

The paper also explores the extent to which these shadow plants represented a government-sponsored attempt at technology transfer from the automobile industry to the aircraft industry.

The rationale for the advent of this policy was that the introduction of metal fabrication to both aircraft and motor industries had narrowed the difference between them. The managerial skills developed in mass car production were deemed essential to the volumes now required from an aircraft industry that had survived the inter-war period on limited government orders.

The shortage of appropriately experienced labour had, during the recovery of the 1930's, prompted the dilution of the proportion of skilled employees, and the deskilling of component tasks. In this situation, women were seen as a significant additional source of factory labour. With the advent of preparations for re-armament, this source of labour gained enhanced importance. The paper charts, in the context of re-armament, the alliance between government and unions on the temporary and crisis character of the widespread employment of women. It also documents the deliberate and open governmental strategy of 'containing' the impact of women's employment by defining it as a discrete and reversible state of affairs appropriate only to a crisis situation.

It is within this context that this paper examines the genesis of the policy decisions relating to the deployment of new manufacturing technology, its impact on work organisation, and the responses of managements, unions and workers.

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Introduction

The relationship between design and the determination (Little, 2004) of social and skill practices has been under-considered within the literature (Zeitlin, 1995). This paper examines the Shadow Factory component of the wartime expansion of manufacturing production in Britain, and its implications for skill formation and gender in the workplace. This programme of governmental intervention in the direction of work organization, with its explicit reliance on the inclusion of women in the industrial labour force, raised a number of issues around the appropriate positioning of women in terms of the industrial structure. An examination of the operation of this programme reveals a number of ambiguities, ambivalences and contradictions in the role of women in the industrial structure present in this period. The exceptional circumstances of anticipated and actual war provided the legitimation for the absorption of women in to the labour force en masse; the expectation was that after the threat had disappeared the return to home would be unproblematic. This article discusses the problems posed by this dichotomous approach to women's employment for their absorption into the war time industrial structure.

A "Shadow Factory" programme formed an integral part of the re-armament strategy of the British Government. The term came into widespread use to describe duplicated facilities under the direct control of the parent company, as well as distributed facilities managed by other companies with appropriate skills.

In the aircraft industry these plants represented a government sponsored attempt at technology transfer from the automobile industry. Initially the government constructed a series of coordinated aircraft manufacturing facilities to be managed by the motor industry. These were followed by a number of integrated plants which eventually devolved to the established aircraft industry. They produced 22% of this industry's total output during World War II, including 45% of heavy bombers.

The rationale was that the introduction of metal fabrication to both aircraft and motor industries had narrowed the difference between them. The managerial skills developed in mass car production were deemed essential to the volumes now required from an aircraft industry that had survived the interwar period on limited government orders.

An additional problem was that the economic recovery underway in Britain in the second half of the 'thirties was based on newer light engineering and electrical manufacture in the Midlands and South East of England. The shortage of appropriately experienced labour had prompted the dilution of the proportion of skilled employees, and the deskilling of component tasks. Women were seen as a significant additional source of factory labour. Consultation with unions was not attempted until 1938. An agreement was reached in the crisis conditions of 1940 on the relationship between traditionally established wage levels and those of the male and female wartime employees.

This paper examines the genesis of policy decisions which produced outcomes which may be traced to the recent takeover of Austin-Rover by British Aerospace. These are related to the deployment of new manufacturing technology, its impact on work organisation, and the responses of managements, unions and workers.

THE SHADOW FACTORY PROGRAMME:

Context of the Programme:

Lord Weir, an industrialist who had advised government on rearmament and production in the First World War, saw the creation of a shadow armaments industry as dependent upon close collaboration between industry and government. As an advisor to the Air Minister he had suggested that air expansion would be less disruptive to the civilian organisation of industrial capacity than army expansion. In a 1934 Cabinet Paper he argued that a shadow armaments industry capable of expansion to meet wartime requirements was essential, some 250-300 major manufacturing firms should be identified for mobilisation upon the outbreak of hostilities.

The aircraft industry preferred the use of sub-contracting to increase production to the expansion of plant, however, government advisors wanted to utilise the mass-production and management experience which had arisen in the relatively new motor industry. As early as 1927 the Air Ministry had decided that it would have to look beyond the established aircraft industry to meet the demands of war production.

From 1936, initially in the face of opposition from much of the aircraft industry, a series of coordinated facilities were constructed by government to be managed by the motor industry. The technical rationale was that the introduction of metal fabrication to both the auto and aircraft industries had produced a common technical base. Additionally, the managerial skills developed in motor vehicle mass production were considered essential to the volumes of aircraft required. Hornby (1958) notes that conversion to metal body fabrication in the motor industry had been completed by 1935. By the end of that year the establishment of shadow plants was being discussed by government and industry. On 17 March 1936, during the Air estimates debate in the House of Commons an agreement with the Austin and Rootes companies to contribute their experience to aircraft production was announced. Lloyd (1978) suggests that the Rhineland re-occupation by Hitler provided the impetus for the final go-ahead.

Group 1 Shadow Factories

At this time a minimum of some five years was required to put a new aircraft design into production, eight for a large, complex type. Aircraft production involves the design and development of both airframes and the engines required to power them.

The first stage of the shadow scheme was an integrated set of aero-engine factories controlled by a group of five motor companies. "Groups" of manufacturing concerns had previously been formed around specific rearmament projects. A long-lived informal group was responsible for the 18/25lb gun conversion programme for the army. The Churchill heavy tank was produced by eleven firms led by Vauxhall Motors, the Crusader tank by eleven firms led by Nuffield Mechanisations. The Stirling and Halifax heavy bombers each relied on a group from within the aircraft industry, and the government envisaged a similar arrangement for the rapid re-equipment and expansion of the Royal Air Force.

These plants produced components for the Bristol Mercury VIII, a nine cylinder supercharged air-cooled radial engine used in the Blenheim medium bomber. Initially some 4000 engines were required. Airframes were to be produced at Speke, near Liverpool, in a new plant managed by Rootes Motors. It was designed in 1936 to produce 40 Blenheim twin engined medium bombers per month, annual extensions from 1938 to 1941 finally gave it a capacity of 60 much more complex four engined Halifax aircraft per month.

Upon the completion of the first plants, "Flight" magazine described the new facilities (Flight; 1937). The five plants of No.1 Group were visited in Coventry and Birmingham. They were located adjacent to "parent factories" belonging to Rootes Securities (Humber), Standard Motor Company, Daimler, Austin and Rover.

Certain production machines and tools were specially produced. Air conditioning and discharge lighting was noted in the "standards room" of each plant. These state-of-the-art facilities were necessary for controlling the close tolerances of separately manufactured components. The complementary nature of the plants maximised economies of scale production for the engines, at the cost of inter-dependence among the units, each company specialising in only certain components. For example, Rover produced rods, pistons, valves and springs, Austin, at Longbridge in Birmingham were responsible crank-shafts, reduction gears, and assembly and test of 50% of the Bristol engines. A new Bristol Aeroplane Company plant at Bristol dealt with the assembly of the remainder. In November 1937, in the classic test of manufacturing tolerances, the first engine from the Shadow plants was tested, stripped and mixed with an example from Bristol's own plant. Both were then reassembled and run again.

Reactions to the Initiative:

The Ministry of Labour was concerned that expanded production would produce inflationary effects on the limited supply of skilled labour. The adoption of the motor industry's model of lower skill content and higher production volume was seen as the answer. The aircraft industry was not entirely convinced by the government's strategy. "Aeroplane" reviewed the current defence programme on May 17 1939 in an article entitled "On what we are getting for our money" reporting private manufacturers' claims of higher productivity than the Shadow Programme (Aeroplane; 1939). Subcontracting was also claimed to be cheaper: "motor mass production is not suitable to the aircraft industry". However, despite the mass-production rationale, Penrose (1980) points out that the Standards plant was the only Group 1 factory to actually use the conveyor belt production line, synonymous with mass motor production.

Fearon (1974) chronicles the relationship between government and airframe industry from 1918 to 1935. In the inter-war years demand for aircraft from the government had been intermittent. Procurement policy had been concerned with preserving the nucleus of an industry by favouring a particular "ring" of manufacturers. The rationale placed greater value upon a diversity of design teams than on a small number of large, experienced producers. A greater variety of aircraft than necessary were acquired in order to keep particular companies in work. As a result, orders were relatively small, and mass-production techniques remained uneconomic. There were mergers during the period, however, with Vickers taking over Supermarine in 1928. Armstrong Siddeley took over A.V. Roe before merging with Hawker in 1935 to form Hawker Siddeley. Both Bristol

Aeroplane and DeHavilland were unusual in being integrated companies producing engines and airframes. On the other hand, firms such as Shorts and Gloster survived only by diversifying to omnibus bodies and milk churns respectively (Fearon; 1974). Only two companies were forced out of the industry during the interwar period: English Electric who had produced hydroplanes, and Austin Motors who had established an airframe factory. Both became re-involved through the shadow programmes.

The Society of British Aircraft Constructors, representing the members of the ring, was concerned to benefit from the renewed demand for aircraft production, without encumbering themselves with capital equipment. The caution of the SBAC members was understandable. The Air Ministry supported the industry's arguments for the peak production rates implicit in government contracts to be determined by existing plant capacity, or for 15 month minimum runs to be planned for any new facilities. However, aircraft production was seen by the Treasury as an acceptable form of rearmament because of its comparative flexibility, in comparison to naval construction, with its long lead times, and commitment of expenditure over several financial years. Similarly, army expansion, presented problems of recurrent expenditure, with its relatively high manpower component. The treasury's perception meant that varying demand remained problematic for the manufacturers.

The choice of the rotary, radial engine for the Shadow group was a consequence of Bristol's relative enthusiasm. The government had followed a more rigorous policy of rationalisation towards aero-engines than airframes, since the advantages of large scale production of good designs outweighed the attractions of diversity. Four companies were favoured with government support, others, including Nuffield who created a Wolesley aero-engine department in 1929, were ignored. Of the four favoured companies, Armstrong Siddeley and Bristol were involved in air-cooled technology, Napier and Rolls Royce in water-cooled engines. Bristol displaced the dominance of Armstrongs after 1926, with their Jupiter engine. This successful engine was in such demand that in 1931 Bristol had agreed to a government request for additional manufacture by Daimler Motors. Napier experienced a similar eclipse, at the hands of Rolls Royce Company which, by 1936, had an effective technical monopoly in water-cooled engines, and was prominent in the SBAC opposition to the establishment of Shadow facilities. Concurring with the SBAC line of increased sub-contracting to expand production the company resisted the suggestion of a Liverpool location for an expansion of its own activities on the grounds of lack of suitable labour. Thus the technical leaders were allowed to pursue their own policies for the expansion of production of liquid cooled in-line engines.

Inman (1957) supports the Rolls Royce viewpoint by stating that pushing sub-contracting to 35% of work produced a greater increase in production than expansion programmes, including Shadow Factories. Lloyd (1978) also notes, however, that Rolls management anticipated internal difficulties if overtime became necessary on aero-engine production while short-time working was in force on the motor chassis line. This was an important concern for a company whose turnover in the aero industry had only surpassed its motor earnings in 1935. Inman (1957) points out that despite short-time operation in the motor industry in 1937 and 1938 the aero-industry was only able to absorb labour slowly.

Rolls were also preoccupied with technical difficulties in the development of the powerful but highly complex Vulture engine, two of which were to power the Manchester heavy bomber. This ill-fated project diverted resources and attention from Merlin production until the Derby works was faced with a 66% rejection rate on Merlin cylinder head castings. When, after persistent problems, four Merlins were substituted for the two Vultures of the Manchester, producing the Lancaster, the project was finally abandoned. Attention focussed on the Merlin which was consequently in even greater demand.

Shadow Group 2 and Subsequent Developments:

In the development of Shadow Group 1, the proximity of motor industry managerial resources was considered important in siting the new facilities. From 1939 more use was made of North West England for plant location, and a supply of suitable labour was becoming a higher priority than proximity to management expertise. Although proximity was seen as less important, management expertise in large-scale production was still regarded as a scarce resource. Both Ford and Vauxhall motor company staff were used in the Shadow programme, although neither company was directly involved. Fearon (1979) points out that the government tackled the problem of increasing the productivity of the aircraft industry itself by insisting on the importation of managerial expertise from other manufacturing sectors.

The Bristol Aeroplane Co. expressed a locational preference for Lancashire over Wales because, although the latter was closer to its main plant, it lacked a tradition of factory-based engineering production. According to Hornby (1958), Rootes had preferred a location at White Waltham for their airframe plant for the same reason. Letters on the loss of rural amenity appeared in the Times when this became public knowledge, but White Waltham airfield was also considered to be in a strategic danger zone. Speke, a depressed area on Merseyside, was substituted.

The original criteria for the location of the shadow manufacturing facilities also included vulnerability to air attack. Distances from German bases determined a boundary from Bristol to Falkirk, excluding the eastern part of Britain. South Wales was considered vulnerable to attack from France and after 1940 the areas were revised.

Claims for consideration from economically disadvantaged areas were effective up to 1938 according to Hornby, but Inman (1957) points out that from April 1936 to June 1939 only £12m. out of a total investment of £248m. went to the "special" or "distressed" areas identified in government aid regulations. This consisted mainly of straightforward fabrication work.

In 1938 Swinton, the Air Minister, was forced to resign over his advocacy of compulsion to ensure an adequate transfer of labour for the required production of armaments. Weir joined him in protest. Their departure was followed by an adjustment in strategy.

The group sub-contract plus final assembly arrangements had antagonized Nuffield, who argued that integrated plants under a single management were essential for the standards required. Swinton's successor as air minister, Kingsley Wood provided the Nuffield group with an order for 1000 aircraft, with a free hand on location and production arrangements. Nuffield constructed an integrated plant at Castle Bromwich, outside Birmingham. The order was switched from Battle light

bombers to Spitfire fighters, before production began. However, the facility had been placed under Vickers' direct control by 1943 when it produced 70% of the peak annual production of Spitfires.

Existing industrial capacity was also utilised at this stage. The English Electric company had up to 400,000 sq ft of plant and a workforce of 2000 available at Preston. These were ear-marked for the production of Halifax heavy bombers. Preston and Blackburn, neighbouring municipal authorities jointly provided an airfield. In the course of the war the facilities were expanded to a total of two million square feet. Metro-Vickers, at Trafford Park, Manchester, produced a new airframe plant for heavy bombers, with assembly initially by A.V. Roe.

As noted above, the cancellation of the Vulture programme had increased the demand for the Rolls Royce Merlin engine considerably. In August 1939 Sir William Freeman, managing director of Ford Motor Company of Britain insisted that Fords must contribute to Merlin production. Ford's main plant at Dagenham had been ruled out of the Shadow programme on the strategic grounds that it lay under the anticipated enemy flight path to London. However, Henry Ford's original Trafford Park factory buildings in Manchester were still in company ownership, and adjacent to the Metro-Vickers plant which produced airframes, each of which required four of the engines. A special Merlin line was set up, with Ford Managing Director A.R. Smith claiming high productivity and quality equal to Rolls Royce, gained at the cost of flexibility.

Previously Rolls had vigorously resisted any suggestion that Fords should be allowed near their engines. By this time, however, they were confident of matching Ford at their own game of standardised production, having embarked upon their own programme of government assisted plants, with one at Crewe already in production, and another at Hillington, near Glasgow under construction.

Rolls Royce's "Clean Slate"

Lloyd (1978) relates how Rolls Royce argued for expansion through an extension of sub-contracting by established manufacturers, as preferable to the creation of shadow factories outside the existing industry. Calder (1971) reports that ultimately some 300 contractors were involved in the production of the Merlin engine for the Spitfire fighter. The Air Ministry, sought to create a separate Rolls Royce Shadow Scheme, had argued the case of the 1931 Daimler motor company's production of the Bristol Jupiter engine.

Rolls Royce were aware of the advantages of new, purpose built facilities. Earnest Hives, a director and the general works manager at Derby wrote to Roy Fedden, chief engineer at Bristol engines:

"The gentlemen who went to Germany after the war and smashed up all their aircraft engines, factories etc and came away thinking they had disarmed Germany had overlooked the fact that they could do nothing to destroy German engineering skill. It was a condition that engineers dream about, that is all the obsolete stuff wiped out and an opportunity of starting off with a clean slate."

Rolls Royce was eventually willing to enter into an agreement on a shadow plant at Crewe. The L.M.S. railway company was discharging labour. The location had rail connections, the municipality and community was enthusiastic, and in July 1938 construction commenced. The first engine was produced after eleven months in June 1939. Contemporary accounts compared this favourably with the fifteen

months for no.1 Shadow Group. This achievement reflected the advantage of a single location and management structure rather than the inherent superiority of private over public sector claimed in the press coverage.

However, insufficient housing was available at Crewe to support the expansion required for the level of Merlin production necessitated by the abandonment of the Vulture engine. Lloyd (1978) emphasises the over-riding importance of the availability of housing in the siting considerations. A third plant was proposed, near Glasgow at a site identified as offering suitable resources. Initial qualms over the likely reaction of "Red Clydesiders" to the arrival of a company still largely known as a luxury car maker were set aside.

Rolls Royce maintained a clear view of the hierarchy of the plants. A report by Hives, dated 15 March 1939 detailed the relative roles of existing and projected facilities (Lloyd;1978). Derby was to remain a development factory first, then a production plant. Crewe was seen as a straightforward production facility. The company controlled the allocation of work between the plants, with the implication that with no war by 1940, cuts would begin at Hillington. Crewe carried out less sub contracting than Derby, but had no drop-forge, crank or cam-shaft production, and also imported cylinder liners and pistons. The Glasgow plant, in contrast, was proposed from the outset as the green field integrated plant, Hives' "clean slate".

Rolls contributed £75,000 capital to Crewe, renting the plant from the Ministry. The Glasgow plant was completely government financed and owned.

Production-engineering Ltd was used to layout and commission the Scottish plant, in marked contrast to the past-cost analysis methods used at Derby. 98% of components were to be produced within Hillington, compared with 57% at Crewe and 51% Derby. 16000 workers were employed by April 1940, with seven shops completed and occupied. To facilitate the start-up of the new plant, existing standard factories were rented at the adjacent Hillington Industrial Estate for training and pilot production. Light alloy foundry work, previously unknown in Scotland, was established with the intention of using women workers. The latest techniques in materials handling and in job analysis were used to reduce the skill and strength requirements of the plant. Key male personnel were given special courses at a local technical college.

WORK ORGANISATION, LABOUR SUPPLY AND GENDER:

Shadow Factories and Dilution:

The shortage of skilled workers throughout the thirties, despite continuing high general unemployment reflected both practices by craft unions and management in the face of economic uncertainty, and the inappropriate skills of many of the unemployed.

The dilution of skilled personnel and consequent expansion of production through partially supervised, semi-skilled workers was used extensively during the First World War, and continued to be sought by employers in the interwar period. Dilution: the admission of relatively rapidly trained workers into craft jobs, evolved in conjunction with deskilling: the breaking down of skilled jobs into sub-tasks requiring less skill. By 1933 57% of the workforce in the factories of the

membership of the Engineering Employers Federation could be described as semi-skilled (Jeffreys; 1945).

McGoldrick (1982) argues that the technical innovations in traditional heavy industry, such as welding which was supplanting rivetting in shipbuilding, were utilised to undermine an existing craft base during the interwar period. Postan (1952) describes welding as involving less skill formation than rivetting or foundry work, a view unlikely to be held today, now that welding is an accepted craft. From McGoldrick's perspective, the lack of control over entry by the established craft unions gave rise to this perception, rather than any intrinsic level of skill content.

During 1936 and 1937 several disputes in existing aircraft factories over dilution of the skilled workforce were reported in the Times and Ministry of Labour Gazette.

The initial Shadow Programme was, in part, premised on taking plants to available skilled labour in the regions of inter-war growth in light engineering. The sub-contracting approach relied on occupational mobility within an external workforce, the Shadow Programme required both geographical and occupational mobility, unless there existed both high and suitably skilled unemployed labour at the location. For Rolls Royce, Crewe and Hillington required both forms of mobility, according to Lloyd (1978).

In this context the Shadow Factories were designed for mass production, not research or development work. Jig construction and semi-skilled labour were utilised to minimise the requirement for qualified staff. Their peak labour demand came in 1941, after Group 1 had entered production in 1937-8 followed by Group 2 in 1939-40,

Despite or because of the innovative production methods and the implicit dilution of the skilled component of the workforce proposed, the pre-war government was anxious to exclude trades unions from discussions. The TUC had made overtures to the government in February 1936 over its role in the developing rearmament programme, but it was only just before the invasion of Austria in 1938 that the government sought support in the smooth transfer of large numbers of skilled workers into the defence industry. Agreement was also reached over dilution and deskilling.

Ministry of Labour statistics were regarded as unreliable by the Ministry of Supply who claimed to be able to find workers in areas designated as short of labour. The AEU acted for the government in identifying shortages of engineering skills, but was unwilling to become involved in the use of direction.

The Mobilisation of Women:

By June 1940 little more than half the unemployed reserve of workers had been drawn into employment, nevertheless, an adhoc Manpower Requirements Committee was established under Beveridge the following month. It was clear to the Committee that the mobilisation of women would be an inevitable consequence of the rapid expansion of both the armed forces and industrial production. The solution to a potential munitions famine was to withdraw men from munitions production to release them to other manufacture, and to the armed services by directly substituting female labour. The committee decided that one million women would be needed in the following twelve months, plus a further 75,000 to replace men in non-munitions industries.

The substitution of women in unskilled jobs was easy, although while a reserve of male unemployed remained, this was not done on a large scale. Women increased in absolute and proportional terms in the engineering and allied occupations, comprising 17% of the 380,000 workers in July 1939, including a very small number in shipbuilding.

Eire was initially a source of unskilled, mobile men of value in filling the demand for heavy unskilled labour created by military conscription. Up to 1941 ICI and Ford Motor Company used their existing Irish recruiting offices on behalf of the Ministry of Labour. Significantly, women were dealt with separately, being recruited into a common pool for munitions and ball-bearing plants.

The Registration for Employment Order 1941 was intended to mop up the remaining men and to mobilise women. From August to November 1941 200,000 workers were transferred. Croucher (1982) suggests that the process was a relative failure however, and subsequently the Employment of Women (Control of Engagement) Order compelled women between 20 and 30 years of age, without dependents, to find employment through labour exchanges. In October 1942 women aged between 18 and 45yr 6mth were registered.

In 1943, top labour priority was given to aircraft production, every available woman was diverted to it, some being transferred from agricultural production. 20,000 additional women were found by the extension of the upper age limit to 50. In addition "immobility" and "domestic responsibility" exemptions were reduced, although it was recognised that married women frequently had reserved husbands at home and were consequently servicing industry already.

By mid 1943 22 million people were in employment in the UK, including the armed forces. 32% of the total population was engaged in war production or the services compared with a maximum of 28% during World War I. Women comprised one third of this workforce, compared with one quarter of the smaller 1939 workforce. At this stage the compulsory transfer of "mobile women" to areas of shortage was considered, even if they were already engaged in essential work, although nationalist resistance was expected from Wales and Scotland.

"Women's Work": Wage Rates and Skills:

According to Postan (1952) Beveridge, through his committee, wanted to achieve a 1 in 4 dilution of skilled workers by September 1941 by "breaking down work rather than upgrading men". The government had produced an emerging generation of armament factories, both Shadow plants and Royal Ordnance Factories, which made this possible to a greater degree than previously. The new Royal Ordnance Factories were designed to be "economical in skilled labour from the outset" (Postan p.152). On the basis of First World War experience, they were also designed to be staffed predominantly by women. Consequently the government was deeply involved in the dynamics of the skilling and remuneration of women brought into industrial production in the emergency.

Royal Ordnance Factory filling factories had very high labour turnovers. The work involved filling the cases of munitions with explosives. For safety reasons they were physically remote for residential areas. The new factory at Chorley had 50% turnover before it was fully in production with its workforce of 30,000. Women were sent from Preston and Blackburn but only half accepted work there. The se factories underwent a 40% increase in production between 1941 and 1942. Three

shift working was introduced, with O&M, structured quality control using "green labour" and novel work.

Women judged to be doing "men's work" were paid similar rates, "women's work" attracted lower rates, but these distinctions were less easily made than in the 1914-8 war. New processes had evolved, interwar technology had allowed deskilling and broken down some of the previous job divisions. The materials handling equipment utilised by Rolls Royce at Hillington typified the technical developments which reduced the need for physical strength.

The range of jobs identified by government as suitable for women reveals contradictory underlying assumptions. Women were trained as welders, a new process assumed to require less skill than the rivetting it replaced. They were also selected for foundry work yet at the same time work of a "delicate and painstaking character" in the emergent electronics industry was also deemed suitable for women (Postan p.218). In addition to the filling factories, women were employed in ROF engineering factories, the preserve of male ex-servicemen in peacetime.

Employers' established definitions of women's work varied regionally, as did the rate of women's participation in paid employment. In areas with strong craft unions and high rates of male unemployment only a few women were employed, on unskilled work. On the other hand, in the relatively prosperous light engineering industries of the West Midlands women were employed in semi-skilled work. The highest proportion of women workers were in the emergent light electrical industries, with an entirely novel skill base. Calder (1982) points out that in 1943 the government discovered that almost half the women surveyed in engineering and metal working, had experience of the same job in peace-time, another quarter of a different job. Only one quarter had come from home or school to the workplace, a significant change from WWI.

Women and the Unions

The government's proposals to substitute women in engineering and allied industries, chemicals and explosives work were met by declared Union objectives of maintaining that work as "men's" by maintaining its cash value. A Memorandum of Agreement was reached in May 1940 between the Engineering and Allied Employer's National Federation and the Amalgamated Engineering Union to "Provide for the Temporary Relaxation of Existing Customs so as to permit, for the Period of the War, the Extended Employment of Women in the Engineering Industry" (Cmnd 6474: Appendix 1). The first article of the memorandum stated that "women drafted into the Industry under the provisions of this Agreement shall be regarded as temporarily employed." Work "commonly performed by women" was not affected by the agreement.

Women worked a probationary period, then achieved a rate based on a rising proportion of men's wages, until after 32 weeks they reached the male rate. There was no objection to the introduction of women in establishments in which they were not previously employed. If women were previously employed, the appropriate rates were used, elsewhere boys or youths rates would apply, whichever was higher.

Work identified as women's work was related to a national schedule of men's wages agreed between the Engineering Employers' Federation, and the General & Municipal and Transport & General Workers' Unions:

	Sched A	Sched B	Male
June '39	30/-	26/-	52/-
May '40	35/-		57/-

Equal pay for equal work only emerged as an issue in its own right, rather than as a defensive posture, relatively late in the war. In 1944 the Engineering Trades Joint Council argued that women with five years experience were as good as time-served apprentices.

The semi-skilled women in ROF filling factories were problematic for the unions, since no men were employed. The ROF engineering factories could, however, derive appropriate rates from the prewar ex-servicemen.

Royal Ordnance Factories paid women on women's rates, with a leads system for increases. The unions pursued men's rates for as many women as possible but in September 1942 75% of ROF women were classed as carrying out women's work, with women's schedules applied throughout the filling factories, the largest employers.

The Ministry of Supply agreed rates for production work in groups of plants derived from their overall characteristics. Filling factories were placed in the women's sphere, except for direct replacement work such as crane and truck driving. Light engineering ROFs were put in the women's category but the manufacture of shell casings was compromised between men and women's work at 75% of men's.

Women's leads for skill additional to the basic unskilled rate were equalised with the men's in April 1942, previously the following differential had applied:

Women: 2/- 4/- 6/- 8/-
Men: 2/- 5/- 7/6 10/-

The 1943 Dispute at Hillington:

The first discussions over the replacement of men with women were held between the Engineering Employers' Federation and the engineering unions in May 1940, resulting in the Memorandum of Agreement mentioned above. Although the agreement entailed full payment of the full male rate to women after a notional 32 week skilling period, few women were progressing to the full male rates of pay.

Because the new generation of aircraft and munitions factories was laid out with jigs and tools to allow the use of semi-skilled and/or female labour, employers were reluctant to pay the fully skilled rates. The AEU argued that the situation constituted new practice, and that established women's rates were irrelevant. Employers argued that women gave low output even with additional supervision. Work at which women excelled was by their criteria of low value.

In 1943 the Rolls Royce Shadow plant at Hillington was the scene of one of the key wartime disputes over the issue of women's pay. As described above, Rolls Royce Hillington represented the state-of-the-art in integrated mass production of high technology aero-engines. According to Inman (1957), the plant was planned for unskilled, largely female labour. By mid 1943 it employed 20,000 people with a small nucleus of skilled men. The remaining workers were regarded as unskilled, with the proportion of women increasing. In October 1943 only 4.5% of employees at Hillington were skilled men, 39% of the total were women, an increase from 19% in 1939 (Cmd 6474; 1943)

Croucher (1982) points out that immediately after the First World War, the constituents of the AEU had maintained a rigid position in the face of changes in the skill structure of engineering. As a result, the general unions had made inroads into undertakings previously the preserve of the craft engineering unions, by recognising the emergence of "semi-skilled" categories. In 1927, the AEU recognised semi-skilled workers for the first time, albeit reluctantly.

Croucher suggests that the 3000 members recruited by the T&G in the Hillington plant was an important breakthrough for the union in Scotland. The continuing reluctance of the AEU to represent non-apprenticed and female workers led to recruitment backed up by a successful strike in the foundry which established the T&G's right to recruit the women. The AEU finally admitted women from January 1943, and by the end of the year these women members equalled 70% of the T&G's entire membership in the engineering industry. Prior to this some AEU stewards had undertaken to represent women's interests in return for a notional levy of one penny per week, Croucher (1982) suggests this was largely a defensive move to preempt the general unions.

The AEU had sought to negotiate over pay, since neither union nor management felt the prevailing 1940 Agreement on the wartime extended employment of women dealt adequately with the situation at Hillington. The general unions who were not party to the 1940 Agreement, also sought to negotiate a separate national agreement of women's rates, independent of the former gender of tasks. They did not need to adopt the defensive posture of the AEU, since the levels sought represented an improvement for their members. In December 1942 the Transport and General Workers Union reached a separate agreement for Rolls Royce's Scottish plants, including Hillington, on this basis, but the Engineering Employers Federation insisted that the new grading system was conditional upon the agreement of the AEU.

The AEU's objectives at Hillington involved both the defence of male pay and conditions and of their position in the engineering industry in relation to the growing representation of the general unions. They felt the 1942 agreement represented a retreat from the 1940 position. A dispute was notified and a court of inquiry met in July 1943, producing its report as Cmd 6474, 1943.

The AEU argued that the greater part of operations carried out had been men's work prior to 1940. Rolls Royce agreed, but argued that since the work had been engineered with equipment designed to allow use by women, a new type of activity, neither "men's work" nor "customarily" women's work and not envisaged by the 1940 agreement had been established.

The Court took the line that the 1940 Agreement, drawn up at a time of crisis and necessarily broadly framed, was intended to cover the developments necessary to allow both men and women to take over work formerly carried out by skilled men. The Court applied the T&G December 1942 agreement, with an examination of the new field to derive intermediate rates. A new grading exercise was carried out with four grades for women resulting.

A week long stoppage by 16,000 workers followed the announcement of the results. The strikers argued for the identification of the actual machines used, not the general process descriptions given against the new rates. They claimed greater versatility (i.e. more skill) than that implicit in new grades. As a result of the Hillington dispute the AEU re-examined its policy on grading and skills. It repudiated the concept of women's work and in 1944 drew up a plan for three principal grades: craftsman, skilled operator and labourer, with a nationally agreed rate for each.

The simplification of grading offered the union a clear basis of negotiation, freed from the detailed machine by machine procedure used at Hillington. The recognition of the semi-skilled category as "skilled operator" also provided a buffer between the extremes of deskilling and the craft core.

THE IMPACT OF THE SHADOW PROGRAMME:

Technology Transfer and Work Organisation

Inman (1957) argues, that in terms of total output, both expansion and the Shadow Programme produced a smaller increase in output than the extension of sub-contracting at existing plants. However, the qualitative effect of relieving the SBAC of 45% of heavy bomber production represents a highly significant contribution to aircraft production.

There was, however, another greater and beneficial qualitative impact also. For the emergence of the shadow factories as a resource and as an exemplar to the two industries involved broke the nexus of the low-volume, low capitalisation and high complacency which characterised the inter-war period. Fearon (1974) describes the long-term outcome of the interwar policy of maintaining a diverse aircraft industry on a low volume of orders. The cumulative effect of low volume production of obsolescent designs utilised in colonial police actions culminated in the deployment of the Gloster Gauntlet aircraft, in May 1937. This interceptor enjoyed a speed advantage of only 18 m.p.h. over the Douglas DC3 airliner simultaneously entering service. Even this was an improvement over the situation two years previously, when Bristol's "Britain First" experimental airliner, which was developed into the Blenheim bomber, was shown to be 50mph faster than current R.A.F. fighters. Fearon also criticises the level of technical understanding of innovations such as metal fabrication. The Air Ministry seemed more concerned with potential wartime timber shortages than the inherent technical superiority of stressed metal construction. Consequently, fabric-covered metal-framed aircraft were considered modern. The technical shortcomings of the industry's products seems to have been less well recognised than those of its productive capacity. Consequently, when re-armament got underway, numbers were inflated with obsolescent aircraft such as the Whitley bomber (Calder; 1982).

The central notion of commonality of technique between metal fabrication of aircraft and motor vehicles was a naive one. The Austin company in particular experienced difficulty in achieving the higher dimensional tolerances which distinguished airframes from car bodies. The most direct transfer of technology was in the opposite direction to that envisaged, with the adoption of aircraft quality jigs by London Transport for the post-war version of their standard RT bus. This allowed ready interchange of body and chassis, and reflected their experience as coordinating organisation of the London Aircraft Group, building Halifax bombers. The transformation of Rolls Royce's production methods at Hillington reflected change at an organisational level as much as a technical one.

The government's intervention in the technical base of the aircraft industry may have simply accelerated an emerging trend in the desired direction. The greater capitalisation implicit in jig construction for metal fabrication would have begun to undermine the seasonal basis of motor production of the early to mid thirties described by Croucher. However, the strategy of exemplar implicit in the construction of the shadow plants resulted in the assimilation of programme's lessons by Rolls Royce and the shift from the 49% sub-contract base at Derby to the 98% integration of Hillington.

While keeping clear of Roll's area of expertise, the government scheme did provide state-of-the-art production facilities, outside the direct control of the SBAC membership. Middlemas (1979) suggests that among the motor companies, only Austin was held to a low profit margin. Shay (1977) indicates, however, that the motor manufacturers themselves felt otherwise. The initial Group 1 strategy of complementary production allowed a different character of negotiation with the motor companies than would have revolved around integrated plants under the control of single companies.

Middlemas is correct in pointing out that for political reasons, the technical advantage the government held, in the form of the advanced shadow facilities, was not pressed against the manufacturers. Instead, generous compensation clauses were offered to offset the cost of possible redundant capacity at the end of the programme. Scott and Hughes (1955) describe the "Capital clause" by which the McLintock agreement with the SBAC was extended with compensation for the creation of redundant capital assets on completion of "expansion". Shay (1977) points out that the agreement gave SBAC members profits calculated on the basis of total turnover of government funds, not on the basis of their own private capital involved.

The change from complementation to integration seems to have been more to the liking of industry, even if no use was made of the stronger negotiating position implicit in the original arrangement. Having started out in a relatively threatening posture, the government was content to switch to a position of greater accommodation through the single owner and operator integrated plants. Ford and Rolls Royce, on behalf of their respective industries made the running subsequently. The interpenetration of objectives can be judged by the cooptation to government from industry of key personnel. Patrick Hennessy was taken into the Ministry of Aircraft Production from Ford Motor Company by Beaverbrook in 1940 (Scott & Hughes: 1955), a clear endorsement of the Fordism implicit in the Shadow scheme.

There was also a self-fulfilling effect in the government's intention to forge closer links between motor and aircraft industries at the level of labour organisation. The Shadow initiative brought craft and general unions into contact. Croucher (1982) describes a mutual transfer of union organisation styles from 1935 onwards, in the wake of a series of disputes in the recently amalgamated Hawker plants. He describes this development, brought about in part by the onset of rearmament, as the first meaningful shop-stewards' movement since the previous war. The AEU began to recognise a common interest in the organisation of the motor industry based shadow plants. A complementary process was also operating. Coming from the other direction, the general unions, including the T&G, were prepared to take into membership the de-skilled workers and the growing numbers of women, as at Hillington. Convergence in the organisation of both management and labour in the two industries was thus furthered by the Shadow programme.

Rolls Royce's resistance to government proposals for new plants may in part be attributed to experience with strongly networked sub-contracting arrangements in the Derby area. They were initially strongly opposed to concepts of Fordism, preferring to rely on network supported sub-contracting, even though Hives dreamed of green field opportunities.

Subsequently their rapid self-education allowed them to synthesise the existing networks of the LMSR community and the advantages of new-build facilities at Crewe. They then moved further from their Derby experience. Left to their own devices in R&D and production, Rolls Royce equalled the government sector in work organisation at Hillington.

It could be argued that the threat of Ford-based competition was as persuasive as the example of the government factories. Whatever the incentive, by 1942, the company was confident enough in its mastery of de-skilled volume manufacture of its products to enter licensing agreements with the Packard division of General Motors, intended to break the technical monopoly of Allison inline water cooled engines in the U.S.A.

The Ford plant building Merlin engines at Trafford Park employed 17,000 workers against 20,000 at Hillington.

Gender: equal pay and adjustment:

The role of gender in the transformation of craft-based low volume manufacture into standardised high volume production resulted both from the overall labour shortage, and from the example of munitions production. In the latter the government drew on its experience from the First World War and current technologies to produce filling factories tailored for a female workforce. Such factories would operate on a much reduced basis, if at all in peace time, since they produced the high- volume consumables of the war effort: shells, bombs, mines and torpedoes.

The 1940 Memorandum of Agreement within the engineering industry also emphasised the assumption that the introduction of female workers was seen as a temporary expedient: emergency conditions.

In engineering production, the location policies which emerged from the shadow programmes ensured a high female participation. The areas of traditional male-dominated heavy industry, such as South Wales, continually lost out in

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location decisions to areas with a more mixed skill base such as North West England.

The latter areas also had a tradition of female participation in factory-based cotton textile production. Rolls Royce Hillington is close to the textile towns of Paisley and Renfrew and directly linked to central Glasgow by railway.

The assumption of the withdrawal of women and the military demobilisation of men upon the cessation of hostilities was referred to as "adjustment" from 1943 onwards. Inman (1957 p.356) provides the following table showing growth of women's employment in a number of fields, and the onset of decline towards the end of the war:

Proportion of women employed (%)

	'39	'40	'41	'42	'43	'44	'45
Eng/blrmkg	10.5	13.2	21.6	31.9	35.2	34.8	31.2
Marine eng.	2.1	2.5	4.8	9.1	14.7	15.8	12.9
Motor/aircraft	9.5	13.0	23.0	31.9	36.6	36.5	31.8
Railway carr.	5.0	5.8	9.7	14.8	16.2	16.3	15.0
Electrical	40.6	44.8	50.7	56.1	59.2	61.1	59.9
Scientific	37.0	40.6	42.8	46.1	48.9	49.9	50.1

Despite the government's expressed intentions, women continued to be less well paid than men for equivalent work throughout the war. The I.L.O. (1942) produced the following table:

Average Weekly Earnings by Industry:

	Oct '38	Jun '42	
Manf.	46/6	68/6	All
	69/1	104/4	Men
	31/9	45/8	Women
Govt.	70/6	75/3	All
	106/-	145/8	Men <53%
	44/9	58/10	Women <31%

The Ministry of Labour became concerned at the discrepancy between women on women's rates and those on rates derived from men's. They sought to reduce the differential by improving the women's rates. However, while women's bonuses

improved, they were calculated on a lower base, and by August 1944 women averaged 56/-, men 75/6 per week.

The post-war "adjustment", frequently cited as one of the major achievements of the 1945 Labour government, simply displaced the majority of women from full and part-time paid employment to make way for demobilised men. The ritual denial of the value of women's contribution to the war effort, through the medium of a Royal Commission on Equal Pay, was a delayed, but essential component of adjustment.

The experience of wartime conditions seems to have had an impact of both male and female perceptions of gender roles (Grieco, 2006). Mass Observation recorded widespread support for equal pay for equal work in May 1944. Male respondents were in favour 82 to 11, with 24 "don't knows". During the passage of the 1944 Education Bill, Churchill intervened to defeat the principle of equal pay for women teachers by making the issue a vote of confidence.

The development of strategies of containment i.e. the policy of adjustment, was necessary to remove the effect of experiential learning and emergent gender solidarity amongst women, and in this context, it should be remembered that the discussion of equal pay for women is not the same as the expression of the desire for continued peacetime employment on the part of women. The issue of equal pay for women in the crisis period, i.e. restricted availability of males leading to the use of female substitutes, has to be considered within the frame of retaining the skill definition of work where the substitution of female labour for male labour is defined as an essentially temporary measure.

Ensuring a wage level appropriate to the skilled definition of the task preserves male interests in two ways. Firstly, there is no erosion of the skill definition of such jobs, so that on the return of male labour, the previous advantages continue to be present. And secondly, equal pay in the crisis period precludes women becoming a source of cheap labour for employers and thus displacing male labour in the long run. It is in employers' interest to make use of women as a source of cheap labour; furthermore, the conditions under which female labour was introduced to this sector having none of the normal disadvantages of accessing a new source of labour. For whereas, normally an employer is likely to experience disruption to existing production on the part of the present work force if he attempts to access a new and competitive source of labour, under these crisis conditions considerations of the national interest typically dominated the discussion (Owen; circa. 1940). But the interests of employers can be viewed as being against male union interest where pressure is in the direction of maintaining the wages around the jobs which males are intended to fill once the crisis is past. The problem is to keep jobs defined as male when they are in fact presently occupied by females. The situation of crisis generated the institutional context in which the mass employment of female labour was possible without the occurrence of campaigns of industrial disruption on the part of the incumbent position holders. The situation of crisis served to reveal the possibility of women's central occupational role.

The existence of a "social contract" on the temporary character of women's new position in the occupational structure served as a mechanism for structural adjustment to the immediate post-war occupational primacy of males but the restoration of the old, domestic ideological order was more problematic, for

women's potential contribution to the occupational order could no longer be in doubt.

Croucher suggests that the newly minted concept of "redundancy" assisted the process of adjustment. A worker simply entered the condition, no one gave it to them like the sack. Redundancy was not a matter of culpability.

Croucher further argues that resistance to proposals for the privatisation of government owned facilities was undermined also because many workers had been transferred to the Shadow plants, and were keen to relocate.

He notes that those issues taken up by unions during the adjustment process concerned the order of the removal of women from the workforce, not the principle. The unions pressed for the demobilisation of married before single women, in part because single women were perceived as more active union members.

The activities and timetable of the Royal Commission on Equal Pay (Croucher 1982; p.295-6) reveals the openness of the government's strategy, in the face of public support for equal pay. Mooted during the peak mobilisation of 1943, finally announced in the Commons in May 1945, the Commission met for the first time in October that year, reporting twelve months later, when "adjustment" was largely complete. War production employed 5 million people in mid 1943, when the mounting pressure for equal pay was demonstrated by the support for the Hillington stoppage. By November 1946, when the commission reported, there were only 500,000 workers (Postan p.383).

The manipulation and delay of the Royal Commission was an important component of adjustment. Bevin's favourable statements on the contribution of women were carefully emphasised by his male civil servants to have referred to the "help of the production engineer" (Croucher p.296). Three of the four women members of the commission produced a minority report attributing women's lower pay to poorer trade union organisation, rather than lower efficiency.

For management equal pay threatened the low cost aspect of the reserve army of female labour, reducing its attractiveness. The institution of low-paid skilled women as an element of flexibility in workforce was under threat in 1944 as a result of skill transfer from male to female within the period of crisis. Despite the 1940 agreement on the temporary character of women's employment under emergency considerations etc, opinions formed through the industrial and occupational experience provided in this crisis period endangered the preferred status quo. In this context, it can be argued that Government and establishment intervened by its utilisation of delay on the issue of equal pay to protect the continued existence of a reserve army of female labour, without such delay, the gender\ skill nexus may otherwise have been ruptured.

The importance of commissioned reports as a mechanism for the legitimisation of the displacement of women from the labour force should not be underestimated. For instance, the Mass Observation File Report no.2059 "Will the factory girls want to stay put or go home?" found that only a quarter of women workers were prepared to remain in employment after the war. These were reported as predominantly women workers of 35-50 years of age, with pre-war employment records (Calder and Sheridan; 1985) The "war-experiment part-timers" were perceived to form another group happy to remain in employment.

Not all women were happy at the prospect of the reduction in the availability of paid employment, however. "The restlessness and dissatisfaction comes mostly from the younger girls; those over 25 are much more sober and realistic in their outlook" (Calder and Sheridan p.180) The evidence offered of "unrealistic outlooks" is the expressed desire of one worker for less monotonous paid employment than deskilled assembly work.

Concerns about the "awful muddle" and "terrible struggle" to be expected after the war are also reported. Both single and married woman are quoted as regarding male employment as the paramount consideration. Commissioned reports set the climate for the normality of the return of women to the domestic space as a consequence of the 'process' of adjustment.

Other Government strategies for accomplishing adjustment included the closure of those nurseries opened to enable women with children to participate in war time manufacturing activity. These had been kept in the local authority sector, and not as plant facilities; with the cessation of hostilities these were more amenable to Government direction as local authority facilities than as plant facilities. According to Croucher, the availability of such facilities was greatly exaggerated by wartime propaganda. Whatever the case, their closure certainly did nothing to aid the women with children accustomed to working in the period of crisis and intending to continue doing so in the so-called period of adjustment.

CONCLUSION:

In conclusion, it can be seen that the crisis context of women's employment resulted in the engagement of women's consciousness in a three cornered fight. The domestic ideal was no longer sufficient to prevent women from exposure to the work place and was placed under considerable strain in the period of female incorporation in the workplace; incorporation took place, however, on a limited and temporary terrain with social contracts constructed and established which guaranteed the expulsion of women from the occupational terrain when hostilities ceased; and finally, there took place the resurrection of the domestic idyll and the self evident moral claim of men to the occupational terrain in the period of adjustment. Women's incorporation in the occupational world, as a matter of critical and immediate national need, and without any vision of female control constituted a complex ideological battle for women on the cultural front. The selective morality of the 'in then out' justifications for women's labour market position is, with hindsight, rendered more transparent. The experience of war time working declared the possibility of a different occupational world: women's work roles had been redesigned and redetermined..

At different points and at different times in this historical schedule, different coalitions held between women and the other agencies involved in the construction of these arrangements. There are a number of conflicts and cross cutting interests.

Firstly, there is a natural linkage between women and management in that a low wage policy could have resulted in the undermining of the reservation of jobs for returning males. Rate cutting was one of the strategies available to women for ensuring the continued use of female labour at the end of the crisis. This would have had, as we have already indicated, the special feature that it would have been accomplished without any significant disruption from the customary labour

force. Women's long term interest could have been served by ensuring a short term difference in wage levels.

As already indicated the relationship of the unions to women workers was largely a defensive one. The unions were concerned to achieve equal pay as a way of ensuring that in the long run the jobs return to men. Individual unions provided coverage for women to ensure that they did not lose their customary membership to other unions with the return of the men to these occupational slots.

The alliance of women and government lay in effecting the entrance of women to those skilled and semi-skilled trades to which they were conventionally denied entrance. The alliance was for the period of crisis only and the involvement of government in returning women to the home was a major feat of regulation.

At various points there were alliances between government management and women against the unions; alliance of unions, government and women against management, the precise basis of alliance shifting with the demands of the period. No one alliance was particularly stable. The institutional distinctiveness of the period is a predominant characteristic; the ability to regulate for the entrance and exit of women to the labour market should not be under emphasised.

It is useful to think about these shifting alliances we have characterised in terms of short term and long term interests of women. Whilst the regulated entry and exit of women to the labour market may have in the short term had a repressive quality to it, in the longer term, it changed the possible ideological characterisations of women's place in the occupational order substantially. Regulating the exit of women does not of itself accomplish the ideological restoration of the status quo. The provision of temporary access to restricted occupations has subsequently consequences for the type of arguments which can be used to segregate labour market experience of women and men.

It is also important in attempting to understand the events of this period that the recognition of the category of semi-skilled by the craft union was defensive, as was its repudiation of the category of "women's work". The bottom line temporary clause of 1940 memo was that inter-war technical developments plus deskilling had blurred the easier distinctions made in WWI. The process of adjustment was consequently of more importance and great attention had to be paid, if male jobs were to be reserved, to insuring against the surrender of skilled job descriptions or jobs to women.

Finally, the craft union versus general union conflict in relation to women's interest mirrors the aero versus mass production firms (RR V Ford) in relation to government's interest. The mass requirements of crisis have the potential to undermine existing quality arrangements and understandings. It is perhaps appropriate to end with two quotes which indicate the ambivalences and ambiguities existing around the contest between skill and womanhood in this context of crisis employment:

Around three in the morning I was introduced by the night superintendent to a woman worker at a lathe who radiated happiness to her woman companions while she handled her machine with the skill of a trained craftsman. (Young; 1942 p.15)

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I have not discussed the question of the ability of the women to adapt themselves to work. In view of their success in this direction already I judge it hardly necessary but I would sound the warning that specialisation is absolutely necessary. (Owen; Circa 1940 p.66)

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