Employment in the Soviet Aircraft Industry, 1918 to 1940: Work Culture, Organization, and Incentives

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PERSA Working Paper
No. 36

Version: 8 September 2004
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Abstract
This paper is about employment in a priority branch of the Soviet economy from the Revolution to World War II. It identifies four historical phases: the Civil War, the New Economic Policy, Stalin’s first two five-year plans, and accelerated rearmament just before the war. The paper describes trends in recruitment and turnover, the composition of the workforce, the working culture, and the impact of policy. The latter combined rapidly growing demands for output with a varying mix of repression, regimentation, and rewards. Despite the context of a command system and intense monitoring from above, it was not possible to improve the quality of effort or working practices by negative stimuli alone.

* I thank Andrei Sokolov for guidance and for not letting me be satisfied by past achievement; I am responsible for remaining errors.

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First draft 8 September 2004.
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It is said that it is not weapons that fight, but people. By the same token it is not factories that build aircraft, but people. In this paper we seek to acquaint ourselves with who they were, standing at their jigs and lathes, how they related to each other in the workplace, how their bosses treated them and tried to extract more effort from them, and with what success.

The research in this paper relies on a broad range of evidence, some of it already in the public domain; the latter includes official histories, memoirs, and the research of other scholars, especially that carried out since the veil of secrecy was lifted at the end of the 1980s. At its core, however, lies primary documentation from the central state and party archives, the central archives of the defence and aircraft industries, and local archives of the aircraft factories and their party organizations. This documentation is introduced into scholarly circulation for the first time.

The paper is organized as follows. Parts 1 and 2 briefly outline the evolution of the industry’s workforce in the periods of the Civil War and the New Economic Policy of the 1920s. Part 3 then examines the position of the engineering and technical specialists over the whole period from various angles. Parts 4 and 5 are devoted to the period of Stalin’s first two five-year plans; Part 4 introduces the figure of Baranov, a leader of Soviet aviation until his untimely death in 1933, and Part 5 is devoted to an issue close to his heart, the level of the industry’s technological and working culture in the 1930s. Parts 6 and 7 show how the industry evolved under the pressure of intensified rearmament in the last years before the war; Part 6 describes overall trends in employment and policy and Part 7 looks at the same issues in the microcosm of a single factory. Part 8 concludes.
1. War Communism: “Ruin in People’s Heads”¹

A result of the Civil War was the disintegration of both the industrial working class and the managerial and technical strata. In 1918 alone the number of employees in the aircraft industry fell from 9,572 to 7,918 (Samoletostroenie 1992, p. 20). Workers and engineers alike fled from factories where they were paid with worthless paper and rations were distributed only on occasion. Monetary compensation, especially, became insignificant; the real wage fell by more than 90 per cent between 1918 and 1920.

To make up for this, centralized rationing was introduced by decrees concerning the payment of wages and bonuses in kind. These discriminated between social classes and equalized within them. But the Soviet leadership not infrequently lacked the real resources to supply food even to workers in the defence factories. In the winter of 1918/19, for example, a true famine set in among the workers at the Nizhnii Novgorod explosives factory who did not even get their prescribed 150 grammes [of bread] per person per day. In February 1919 there was a mass exodus to the countryside where the workers were taken on as farm labourers or sold their belongings for food (Vernidub 1993, p. 134).

A government decree of 30 April 1920 introduced food rations for workers in three categories with a ratio of 4:3 between the highest and lowest. Red Army servicemen got the most; engineers and specialists got the least, with manual workers in between. Decrees were also adopted that began to socialize consumption in the form of free housing, health services, transport, and so on, although their realization was often ephemeral. The difficulties of the time tended to result in discriminatory access. Some establishments were designated as “shock factories” or “model enterprises” and given privileged supplies, not so much to reward their productivity as just to keep them in existence and operation. There were attempts to use extra rations to reward individual effort such as a government decree of 23 October 1920 on paying bonuses in kind. But nothing could retain the workforce in the face of hunger (Sokolov 2000).

At the outset aircraft industry employees, like workers everywhere, took up the artisan production of “mass consumption goods” like cigarette lighters, to make up their earnings; in the next phase they just quit their jobs for the countryside. This was particularly prevalent among the engineers and specialists who frequently missed out when rations were distributed according to “class” principles. But the position of the manual workers in the aircraft industry was particularly vulnerable.

¹ In Bulgakov’s (1968) novel Professor Preobrazhenskii protests that “Ruin … is something that starts in people’s heads. So when these clowns start shouting ‘Stop the ruin!’ – I laugh! … I swear to you, I find it laughable! Every one of them needs to hit himself on the back of the head and then when he has knocked all the hallucinations out of himself and gets on with sweeping out backyards – which is his real job – all this ‘ruin’ will automatically disappear. You can’t serve two gods! You can’t sweep the dirt out of the tram tracks and settle the fate of the Spanish beggars at the same time! No one can ever manage it … and above all it can’t be done by people who are two hundred years behind the rest of Europe and who so far can’t even manage to do up their own fly-buttons properly.”
factories was hardly comfortable. A letter to Lenin dated June 1918 reads: “We workers of the Singer factory, not having been paid for three months … being literally in a famine [sic] sincerely request on behalf of our 2,600 comrades …” (Lenin 1979, pp. 139-140). On 13 February 1919 the communist deputies on the All-Russian Council of the Air Fleet wrote to the Butyrki district party committee (VPR 2003, pp. 96-98):

Beginning in September 1918 the pace of work in [the] aircraft factories has increased sharply, especially at the Duk factory: after virtually zero productivity in September the factory delivered 25 aircraft in October, 25 in November, and 20 in December; the comrade workers have been deserting the factory only recently because of the lack of food stocks and this is undoubtedly affecting productivity.

The exodus of aircraft industry employees from the towns gradually acquired critical dimensions. The numbers of workers and staff employees at the Moscow factories halved between 1917 and 1918, from 3,700 to 1,900 (VPR 2003, pp. 347-356).

In the first half of 1919 roughly 30 percent of aircraft industry employees were absent from work. As of 1 May 1919 the Motor factory was short of 42 percent of its manual workers and 23 per cent of its specialist personnel. The corresponding figures at the Sal’mson factory were 38 and 50 percent (Samolotostroenie 1992, p. 20). In October 1919 the Duk factory had a nominal payroll of 760 employees, including 585 manual workers (TsMAM, 1135/1/8, f. 51). But only 420 manual workers were actually at work. Of the 165 missing, 23 had been sent on food expeditions, 25 were sick, and 5 had been elected to the district Soviet; the remainder had gone to trade or work for food in the countryside. Meanwhile the factory was being given plan assignments on the basis of its management claim to 900 employees.

The situation was no better elsewhere. Table 1 assembles data reported by the air force to the Revolutionary Military Council on 3 October 1919:

<table>
<thead>
<tr>
<th>Factory</th>
<th>Manual Workers</th>
<th>Office Workers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Actual</td>
<td>Required</td>
</tr>
<tr>
<td>Aircraft Factories:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duk</td>
<td>840</td>
<td>1500</td>
</tr>
<tr>
<td>Moska</td>
<td>126</td>
<td>300</td>
</tr>
<tr>
<td>Aeroengine Factories:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gnome et Rhône</td>
<td>239</td>
<td>300</td>
</tr>
<tr>
<td>Motor</td>
<td>162</td>
<td>300</td>
</tr>
<tr>
<td>Sal’mson</td>
<td>55</td>
<td>75</td>
</tr>
</tbody>
</table>

Source: VPR 2003, pp. 135-137.

There was also a steady trickle of aircraft industry employees into the specialist ranks of the armed forces: air bases, frontline and travelling repair workshops, and so on. These gained better supplies as Red Army employees than their colleagues in the aircraft factories.

In 1917 and 1918 the aircraft factories had lost the greater part of their workforce. By the beginning of 1919 employment stood at one third the level of 1917 and half that of 1918. In February of 1919 barely 1,000 manual workers and 400 staff employees remained (VPR 2003, pp. 347-356).
In 1920 the outflow of technical specialists from the industry became so great that on 25 October STO announced that “in view of the need to urgently provide the factories of the aircraft industry with labour, technical staff (engineers and technicians) from 18 to 60 who have been employed in aviation or airborne factories or airfields or other aviation institutions or units in Russia or elsewhere for not less than 6 months in the last 10 years are mobilized” (Lenin 1979, pp. 107-109). The ninth party congress also proposed measures to combat “desertion from the labour front” by workers looking for food by such means as naming and shaming deserters, setting up penal battalions, and imprisonment in concentration camps (KPSS 1970, vol. 2, pp. 251-252).

In 1918 the realities of the Civil War had forced the Soviet leadership to focus its resources on the production of infantry and artillery armament, while the aircraft factories were relegated to the fourth, lowest priority of supply of fuels and raw materials of which they became the residual claimant (Kostyrchenko 1988). Despite the fact that the course of the war created pressure to give more attention to the industry, the situation in those aircraft factories that were still in operation at the beginning of the 1920s remained extremely difficult.

Not until 1920 did such things appear as food supply departments, incentive payments, and special rations (Samoletostroenie 1992, p. 21). In May 1920 a commission for raising labour productivity under the Council of Military Industry proposed to give the equivalent of Red Army rations to the leading aviation staff who could not be replaced – professors, designers, and technicians – based on individual evaluation (Ivanov 1995, p. 35). Even after this, however, the industry’s employees still lived in poverty. For example, a government report of August 1921 (Lenin 1979, pp. 128-129) suggested that productivity would improve at the Dukh factory if collective food supplies were organized, implying that food continued to constrain effort. Wages were systematically in arrears at the Gnome et Rhône factory in 1922; rations included only flour, and this was about to stop. The factory trade union committee threatened strike action unless wages and food supplies were forthcoming (TsAODM, 3/11/9, f. 14). The resentment was increased by the high expectations of the workforce associated with their advanced skills and qualifications; for example, the average level of skills at the Gnome et Rhône factory corresponded to levels 7 and 8 of the pay scale across industry, where level 9 was the highest.

Despite these difficulties there was some improvement in conditions as a result of which the number of aircraft industry employees rose from 3,150 on the first of 1921 to 5,150 a year later, i.e. by almost two thirds. This number remained insufficient and it was proposed to boost them, in particular by recruitment from overseas (VPR 2003, pp. 347-356).

2. The 1920s: The Communists Make Airplanes

By the mid-1920s the devastation had mainly been overcome. All the same, the industry’s endowment with instruments and machine tools remained under great pressure, mainly because of disorder and incompetence. The documentary evidence pertains mainly to factory no. 1, the Aviakhim works; since Aviakhim alone accounted for two thirds of aircraft production, what was true for this factory was largely true for the industry (Mukhin 2004). A
minute of the factory party committee meeting on 27 July 1926 is typical: “the workers are standing in line for the machine tools and are losing much time to no purpose. Various materials are lying around in the despatch office from which it would be possible to assemble an additional machine tool” (TsAODM, 373/1/12., f. 153).

Meanwhile, something new began to appear in the factories: the influence of the party in production. We have the impression that, even in something as particular as aircraft manufacturing, party agencies were putting on weight as one corner of the management-trade union-party triangle. Most staff were beginning to see party membership not as a political commitment but as an administrative attribute that would give access to a variety of service advantages. It was observed that the “Lenin recruitment” into the party that followed the leader’s death brought many guided by “selfish considerations” (TsAODM, 373/1/12., f. 153).

In early 1926 there was a crisis in the supply of materials to the Aviakhim factory as a result of which Aviatrest proposed to lay off some workers. The party bureau opposed this categorically on the grounds that the skilled workforce would be quickly dispersed and hard or impossible to reassemble (TsAODM, 373/1/12., f. 12). The confrontation between the Aviakhim factory managers and Aviatrest worsened through the spring of 1926 while the party committee consistently worked to politicize the argument. Thus it opposed the sacking of the factory director Onufriev and his deputy Babuto on the grounds that both were party members while their proposed replacements were disqualified as follows: Anan’ev was “non-party, and an anarchist by conviction”; Sinitsyn was a “person with a drink problem” (TsAODM, 373/1/12., f. 14). The new director, Desiatnikov, was probably a compromise figure.

Meanwhile the supply difficulties did not improve but the party committee and, presumably, the managers under its control, agreed to a 20 per cent cutback in the workforce. It seems likely that party membership was one criterion of selection for redundancy and that this explains why, a week later, the party committee resolved “in view of the cases of abnormal conduct of the dismissed workers that have been observed, the party branch considers it necessary for all bureau members to take an active part in clarifying all the questions raised among the dismissed wokers” (TsAODM, 373/1/12., f. 52). What this shows is that in the 1920s the party branches were already fully endowed informal “power centres” in the management system and that their influence was not only over party members but also over non-party workers.

The growing role of the party is further illustrated in the issue of administrative cutbacks that arose a few months later. In the summer of 1926 the materials supply situation improved and it was considered whether to rehire the workers laid off in the spring. At the same time the factory was fulfilling its production assignments with its reduced workforce, so the question was put off. Then it was proposed to cut the “office staff” by 15 per cent. After long discussion in the party branch on 15 October a list of redundant staff was published with only 16 names (TsAODM, 373/1/12., f. 239). This was followed by debate at a party meeting with opinions for, against, and for remitting the list for reconsideration. The outcome was to invite the regional officer of the Workers’ and Peasants’ Inspectorate to audit the factory’s workforce establishment. The party fraction seems to have got
what it wanted in that as of 25 November eight office workers had already
been laid off and 14 office and 16 manual workers were nominated for
redundancy (TsAODM, 373/1/12., f. 283). The important thing is that once
again it shows a production management issue being dealt with at a party
meeting.

The aircraft industry workforce of the 1920s was privileged by comparison
with conditions elsewhere. An Aviatrest report on plan fulfillment for 1925/26
(VPR 2003, pp. 905-915) notes that “

… the aircraft factories have been singled out by [the ministry] and the
union as having more highly skilled workers into a special group with
enhanced perquisites (110 per cent for level IX instead of the usual 75 per
cent). In view of the products being newly innovated piece-rate norms
were extremely soft and were easily exceeded … a worker could achieve a
high wage with low productivity. Perquisites could reach 400 or more per
cent in some cases.” Essentially Aviatrest was blaming the union for
seeking overprivileged conditions for the workers. “Last year the Aviatrest
management … tried to bring essential changes into the new collective
agreement to remedy the wage situation but in the outcome, after
arbitration, only the following were achieved: piece rate norms rose on
average by 18 per cent, the piece rate tariff rose by 18 per cent, and the
average perquisite was cut by 10 per cent. The result of introducing the
new collective agreement was that wages remained at about the same level
by comparison with the fourth quarter, and productivity rose by about 6
per cent. The average percentage overfulfillment of norms was as follows:
April to August – 44; September – 38, October – 34, November – 42,
December – 38. In January this year the collective agreement expired and
the [union] is proposing a 5 per cent increase in the wage fund to level pay
upward for some factories and the less skilled workers. Taking into
account the financial situation of Aviatrest, this proposal is completely out
of the question.

At this point, we see that the aircraft workers had not only secured
privileged conditions but were temporarily able to veto management attempts
to undermine them. It is hardly surprising that they held on to their jobs and
resisted all attempts to lay them off.

3. The Engineers are Knowingly to Blame
In the 1920s the aircraft industry normally failed to fulfill its production
targets (Mukhin 2004). This created a powerful temptation to search for
scapegoats, and specifically to blame the engineers of whom a significant
section belonged to “socially alien” classes.

A report on the industry as early as 1923/24 noted: “At the Obukhov
factory a group of specialists involved in the disruption of aeroengine
building, associated with monarchists, has been exposed. Arrests have been
made and an investigation is continuing. Criminal activity in this connection
has ceased. Shoddy work had reached 90 per cent, and losses were running
into millions. Engine production is now being restored” (VPR 2003, pp. 676-
678). After that, the success of aircraft production in the second half of the
1920s diminished the compulsion to search out the guilty for a time.
In 1928 and 1929 two out of the three leading Soviet aircraft designers were arrested, Polikarpov and Grigorovich. Along with them were also detained 20 other leading aircraft specialists (Grakina 1999, 137). But the matter did not end there, and a wave of “specialist baiting” swept the industry in the wake of the trial of the Industrial Party, the Shakhty trial, and similar cases launched by the OGPU. The aircraft designers were accused of disrupting experimentation, putting untried designs into production, and so on.

The process of defamation was not infrequently initiated from below, from the factory management and most often from the party committee. In September 1929, for example, the party committee at factory no. 1 (Aviakhim) wrote to the Krasnaia Presnia district committee (TsAODM, 3/11/722, f. 22), with copies to a wide range of other addressees from the central committee to GVPU: “During the last two or three years we have witnessed the extremely abnormal production life of the factory particular facts of which leave no doubt whatsoever of the presence of a malevolent wrecker’s hand at work … we have egregious and outrageous facts of disruption of the [production] programme, the disorganization of production, the squandering of the people’s assets, the dislocation of [the rhythm of] work, and the weakening of the combat readiness of the Red Army.”

One cause of this anxiety is indicated in the document: “The factory has found itself without a firm production programme, and is waiting for a perspective for developing production and a large cutback of the workforce.” The district committee’s investigation that followed pointed the finger of blame for this at the air force purchasing administration, but “organizational conclusions” were directed in the first instance against the engineering and design workers. The findings were not a matter of logic. On one hand it was acknowledged that the production plan for the economic year 1929/30, i.e. from October 1929 to September 1930, was ready only in March 1930 so that the factory had had to work half the year without a plan; as a result, it had missed the final target by 30 per cent. On the other hand it was not the planning agencies who were found guilty of all the bad things that had happened, but wreckers in the persons of Aviatrest director Makarovskii and the technical directors Polikarpov and Kostkin of experimental factory no. 25 and factory no. 1 respectively (TsAODM, 3/11/726, f. 44).

Not infrequently the defamation of factory, workshop, and brigade leaders grew out of campaigns to plaster over the defects of the “hegemon of the revolution,” the working class itself. Veterans of the Khar’kov aviation factory recall (Savin 1994, pp. 120-121) that:

… during inspection of the fuselage of one of the aircraft being assembled a quality assurance inspector [brakovshchik] noticed double rivet holes, a defect that could have caused the aircraft to crash in flight. It turned out that the workers responsible had smeared over the extra holes and put in false rivets. When confronted, they began to complain to everyone accusing the foreman and his management of all the deadly sins. There was an investigation and a commission [of inquiry]. The situation was aggravated by the fact that one of the shoddy workers [brakodely] was an old Bolshevik. Even when their guilt was proved they carried on repeating in varying tones: ‘I’m not to blame for shoddy work, the foreman is to blame, the foreman is a bad organizer.’ And so on and so forth.
The behaviour of the shoddy workers is to be explained by the fact that at that time the press was flourishing with various “anti-specialist” publications. Articles regularly featured the “exposure” of the next “wrecker.” Front page articles bore hard-hitting headlines “On the Cunning of Fisheries Engineer Kolesov,” “Engine Driver Lebedev Got the Better of the Specialists,” and so forth. In the later 1920s the press regularly served up cases of assault by workers against specialists and even factory directors. This phenomenon became known as Bykovshchina after the young worker Bykov who shot a foreman at the Skorokhod factory (RN 2002, p. 389).

By 1930 the campaign to root out “internal enemies” had become widespread. There was a special commission “to eliminate wrecking” at every defence factory. It should also be remembered that the Soviet leadership was psychologically ready to believe in wrecking and the treachery of the technical specialists in general without any evidence.

3.1. “Intellectuals … Who Think They Are the Brain of The Nation”

The roots of this phenomenon probably lie in the very beginning of the 1920s. In January 1918 the Third Congress of Soviets adopted a “Declaration of the Rights of the Working and Exploited People” which set out “the destruction of all kinds of exploitation of one person by another” and “the pitiless supression of the exploiters” as basic tasks of the new state. It follows that the first problem was to identify the exploiters who were to be pitilessly suppressed. It transpired unexpectedly that most Bolshevik leaders were convinced of the inimical character of the entire “technical intelligentsia.” It was no less that Lenin (PSS, vol. 51, p. 48) himself, who remarked in September 1919 that “The intellectual forces of the workers and peasants are growing and strengthening in the struggle to defeat the bourgeoisie and its underlings, the intellectuals, the lackeys of capitalism who think they are the brain of the nation. In fact they are not the brain, just the ——.”

Lenin’s closest associates, to whom his view was not exactly a secret, gave it more substance and detail. Bukharin (1989, p. 163), for example, listed the main groups opposed to the proletariat in building the new society:

1) parasitic strata (former landlords, rentiers of all kinds, bourgeois entrepreneurs who lack a relationship to the production process) … 3) bourgeois entrepreneurial coordinators and directors (organizers of trusts and syndicates, hard-headed industrialists, prominent engineers associated directly with the capitalist world, inventors and others); 4) educated bureaucrats – civil servants, military and church officials; 5) the technical intelligentsia at large (engineers, technicians, agronomists, zoologists, doctors, professors, lawyers, journalists, most teachers, etc.

Bukharin’s position was not the only expression of anti-intellectualism nor was it the most radical. Larin (1924, p. 123) went still further by declaring that everyone who had completed secondary and higher education under the old regime was in opposition to the new society. Lunacharskii (1924, pp. 41, 43) explained that the intellectual was “a petty bourgeois who lives exclusively off the original labour of his own individuality, knowledge, talent, etc., and so places an infinitely high value on individuality and puts it before everything else … I would say that he fears the collective and the social principle as
prejudicial to his own individuality.” The intrinsic enmity of the intellectuals towards the new classless society based on collectivism followed logically (on the Bolsheviks’ relationship with the intelligentsia in the 1920s and 1930s see further Smirnova 2003).

Theoretical reasoning had practical implications. In June 1921, for example, the Fourth All-Russian Congress of Workers in Aviation, held in Moscow, called for “a pitiless struggle with wrecking elements in aviation.” The delegates declared that “alien elements … have colonized aviation and infiltrated responsible positions” and called for efforts “to cleanse aviation of malicious specialists, neutralize them and deprive them of everything … to appoint communists everywhere”; they required anyone with relevant information to pass it on to the Cheka, the secret police (Savin 1994, p. 73).

The results of the “specialist baiting” policy were so lamentable that the party central committee was compelled to adopt a resolution “On the Work of Specialists” on 18 September 1925; this called for an end to the persecution of specialists in the press and for efforts to disseminate the positive work being done by the technical intelligentsia, to ease the entry of their children into universities, to improve their living conditions, provide tax allowances, etc (RN 2002, 388-389).

At first sight it would appear that this had some effect. A Pravda editorial on “Socialist Construction and Scientific Workers” that appeared in February 1927 during the Second All-Union Congress of Scientific Workers in Moscow announced that “the alienation of the intelligentsia from the working class that was formed historically under the influence of Tsarism and and their ‘domestication’ by capitalism has been broken by the victorious growth of the Soviet state. Now we can confidently say that there is no other country in the world where there is such a close relationship between the interests of science and labour as in the USSR” (cited by Esakov 1971, p. 44).

The real situation, however, differed substantially from the declared one; NEP did not really change Bolshevik attitudes to the “bourgeois specialists” (RN 2002, p. 388). This became clear with the 1930s. Molotov, for example, speaking about the aircraft designer Tupolev and others like him, claimed that such intellectuals were “very necessary to the Soviet state, but they are against it in spirit and through their personal connections they did dangerous and disruptive work, and even if they didn’t do it they were breathing it in and out. They couldn’t do anything else!” (cited by Kulikova and Iarushkina 1999, p. 97). He went on:

They were all inside, they all talked too much. Their circle of acquaintance, as one should expect … they certainly didn’t support us … Our Russian intelligentsia was to a large extent connected with the well-to-do peasantry, which was pro-kulak in its orientation … This very Tupolev could have turned into a dangerous enemy. He was well connected with the intelligentsia that was our enemy. At that time the people like Tupolev were a serious problem for us. At one time they were enemies and we needed time to align them with Soviet power … It’s one thing now when those like Tupolev are famous, but at that time the intelligentsia was against Soviet power! We had to find a way of managing the situation. We put them behind bars and we told the Chekists to let them have the best conditions but not to let them go; let them work and design the things the country needed, these most necessary people.
3.2. “To Establish Contact with the OGPU”

The situation at factory no. 1 was the subject of a meeting at the Moscow district party committee in October 1929. “Noting the element of undoubted wrecking,” the meeting resolved “to consider it necessary for Aviatrest … to establish contact with the OGPU” (TsAODM, 3/11/722, f. 44). The first aviation sharashka, or prison design bureau, dates from this period. In 1929 the VT (“Internal Prison”) design bureau was set up in the Butyrki jail (Simonov 1996, p. 113). In this context the party central committee resolution of 15 June 1929 on defence industry and aviation appears all the more ironic: “The establishment of a Red air force should be recognized as one of the most important results of the last five years … a most important task of the next few years in the construction of Red aviation is to bring its quality speedily up to the level of the advanced bourgeois countries and by all means we must implant and cultivate our own Soviet scientific and design forces, especially in engine building.”

The “competent agencies” had their own methods of “cultivating” and “developing” scientific workers. It must also be understood that the threat of repression hung over not only the “bourgeois specialists” but also the Soviet officials, not only for their own actions but also for their failure to denounce the actions of others. This was the typical situation throughout Soviet defence industry at the time. The same decree commissioned the party control commission “urgently to consider imposing penalties on and bringing to account the past and present leaders of military industry … who are guilty of lack of vigilance and longstanding and clear wrecking and dereliction in military industry” (SR 1999, p. 90). A commission set up to implement this instruction with Rozengol’ts, Pavlunovskii, and Peters as members announced penalties and replaced a number of defence industry leaders. Only one, the head of the artillery industry, admitted his neglect of the struggle against wrecking, and for this his punishment was possibly lightened. The others claimed that the GPU had exaggerated the prevalence of wrecking (SR 1999, p. 93).

Most leading officials of the defence industry were labelled as wreckers and repressed (Simonov 1996, p. 74). In a special resolution of 25 February 1930 the Politburo declared: “Having heard the report of the OGPU on the liquidation of the consequences of wrecking in enterprises of the military industry the [party central committee] declares that up to the present adequate measures have not been adopted in the military industry as a whole for the liquidation of these consequences … Heroic efforts are necessary to repair what has been omitted” (RGASPI, 17/162/8, f. 85).

In September 1929 the defence ministry had adopted reasoned proposals to speed up the development of the aircraft industry through a combination of organizational and financial provisions (Mukhin 2004). Despite this the Soviet leadership bent its course towards using the police and the courts. On 15 May 1930 the minister for industry Kuibyshev and deputy OGPU chief Iagoda signed a joint assessment of the situation in Soviet aviation research and development: “To summarize: it is necessary on the way and without slowing the advancing progress of socialist construction to put right all the wrecking measures that have been accomplished by wrecking organizations in Aviatrest and the [air force purchasing administration] that were ultimately aimed at disrupting the planned supply of the air force with modern types of combat
aircraft and supplying the air force with obsolete designs; and to neutralize the results of wrecking. The OGPU organs are to take all measures to make use of the engineer wreckers in putting wrecking right ... To coordinate action with the OGPU so that the wreckers’ work should proceed in the most normal circumstances and to provide them with the necessary literature, materials, and equipment” (Chuev 1998, p. 45).

3.3. The “Wrecker” Has Been Arrested. Who Will Replace Him?
Since engineers en masse could be watched at work, for a while there was a tendency to activate the forces of workers’ control in the aviation factories. Thus the February 1930 Politburo resolution on wrecking in defence industry demanded “the engagement of the non-party and communist activists ... not only in participation in the organization and rationalization of production but also in the struggle [with] and liquidation of the consequences of wrecking” (SR 1999, p. 112).

A joint decree of the defence and industry ministries and the trade unions implemented this resolution by widening the rights of production committees and assemblies and widening the agendas of workers’ mass meetings; according to Voroshilov, however, this decree had not yet reached the defence factories in March 1930 and so had not come into force. The manufacture of aviation goods needed specialist knowledge, not meetings. On the other hand the Soviet leadership was intensifying the training of “Red” engineers belonging to a new generation that it hoped would countervail against the “bourgeois specialists.” A government decree of 3 July 1929 anticipated measures to supply more engineers by training up at least one quarter of those personnel in engineering posts who were completely unqualified and 10 per cent of those who were underqualified.

Despite this the party central committee plenum held in November 1929 noted the inadequate training of specialist personnel which “is going on at nothing like the rates of industrialization” (KPSS 1970, vol. 4, pp. 26-28).

Like it or not, they had to find some mutual understanding with the old specialists. In his speech of 23 June 1931 Stalin condemned their persecution. Harrying them when they were already in short supply only made life more difficult in production. Under the watchful eyes of the OGPU they began to return to their former posts and those formerly associated with “wreckers” were granted forgiveness in view of their willingness to work for the good of socialism.

The fate of the detained aircraft engineers was worked out in parallel. The group held in the VT design bureau was transferred from the Butyrki jail to factory no. 39 on the outskirts of Moscow. There they continued to work in detention under the uninformative title of Hangar no. 7 (Iakovlev 1972, p. 73) and subsequently, having reached around 300 in number, as the OGPU Central Design Bureau (TsKB OGPU); the latter was headed by chief of the OGPU technical department A.G. Gor’ianov (Chuev 1998, p. 45). In March 1931 Polikarpov had his death sentence commuted to 10 years’ forced labour for building the advanced I-5 fighter (Demin 1998); this design had originally been coded VT-11 for Internal Prison [vnutrenniaia tiur’ma]. In July he was released, although not cleared of charges.

Finally, it should be noted that prison design bureaux were also set up in other branches than aviation; sometimes they gave results, sometimes not. For
example A.N. Asafov worked on the design of the Pravda class submarine under similar conditions (IOS 1996, p. 128).

3.4. The Second Wave: 1937

The persecution of engineering and technical specialists died away during the first half of the 1930s. In 1936/7, however, the application of repression to production problems was resumed.

In the mid-1930s the Soviet leadership placed great hopes on the introduction of new aircraft types, some designed at home and other licensed from abroad (Mukhin 2004). For various reasons these plans were either not carried out or implemented with considerable delay. It was decided to lay the blame for this on the engineering personnel of the aircraft industry. For a typical example, Soviet control commission member Khakhan’ian claimed in a report on innovation in the aircraft industry (GARF, 8418/11/80, f. 7) submitted on 11 December 1936:

Analysis of the causes of unsatisfactory rates of introduction and production of new aircraft shows that one of the main causes is the completely intolerably hostile attitude of chief engineer Tupolev of the aircraft industry chief administration to the introduction of machines not of his design.

Khakhan’ian went on to give the history of the DB-A four-engined heavy bomber, designed by Bolkhovitinov, which was to be brought into production at factory no. 124; Tupolev had supposedly held the DB-A back so as to make way for his rival TB-7 then in the pipeline. The TB-7 was possibly a better aircraft, although completely untried in 1936. Additionally Tupolev was accused of stealing the idea of a central supercharger from the engineer Treskin (GARF, 8418/11/80, f. 8). This was not the last of Tupolev’s alleged sins; Khakhan’ian accused him of a hand in holding back the work of every one of the other design bureaux (GARF, 8418/11/80, ff. 9-10):

Kocherigin’s SR [high-speed reconnaissance aircraft] is being delayed … They are losing Neman; they are not creating conditions for him to work and were not going to let him go [on a delegation led by Tupolev] to American (although a place found for Tupolev’s wife) … A place was only found for Neman thanks to intervention by the ministry … At Izakson’s they have disrupted the autogiro tests, and they are blocking our Soviet-designed variable-pitch propellers … Grigorovich has been stopped from working.

After discussing Tupolev’s leadership style Khakhan’ian went on to his design activities. His main conclusion was that Tupolev aircraft were generally poor. “The I-14 has been taken out of production, the T-1 has been stopped because it broke up in flight trials, the MDR-4 crashed twice with loss of life, the MTB-2 is worse than the Glenn Martin 156, and the SB has been put into serial production only with difficulty” (GARF, 8418/11/80, f. 11).

While it is difficult to evaluate the detail of the report there is no doubt of its general bias. In any case its accusatory tone is sufficiently explained by the fact that it was composed after Tupolev’s arrest, when the detained prisoner could be freely charged with anything and everything. Thus the Elektrozavod works, having to explain the slow pace of bringing new magnetos into production, announced that the problem lay with the type, made by the French
firm Voltex, that Tupolev had selected “wreckingly” (GARF, 8418/12/165, f. 209).

The defence significance of the industry gave its workers no protection against unfounded repression. The production decline of 1937 is hardly a surprise considering that at factory no. 24 in Moscow, for example, in the same year were “exposed and liquidated 5 spying, terrorist, and subversive wrecking groups numbering 50 persons in all, including: 1. An anti-Soviet rightist-Trotskyist group comprising the former factory director Mar’iamov and technical director Kolosov. 2. A spying subversive group of the Japanese secret service comprising 9 persons. 3. A spying subversive group of the German secret service comprising 13 persons. 4. A spying subversive group of the French secret service comprising 4 persons. 5. A terrorist and spying subversive group of the Latvian secret service comprising 15 persons led by the former deputy factory director Gel’man” (cited by Simonov 1999, p. 290).

Another striking illustration is provided by aeroengine factory no. 19 in Molotov. Here was exposed “an anti-Soviet terrorist disruptive organisation” led by the factory director, chief despatcher, chief metallurgist, and chief engineer. But within a few months it turned out that those appointed to replace the “unmasked wreckers” were themselves members of a “disruptive counterrevolutionary organization” (cited by Simonov 1999, p. 290).

The aviation department of Amtorg was the organization responsible for purchasing aircraft equipment in the United States; its case provides further vivid illustration of the prejudice of the time against the aircraft specialists. By 1938, with manufacture of the Li-2, the Soviet version of the Douglas DC-3 Dakota, only just getting going, none of the aircraft models purchased from the United States had entered serial production. Combined with the fact that most of the Soviet specialists who had gone to America to negotiate their purchase had been arrested, this inclined the Soviet side to look negatively on American technical assistance. In 1938 a joint team from the state bank and the ministry of foreign trade examined a number of the defence industry’s agreements to purchase foreign equipment and technology. They found (GARF, 7523/65/249, f. 2) that these agreements:

… were mainly concluded by enemies of the people and for this reason a significant proportion of them are one-sided or wrecking … The agreements were concluded with firms that are clearly hostile to the USSR, unconditionally not interested in giving us real assistance (Glenn Martin, …. Seversky, …. Douglas, etc.) … Often the agreements were concluded for items that are technically inappropriate for defence requirements. For example, of the agreements concluded by the first chief administration [for military aircraft production] only two (with Douglas and Consolidated) should be recognized as effective, and the remaining agreements for military aircraft with Seversky and [Vultee] and for civilian aircraft with Glenn Martin have no value for us given their tactical and technical backwardness.

The commission reserved its special indignation for the terms on which the agreements were concluded. The auditors clearly could not or did not wish to imagine the conditions and contrivances that the Amtorg representatives had to undertake to make deals for aviation equipment in the United States; instead, they blamed Amtorg for every obstacle that arose whether for
economic or political reasons. The agreement with Douglas, for example, required payment seven months after signature. The commission judged that as soon as payment had been received Douglas had begun to sabotage the agreement’s implementation by delaying deliveries and refusing Soviet engineers access to their facilities; the Amtorg people were guilty of leaving the Soviet side without sanctions in this event. The possibility that a flourishing firm that was marketing the DC3 successfully around the world, faced with a contract overstuffed with restrictive conditions, could simply have refused to sign, was not considered. An additional factor was that “the agreement was concluded by enemy of the people Kharlamov” (GARF, 7523/65/249, f. 3).

There was also severe criticism of the utilization of specialists who had been given foreign apprenticeships. It was claimed that twenty had been placed at the Douglas factory, but only ten had been assigned to factory no. 84 on their return to start up production of the PS-84, the military version of the DC-3; similarly, only five of the 15 trained at Glenn Martin had been assigned to factories nos 31 and 126. But this was a red herring; the fact was that the priceless experience they had gained was relevant throughout the Soviet aircraft industry, not just in the factories listed.

Arrests as a rule followed a pyramidal pattern. Typically they arrested the chief first, and then his subordinates since they were incriminated by association with an “enemy of the people.” This is well illustrated by the verification of staff at factory no. 22 that the commission of party control carried out on 31 May 1937 following the arrest of the director Margolin. The audit documents (GARF, 8418/12/180, f. 28) showed that:

The factory leadership has a weak party stratum. Of nine management staff … two are party members. Acting director Tarasevich is non-party and a former wrecker. Of 20 department heads, 10 are non-party. Of 20 workshop heads 12 are party members, but the most important are headed by non-party persons. The sections where the most secret information about the work of the factory and the most important workshops is concentrated are headed by persons who either have a doubtful past or are Margolin’s protégés. Chief of the planning department V.V. Kondakov was sacked from Aeroflot as an anti-social person, a bureaucrat, and a person demanding specialized screening. He was invited to the factory by Margolin. His deputy Morasanov, party member, was reprimanded in 1936 for association with Trotskyists. Deputy technical director I.L. Degtiarev is a former Menshevik; expelled from the party in 1921 as an alien element; a Margolin protégé. Of 63 leadership personnel investigated only 23 do not have compromising circumstances in the past. The remainder either originate from a socially-alien environment or have previous convictions, links with abroad, etc., or are Margolin’s protégés.

This system was so destructive of production units that by 1939 the issue of its adverse economic consequences was being raised in workplace meetings, at least in a discreet or roundabout way. Thus a party meeting in factory no. 22 affirms that “if the no-good [workshop chief] Kolomenskii was there [in no. 3 workshop] it doesn’t mean that everyone there was no good, but the result has been that they have started to get rid of everyone down to the senior foremen, section chiefs, etc.” (TsAODM, 217/1/49, f. 31).
Even before this the assault on training personnel in the industry had begun to alarm the country’s leaders. The Defence Committee meeting on 25 October 1937 noted “the unacceptability of the wholesale dismissal of all those expelled from the party from factory no. 1. Dismissal should follow careful examination of the materials serving as a basis for expulsion” (GARF, 8418/12/137, f. 46). Evidently it was easier to wind up the fly-wheel of repression than to slow it down. Meanwhile factory no. 1 was regarded as an enterprise with “contaminated” staff personnel. It suffered 602 expulsions from the party, of which 118 had been dismissed by 1938, suggesting that the Defence Committee resolution had had a restraining effect; of those dismissed 10 had been arrested for “espionage.” Of the factory workforce 681 had been reported as having relatives abroad or having lived abroad in the past; 400 had relatives expropriated as kulaks; 24 were former “White guards” and 20 of these had been dismissed; 31 were immigrants of whom 25 had been dismissed; there were 19 former officers or civil servants or the old regime.

Those found guilty of simple theft, however, numbered 200, of whom all but 12 had been dismissed (GARF, 8418/12/137, f. 240). In short, at least half of those “cleaned out” of the factory had been accused not of wrecking but of theft, although the facts of wrecking were not in dispute.

Taking an overview it would seem that punitive measures had been applied at least in part to increase production discipline. On the other hand the political component of the process is undeniable. In December 1937, for example, the former Saratov agricultural combine factory, now no. 292, began to produce aircraft, but the conversion went badly. Unsurprisingly, there was a shortage of skilled staff. The NKVD, especially alert for signs of “socially alien” attributes amongst the defence industry workforce, had weeded out 40 to 50 per cent of its personnel. Engineers were heavily represented among those “cleaned out” (GARF, 8418/12/142, f. 163).

There is now doubt of the adverse consequences of the growing burden of repression on the engineering and technical specialists, especially given their short supply. This was even true of a large, well-established factory like no. 18 in Voronezh. Reported as typical was the following remark by an engineer: “I know very little about aviation and I can’t cope with my duties; I asked them to let me go but they haven’t let me go yet” (GARF, 8418/12/143, f. 171). The industry’s growth was outpacing the supply of skilled engineers year after year. Between 1 January 1933 and 1938 the proportion of engineering and technical personnel with higher education at a leading fighter aircraft factory, no. 21, actually fell from 15.3 to 9.6 per cent (Talanova 1999, p. 93). It is hardly a surprise to find that under such circumstances the managers did quietly try to sabotage the attempts of personnel departments to rid their factories of “socially alien elements” (GARF, 8418/12/143, f. 176).

A particular consequence of the persecution of the specialists was the appearance of charlatans and fraudsters who claimed to have discovered the answer to the industry’s problems. Such people can appear under almost any circumstances, but these were especially favourable for the claims of “unrecognized genius.” On one hand “Red managers” often lacked the professional knowledge to see through fraudulent claims. There was a strong desire to show up the highbrow specialists with revolutionary solutions to the problems that had defeated them. On the other side any who objected were liable to be accused of wrecking or assisting the wreckers. Symptomatic of
this was the saga of a certain Barbashin who eventually succeeded in gaining the attention of minister for the aircraft industry Mikhail Kaganovich. In September 1939 Kaganovich wrote to Nikolai Voznesenskii, deputy chairman of the Defence Committee (GARF, 8418/ 23/1102, f. 121):

… comrade Barbashin, who in 1930 was working at factory no. 22, put forward a proposal for a fundamental reorganization of aircraft production … Despite the obvious absurdity of this proposal, the factory’s former leaders provided funds for its implementation which were expended without any results … From 1935 to 1938 comrade Barbashin more than once proposed also to implement his proposals at factory no. 126 and appealed to comrade Stalin and comrade Molotov … In his letters comrade Barbashin accused all the aircraft industry leaders of wrecking by blocking his proposals … On the proposal of the Defence Committee I appointed a specialist expert commission of authoritative aircraft industry workers … The commission proved that his proposals were impossible to realize.

Comrade Barbashin’s new proposals for factories nos 125 and 126 that have been sent to you are like the old ones in their absurdity. I consider that comrade Barbashin is a abnormal person who achieves nothing and spends his time writing slanderous letters.

For an impression of Barbashin’s proposals it is enough to quote from his long letter to Molotov dated 20 November 1939: “The right solution to this question … is to liquidate everything that has been built up by the enemies of the people, and then go on to expose the present culprits with the facts that have been ascertained!” (GARF, 8418/ 23/1102, f. 124). Despite this Voznesenskii was not satisfied by Kaganovich’s letter and a Defence Committee staff member met with Barbashin. According to the report made to Voznesenskii, “from conversation with Barbashin it is hard to understand his proposals. They amount roughly to the following: ‘give him 300 engineers and a functioning factory for four months and he will produce a lot of aircraft.’ Kaganovich has personally talked to Barbashin and offered to put him in technological charge of a factory (as chief engineer or chief technician) but Barbashin refused” (GARF, 8418/ 23/1102, f. 126).

3.5. Stick Without A Carrot

It is evident that from the beginning of the 1930s the Soviet leadership of considered that it did not need to buy the loyalty of the aviation specialists but rather used the Damoclean sword of repression to keep it in line. When one already has a good stick, why splash out on carrots? Thus, the Aviatrest report of work for 1924/25 remarked (VPR 2003, vol. 2, pp. 841-848):

In so far as technical personnel are in short supply and cannot be attracted from other employments under existing conditions this question is extremely serious. Not a single highly qualified specialist will go to the provinces for the pay we offer. All highly qualified specialists live in Moscow and Leningrad and will not go to Aleksandrovsk or Taganrog on current pay conditions. In the final analysis one must conclude that to attract highly qualified specialists it is necessary to improve their conditions of work.

But there was no such improvement. In 1931 Grigorovich, for example, lived on the site of factory no. 5 in a building which the residents called
Wanzenburg because its equivalent in Russian, Fleapit, sounded too unpleasant. When asked “How are you doing?” Grigorovich usually answered “Like a moth, I’m eating my winter clothes.” The engineer Mil’ who was also living in the Fleapit at the time met Polikarpov in a queue for shoe repairs (Arlazarov 1987, pp. 43-44). Still, defence industry was better supplied with engineers than other branches, as Table 2 shows.

Table 2. Numbers Employed by the ministry of heavy industry (NKTP) and its chief war-mobilization administration (GVMU) in 1933 (daily averages)

<table>
<thead>
<tr>
<th></th>
<th>NKTP Total</th>
<th>GVMU Total</th>
<th>2:1, per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual Workers</td>
<td>2514356</td>
<td>199818</td>
<td>7.9</td>
</tr>
<tr>
<td>Junior Personnel</td>
<td>168832</td>
<td>10685</td>
<td>6.3</td>
</tr>
<tr>
<td>Office Staff</td>
<td>233046</td>
<td>20487</td>
<td>8.8</td>
</tr>
<tr>
<td>Engineers and Technicians</td>
<td>239046</td>
<td>24770</td>
<td>10.4</td>
</tr>
<tr>
<td>Apprentices</td>
<td>193149</td>
<td>22588</td>
<td>11.7</td>
</tr>
<tr>
<td>Total</td>
<td>278348</td>
<td>334842</td>
<td>8.3</td>
</tr>
</tbody>
</table>

Source: Col. 1 from Trud (1934), p. 30; col. 2 from RGAE, 7297/41/57, ff.1-105; RGAE, 7297/41/86, ff. 2-35.

We see that in 1933 the defence enterprises under GVMU employed just over 8 per cent of the total workforce in heavy industry, but more than 10 per cent of the engineers and technicians and nearly 12 per cent of the apprentices. A comparison with light industry would have shown still greater differences.

If we turn from numbers to wages, however, we see from Table 3 that while manual workers and junior personnel in defence industry were paid substantially above the rates available elsewhere, office staff were actually paid less.

Table 3. Earnings in 1933 (rubles and monthly averages)

<table>
<thead>
<tr>
<th>Industry, Group</th>
<th>Industry Total</th>
<th>Group “A” Total</th>
<th>Engineering Industry</th>
<th>Chemical Industry</th>
<th>GVMU Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual Workers</td>
<td>127.17</td>
<td>138.42</td>
<td>151.36</td>
<td>129.81</td>
<td>150.41</td>
</tr>
<tr>
<td>Junior Personnel</td>
<td>83.58</td>
<td>82.71</td>
<td>89.44</td>
<td>87.98</td>
<td>91.50</td>
</tr>
<tr>
<td>Office Staff</td>
<td>186.50</td>
<td>193.36</td>
<td>185.30</td>
<td>198.04</td>
<td>181.30</td>
</tr>
<tr>
<td>Engineers and Technicians</td>
<td>338.42</td>
<td>354.49</td>
<td>348.34</td>
<td>350.45</td>
<td>366.83</td>
</tr>
<tr>
<td>Apprentices</td>
<td>45.08</td>
<td>45.62</td>
<td>43.18</td>
<td>45.26</td>
<td>44.41</td>
</tr>
</tbody>
</table>


Defence industry engineers, in contrast, were definitely in a privileged position. Evidently, those who still “lived like a moth” were no longer the rule. But in the late 1920s and early 1930s the aircraft builders had not yet joined the Soviet elite. Other branches of the defence industry remained the
favourites (Mukhin 2000) and their own specialists still stood first in line for foods and services in short supply.

3.6. Effectiveness of the Stick

The motivation of the aircraft engineers is a complicated question. Those educated before the revolution could easily have chosen to work elsewhere and had freely chosen to live in a Fleapit. Evidently they were drawn by the inner desire to make objects that could fly.

While the industry was permanently short of skilled personnel, it is also the case that its specialists were not used efficiently; sometimes they were diverted from their specialized tasks without explanation. Thus S.M. Alekseev (1995), who worked at time as an engineer in several aviation design bureaux, recalled that:

… about six months before this [i.e. in 1935/36] they sacked me from [the] Il´iushin [bureau] on some suspicion or other and I became unemployed. As it happens the supervisor of my student project had been Dubrovin. I’d gone to the factory (to Il´iushin) on a routine enquiry, and there Aleksei Alekseevich [Dubrovin] met me. ‘What are you up to?’ ‘They sacked me, Aleksei Alekseevich.’ ‘What do you think you’ll do?’ ‘What can I do, I want a job but no one will take me on.’ ‘Here’s what. I’ve been made chief designer at factory no. 301 in Khimki. Go there. The director is Iurii Borisovich Eskin. Say I sent you and that they should sign you up right away for the design bureau.’ Thus I went to Khimki and began to work in the Dubrovin design bureau.

This shows that a skilled engineer who had fallen out with the leadership could be unemployed for a considerable time, with all the material losses that followed from this. If Alekseev had not bumped into Dubrovin his idleness could have been further prolonged. This sort of outcome not only put a brake on the development of the industry, which was already crying out for skilled personnel; it also further poisoned the relationship between the leadership and the other specialists.

This does not mean that specialists were indifferent to incentives. Between 1937 and 1939 new accommodation was built for TsAGI, the famous Central Aero-Hydrodynamic Institute, in the settlement of Stakhanovo, today Zhukovskii, in Moscow’s suburban hinterland. At that time the level of consumer supplies and services beyond the city limits was so sharply below that in the city itself that the TsAGI staff were reluctant to move to “the provinces”. In point of fact there was nowhere to move to. They had built test beds and research laboratories but had forgotten to build residential accommodation. Engineers with the right to reside in Moscow were in no hurry to rent a corner from the local farmers (Petrov 1992, p. 40). The mass relocation of the aviation researchers to the “fresh air” of the countryside began only after supplies in Stakhanovo had been lifted nearer the metropolitan level and some effort had gone to providing apartments for them.

Similar problems affected a number of design bureaux. It was decided to produce the II-2 at factory no. 18 in Voronezh, more than 450 kilometres south of Moscow. Minister of the aircraft industry Shakhurin, who appears to have disliked Il´iushin (Talikov 1999, p. 15), ordered the Il´iushin bureau to be relocated there. Again the Muscovite engineers put up passive resistance to
their removal to “the provinces” and there were mass departures from the team (Chuev 1998, p. 103). To persuade the designer Sukhoi to move to the same factory no. 18 in Voronezh took the personal intervention of minister Mikhail Kaganovich (Kuzmina 1993, p. 51). Somewhat before this a group of engineers was sent from the design bureau of I.F. Nezval’ in Moscow to factory no. 124 in Kazan’, more than 700 kilometres east of Moscow, to start up the serial manufacture of the TB-7 bomber. When the year was up the ministry leadership took a hard line, announcing that while their secondment would not be extended the Muscovites in Kazan’ would be attached permanently to factory no. 124. Rather than lose their right of residence in the capital the Moscow engineers began to leave for home anyway, even if it meant dismissal and loss of employment in aviation (Rigmant 2002, p. 24). To break this mood the ministry managed to secure the upgrading of consumer supplies for the Lenin district of Kazan’ to the same level as the industrial centres (GARF, 8418/22/267, f. 96).

It appears that the ministry leaders were able to learn from these bitter experiences. Thus in May 1939 the serial production of the Kocherygin-designed BB-1 was to start up in Saratov on the Volga, 450 kilometres southwest of Moscow, and it was proposed to relocate the design bureau to the site; the ministry promised from the outset that all the engineers who agreed to move temporarily to the Volga region would be allowed to retain their accommodation in Moscow (RGAE, 8044/1/133, f. 115).

In short, the right to reside in Moscow and the goods and services to which this provided access was much more important to the aircraft engineers at this time than their rate of pay. At the same time there were two different groups among them. The specialists of the older pre-revolutionary school were hardier than the new ones, and were motivated to build aircraft even at the price of living in a Fleapit. The younger generation, mostly products of Soviet higher education, placed the highest valuation on the right of residence in Moscow.

4. Leaders of the Industry
The rapid growth of the aviation industry could hardly have been achieved without active leadership and initiative. For this reason it is interesting to look more closely at the leaders themselves.

Within a dozen years the industry changed from a cottage industry based around a few artisans to a large-scale operation with factories and production lines for serial manufacture. This transition is forever linked with the name of Petr Ionovich Baranov, “father of the Soviet aircraft industry.” Born in 1892, he joined the Bolsheviks at the age of 20. In August 1923 he became a political assistant to the Red Army air force chief and was appointed to head the air force in December 1924. On his proposal the air force established a Scientific and Technical Committee to lay down guidelines for the development of the aircraft industry and aircraft design and equipment as well as for the air force itself (Kharlamov and Shpanov 1933).

In 1931 Baranov was made head of the All-Union Aviation Association VAO which at that time was still within the defence ministry. Compared with leading the air force this could have regarded as a demotion, but Baranov was simultaneously appointed to the industry ministry VSNKh where he became a
deputy minister with responsibility for the aircraft industry. He also became head of the chief administration for civilian aviation at this time (Kilmarex 1962, p. 80). Voroshilov remarked (SR 1999, p. 154) that Baranov “moved over to VAO without any apparent resentment (as far as I could tell) and flung himself into his work so heartily that he was soon proposing to cut back our orders for engines – ‘environment [determines consciousness]’.” When the industry ministry was broken up Baranov joined the ministry for heavy industry as head of the aircraft industry chief administration and deputy minister (IMLS 1983, p. 108). He was killed in an air crash on 5 September 1933. Tupolev (1991, p. 5) wrote:

Basically there were two leaders of aviation, Sergo Ordzhonikidze and Petr Ionovich Baranov … This period was marked by very big movements forward and very much organizational work, as by Sergo so also by Baranov, to provide for the establishment of a large aviation industry.

Factories were rapidly established and much attention was given to this and the state provided a lot of funding. Sergo gave much attention to this cause, and Baranov dedicated all his efforts. Here I want to remark on the scope with which Orzhonikidze and Baranov developed our aircraft industry.

Petr Ionovich considered that our industry should be developed and equipped to the point that in the event of war it could supply of the order of a hundred thousand aircraft. Did he understand the true significance of this number? Everyone who knows how many aircraft we had during the Great Patriotic War can see that he predicted this number pretty well correctly.

After Baranov’s death two candidates were considered for the post of VAO chairman: Alksnis and Lominadze. Pending the final choice, director Korolev of factory no. 26 was appointed to act in this position. Ordzhonikidze used his influence to block the appointment of Lominadze (SR 1999, p. 255). At the end of 1936, the post went to Mikhail Kaganovich (Kostyrchenko 1988).

5. The Technological Culture

The technological culture, by which I mean the degree of conformity to the highest standards at which work should be carried out, is fundamental to aviation. Mass or serial production demands a high level of technological culture. Thus the creation of an aircraft industry involved more than just establishing a number of enterprises and hiring hundreds of skilled artisans to build a few hundred aircraft a year.

5.1. Baranov’s Diagnosis

The level of technological culture was not high at this time. It was difficult for the industry to conform to high standards when the standards themselves were soft. The frequency of alterations to designs and processes was an important influence. Even factory no. 1, the standard bearer of Soviet aircraft manufacture, suffered continually from design variations which themselves frequently corrected for previous “corrections.” After the factory had started
up production of the R-1 reconnaissance aircraft, for example, it received a directive to replace the wooden undercarriage with a metallic assembly. An instruction to overturn the previous directive and revert to wooden undercarriage naturally arrived only after the factory had converted to the metallic one. The drawings for the I-2b fighter reached the factory nine months late; 500 errors had been identified by the time production started.

There were two sides to the process. The purchaser was often a source of delay; the factory produced a batch of 152 I-3 fighters based on a design approved by the Air Force; then the defence ministry required 300 design modifications before it would accept the aircraft. Not surprisingly, a considerable proportion of the batch ended up in the scrapyard (TsAODM, 3/11/722, f. 22). This hardly encouraged the workers to take responsibility for outcomes: “Why bother? We’ll have to do it all over again next month.” It also hindered the stabilization of production processes for a given model.

But the producer was also often at fault. The rapid expansion of aircraft production in the late 1920s and early 1930s inevitably diluted the stratum of skilled workers. Since they were in short supply, their employment share tended to shrink. In 1929 highly skilled workers accounted for 8.5 per cent of the industry workforce and semi-skilled workers for 48 per cent. By 1931 these shares had shrunk to 2 and 28 per cent respectively (Talanova 1999, p. 88). The skill shortage encouraged factories to adapt designs to their own technological capacities, usually to the detriment of design quality.

Air force chief Baranov offered a penetrating diagnosis of the problem (TsAODM, 3/11/722, f. 38). In 1921 the Soviet aircraft industry had been rebuilt from nothing around copied western designs, the R-1 and U-1 aircraft and M-2, M-5, and M-6 aeroengines;

… it has taken the industry eight years to get them into production and even now there are hold-ups everywhere and continual demands from industry to reduce quality standards … From a design standpoint they [the aircraft and engines] are extremely complex and are not fully understood; in some aspects of their operation they yield only to approximate calculation … it takes three to four years for the sort of aircraft the air force needs to get from the commissioning of a design to a prototype and industrial production. In the context of developing Soviet aviation, this lag is completely unacceptable. At this rate an aircraft with design features that would be advantageous in combat would be obsolete by the time it left the factory and suitable at best for training.

The process of developing a new model, according to Baranov, actually went like this: so long as the test results showed some approximate correspondence with the required “tactical-technical characteristics” the Air Force officials gave the nod for it go into serial production, hoping to narrow the gaps, as one would say today, “interactively.” But this often did not work out, leading to procurement refusals, demands for remedial manufacture, and general disruption.

On the other hand the models presented for testing had typically been produced by the hand labour of master craftsmen. When the factory had to adapt it to the requirements of serial production the factory usually introduced simplifications which inevitably led to a worsening of its tactical-technical characteristics. The use of substitutes in the place of materials in short supply
also undermined quality. In Baranov’s view, however, “the basic fault in the work of Aviatrest is working without blueprints, from unauthorized outline sketches that have been crossed out and corrected innumerable times” (TsAODM, 3/11/722, f. 40). Thus it was the low level of production culture that conditioned the extensive character of the industry’s development.

Management attempts to “simplify” designs and adapt them to the usual technological improvisations were a daily occurrence. In July 1932 GUAP abandoned the struggle to make factories build aircraft “as laid down in the blueprints sent from the design bureau” and officially permitted factories to introduce design modifications “to suit the factory” (Talanova 1999, p. 69). Subsequently the industry’s leaders make despairing efforts to break this tendency by circulating threatening decrees on the enforcement of responsibility for technological discipline two or three times a year. There was no discernable improvement, however, until the minister issued decree no. 518 on 2 October 1940. This directive categorically prohibited alteration of designs and blueprints for serial production without preliminary testing and the permission of the chief designer and the minister. It also banned any variation of the approved production process without permission of the factory chief technician, chief engineer, and chief designer, countersigned by the head of the chief administration superior to the factory (Talanova 1999, pp. 111-112). This to some extent reduced the factory’s discretion over the adjustment of designs to fit manufacturing capabilities.

5.2. Treatment and Results

Some responsibility belongs to the workforce and its factory managers for failing to regulate labour utilization effectively. Visiting the United States in 1930, Tupolev (cited by Kerber 1999, p. 50) was astonished not only by the American factories’ technological level but also by the American workers’ attitudes to working time. “Their factories [give] a surprising impression – you walk from one workshop to another and you never see a single idle person. I gave Petr Ionovich [Baranov] a nudge: I bet you’re waiting like me to find some workers standing through this door having a smoke. But there weren’t – we saw nobody smoking or chatting!”

This is not what Tupolev was used to in the Soviet Union. Tupolev believed that the best way to improve discipline was not to punish cigarette breaks more severely but to improve working conditions. He regularly carried out factory inspections and not infrequently uncovered scandalous facts: once he found a fishbone in a glass of stewed fruit juice; another time he marched a factory director to the workers’ toilet and lectured him on the relationship between filth and product quality (Kerber 1999, p. 53).

The general level of working culture was not particularly high, however, even in the leading factories. A report on factory no. 1 notes: “Labour discipline low. The workers drink, a great deal at times, and turn up drunk, especially after being paid … The factory is severely lacking in higher and middle technical personnel and skilled workers” (TsAODM, 3/11/726. ff. 47-50). A serious bottleneck was the low proportion of working time that was used productively. In a lecture on “Modern Aircraft Abroad” (cited by Ivanov 1995, pp. 150-151) the designer Polikarpov lamented:

Reading our newspapers we see that in a number of branches we find the phenomenon of so-called storming [shturmovshchina] when 50 to 60 per
cent of the production programme is completed in the last week of the month, but [only] 2 or 3 per cent in the first week … I am always amazed by the planning and discipline that exist abroad. You arrive at the factory and you see that no one is in a rush, everyone is working calmly.

If they see you, even if they take a break, it doesn’t break into their work. You think: working like that, how can they get first-class results? It turns out that of the eight or nine hours that they spend at work each day they are actually working eight or nine hours; meanwhile we are rushing around, doing something or other, but actually working two or three hours a day and we have no idea how we spend the rest of the time without making an input.

Even if he exaggerated for effect, for two to three hours of real work per shift is surely too little, Polikarpov’s overall judgement is supported by other evidence. The party central committee’s industrial department, for example, investigated aircraft factories nos 24 and 29 in connection with their successful completion of the 1936 annual plan. The audit established that in the first ten months of the year only 57 per cent of the aircraft plan had been completed, and 76 per cent of the aeroengine plan (GARF, 8418/11/103, f. 43). The lag of reality behind the plan that gave rise to the need for storming had accumulated not only within each month but also across the months of the year. In short, the bitter words of Polikarpov were not exactly news for the industry’s leaders. The investigation defined the industry’s management problems in the mid-1930s quite precisely (GARF, 8418/11/103, ff. 47-49):

Managers rely on storming instead of production improvement. In the first nine months of 1936 in just seven factories (no. 1, 21, 22, 23, 24, 26, and 29) there were 3,156,000 hours of downtime and 5,676,000 hours of overtime. Substandard goods made up 31.4 per cent of the value of commodity output of factory no. 29 and 15 per cent for factory no. 24. The current Sovnarkom decree on factories’ material accountability for substandard goods is not normally enforced. Chief Brandt of no. 2 machinery workshop, factory no. 24, claims: ‘We are afraid to fine shoddy workers since even without that we are experiencing a labour shortage.’ A very large proportion of substandard work is the consequence of unpunished violations of production processes and weak labour and technological discipline … Those who violate labour discipline are often leading factory employees. As a rule the workshop chiefs at factory no. 22 go home at midnight or 1 a.m.; at least five times a month the director holds meetings with the workshop chiefs that begin not earlier than 11 p.m. and finish at 3 or 4 a.m. Because of this the workshop chiefs are usually late to work …

When the [overall] programme is not completed the great majority of workers [still] overfulfill their [individual] work norms. At factory no. 1 only 4 per cent of the workers have not fulfilled their norms. Factory no. 22 has fulfilled [only] 40 per cent of the annual programme, but less than 7 per cent of workers have not fulfilled their norms. Factory no. 31 has fulfilled 18 per cent of the programme, but only 28 workers have not fulfilled their norms. A huge quantity of worktime is spent on substandard
work, repairs, and remedial work. There is colossal labour turnover, 25 per cent in total across the aircraft industry.

In some respects the aircraft industry came out ahead of other high-technology sectors. It led, for example, in its approach to pay and incentivs. In 1930, for example, 65 per cent of the employees of factory no. 1 were on piece rates (TsAODM, 3/11/726, f. 52) compared with only 42 per cent at another technologically advanced enterprise, the Moscow Elektrozavod (TsMAM, 2090/1/581, f. 4). But this lead was not maintained. In 1938-39 less than 62 percent of the total working time in the aircraft industry was paid by piece rates (RGAE, 8044/1/ 2748, f. 2ob), less than the 63 per cent recorded in 1932 (Samoletostroenie 1992, p. 420). One explanation may be that factory no. 1 was untypical; it was one of the oldest plants not just in the industry but in the country. It was beyond the capacity of the newer factories, often scattered far from the established industrial centres and plagued by recruitment difficulties, to catch up in this regard.

The Stakhanov movement did not pass by the aircraft industry. In 1936 no less than 1758 or the 8452 employees of factory no. 19 were registered Stakhanovites (GARF, 8418/11/100, f. 16). This certainly gave some striking results. Before Stakhanovism it took two workers per shift to produce seven or eight rear engine covers. By comparison the equivalent rate at US factories was 10, and even factory no. 19 managed 9. Using Stakhanovite methods two workers, Fedineev and Tot, raised the rate to 18. Their earnings per shift also rose from 10 or 11 rubles to 25 to 30 rubles. This was a real achievement. But it could not be generalized to all lines of work or all factories (Mukhin 2003).

5.3. Some Comparisons

We will now compare the position of workers in the aircraft industry with that in other defence branches. The aircraft industry was to some extent gathering weight at this time, its employment share in the ministry of defence industry rising from 17 per cent in 1933 to 19 per cent in 1936 (RGAE, 8044/1/ 2737, f. 2). Table 3 shows that throughout the second five-year plan period ruble productivity in the aircraft industry was below that for the entire defence industry; wages, on the other hand, were higher:

Table 4. Gross Output per Manual Worker and Manual Workers’ Average Earnings, 1933 to 1936 (rubles)

<table>
<thead>
<tr>
<th></th>
<th>Aircraft Industry</th>
<th>Defence Industry as a whole</th>
<th>Manual Workers’ Average Earnings</th>
<th>Aircraft Industry</th>
<th>Defence Industry as a whole</th>
</tr>
</thead>
<tbody>
<tr>
<td>1933</td>
<td>7560</td>
<td>7428</td>
<td>2016</td>
<td>1583</td>
<td></td>
</tr>
<tr>
<td>1934</td>
<td>8652</td>
<td>8712</td>
<td>2328</td>
<td>1769</td>
<td></td>
</tr>
<tr>
<td>1935</td>
<td>8928</td>
<td>9397</td>
<td>2820</td>
<td>2200</td>
<td></td>
</tr>
<tr>
<td>1936</td>
<td>11304</td>
<td>11779</td>
<td>3648</td>
<td>2649</td>
<td></td>
</tr>
</tbody>
</table>

Source: RGAE, 8044/1/ 2737, ff. 3-4.

The aircraft industry’s rated their own capability to regulate wages as low. Deputy minister Kaganovich reported in 1936 (GARF, 8418/22/34, f. 12):
In 1934-5 issues of wage organization in the aircraft factories were set aside. No one from the chief administration or the factories really engaged with these issues. There was a labour department in the chief administration, weak in both numbers, 5 persons, and in their make-up. It was headed by an enemy of the people. He had no authority in the factories. At the factories labour issues were scattered under different headings … wages, payment accounts, and incentive systems were dealt with dealt with in factory planning departments, while technological departments dealt with norm setting and piece rates. At the largest works [only] one to three people dealt with wage issues. There was one at factory no. 39 and two at factory no. 18. In factory plans wage issues were regarded as subsidiary and did not get enough attention so that wage-levelling, large unjustified side-payments, and distorted norms and piece-rates ruled on the shop floor.

It is relevant to note, however, that this was not self-criticism; Kaganovich was criticizing his predecessors and had a clear interest in portraying the state of affairs that he had inherited as one of gloom and desolation so as to puff up his own achievements.

We noted above that by 1932 the aircraft industry already had a high proportion of its workers on piece rates. In other respects, however, the wages policy of the early 1930s does not look so good. Many different pay scales were in effect at different enterprises: in 1935 there were no less than 50. On the grade I scale there were 28 different points for time workers and 28 for piece workers. Characteristically, the ratio of grade VIII to grade I pay varied between 2.58 and 2.83 to one (GARF, 8418/22/34, f. 17). Thus there was little incentive for workers to acquire new skills and win promotion from grade to grade. In an attempt to break with this situation the industry leadership attempted to review work norms and restructure pay scales in 1936. The number of points on the grade I scale was cut back from 56 to 20. In 1938 it was intended to cut back the number of points to five for the Moscow region and 10 for the whole country. The grade VIII to I ratio was increased to 3.5 to one in order to increase incentives. This degree of wage inequality was relatively uncommon in the Soviet economy at that time; for example, at the Moscow Elektrozavod it varied between 2.8 and 3 to one (TsMAM, 2090/1/579, f. 3ob., TsMAM, 2090/1/1686, f. 16). Piece workers were paid one third more than time workers as a rule.

As shown above, the share of intellectual work in the defence branches was above the average for industry as a whole. Table 5 shows that, while total employment in the aircraft industry rose by one half, the share of engineering and technical specialists rose from less than 12 per cent to over 14 per cent. The shares of manual workers and junior personnel also increased, so that the shares of office staff and apprentices fell back; the number of apprentices declined absolutely. The shrinkage of apprenticeships was reversed in 1936 because of the appearance of a new category: “adult apprentices,” i.e. workers who were being assimilated to new occupations (RGAE, 8044/1/2737a. ff. 6-7). Evidently this symbolized the induction of new masses of unskilled workers into the industry. The basic proportions of manual and specialist workers, however, persisted through 1937 and 1938 (RGAE, 8044/1/2750a. ff. 95-97).
Table 5. Numbers Employed in Enterprises of the First Chief Administration of the Defence Industry

<table>
<thead>
<tr>
<th>Year</th>
<th>Manual Workers</th>
<th>Engineers and Technicians</th>
<th>Office Staff</th>
<th>Junior Personnel</th>
<th>Apprentices</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1932</td>
<td>63182</td>
<td>11284</td>
<td>10560</td>
<td>3027</td>
<td>7474</td>
<td>95527</td>
</tr>
<tr>
<td>1933</td>
<td>66728</td>
<td>11989</td>
<td>9465</td>
<td>3568</td>
<td>6355</td>
<td>98105</td>
</tr>
<tr>
<td>1934</td>
<td>79530</td>
<td>14070</td>
<td>9825</td>
<td>4729</td>
<td>4623</td>
<td>112777</td>
</tr>
<tr>
<td>1935</td>
<td>89427</td>
<td>17811</td>
<td>11537</td>
<td>6434</td>
<td>4394</td>
<td>129603</td>
</tr>
<tr>
<td>1936</td>
<td>102521</td>
<td>21118</td>
<td>12289</td>
<td>7792</td>
<td>4867</td>
<td>148587</td>
</tr>
</tbody>
</table>

Per cent of total

<table>
<thead>
<tr>
<th>Year</th>
<th>Manual Workers</th>
<th>Engineers and Technicians</th>
<th>Office Staff</th>
<th>Junior Personnel</th>
<th>Apprentices</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1932</td>
<td>66.1</td>
<td>11.8</td>
<td>11.1</td>
<td>3.2</td>
<td>7.8</td>
<td>100.0</td>
</tr>
<tr>
<td>1933</td>
<td>68.0</td>
<td>12.2</td>
<td>9.6</td>
<td>3.6</td>
<td>6.5</td>
<td>100.0</td>
</tr>
<tr>
<td>1934</td>
<td>70.5</td>
<td>12.5</td>
<td>8.7</td>
<td>4.2</td>
<td>4.1</td>
<td>100.0</td>
</tr>
<tr>
<td>1935</td>
<td>69.0</td>
<td>13.7</td>
<td>8.9</td>
<td>5.0</td>
<td>3.4</td>
<td>100.0</td>
</tr>
<tr>
<td>1936</td>
<td>69.0</td>
<td>14.2</td>
<td>8.3</td>
<td>5.2</td>
<td>3.3</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Source: RGAE, 8044/1/2737, f. 37.

Table 6, showing the distribution of manual workers across pay grades, suggests that their skills were average for the Soviet economy at the time.

Table 6. Manual Workers in the Aircraft Industry: Numbers by Pay Grade, 1937 (per cent of total)

<table>
<thead>
<tr>
<th>Grade</th>
<th>Number</th>
<th>Grade</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>5.3</td>
<td>V</td>
<td>14.0</td>
</tr>
<tr>
<td>II</td>
<td>22.5</td>
<td>VI</td>
<td>8.6</td>
</tr>
<tr>
<td>III</td>
<td>25.1</td>
<td>VII</td>
<td>4.1</td>
</tr>
<tr>
<td>IV</td>
<td>18.5</td>
<td>VIII</td>
<td>1.9</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>100.0</td>
</tr>
</tbody>
</table>

Source: GARF, 8418/22/34, f. 18.

The nominal pay of all workers in the industry (Table 7) approximately doubled between 1932 and 1936; earnings of manual workers and junior personnel rose somewhat faster while those of office staff lagged behind.

Table 7. Average Earnings in the Aircraft Industry (rubles per head and per cent)

<table>
<thead>
<tr>
<th>Year</th>
<th>Manual Workers</th>
<th>Engineers and Technicians</th>
<th>Office Staff</th>
<th>Junior Personnel</th>
<th>Apprentices</th>
</tr>
</thead>
<tbody>
<tr>
<td>1932</td>
<td>1788</td>
<td>3852</td>
<td>1956</td>
<td>948</td>
<td>456</td>
</tr>
<tr>
<td>1933</td>
<td>2016</td>
<td>4272</td>
<td>2160</td>
<td>1020</td>
<td>480</td>
</tr>
<tr>
<td>1934</td>
<td>2328</td>
<td>5028</td>
<td>2544</td>
<td>1332</td>
<td>588</td>
</tr>
<tr>
<td>1935</td>
<td>2820</td>
<td>6036</td>
<td>2976</td>
<td>1908</td>
<td>840</td>
</tr>
<tr>
<td>1936</td>
<td>3648</td>
<td>7536</td>
<td>3480</td>
<td>2208</td>
<td>864</td>
</tr>
</tbody>
</table>

1936, per cent of 1932:

<table>
<thead>
<tr>
<th></th>
<th>Manual Workers</th>
<th>Engineers and Technicians</th>
<th>Office Staff</th>
<th>Junior Personnel</th>
<th>Apprentices</th>
</tr>
</thead>
<tbody>
<tr>
<td>1936</td>
<td>204</td>
<td>196</td>
<td>178</td>
<td>233</td>
<td>189</td>
</tr>
</tbody>
</table>

Source: RGAE, 8044/1/2737, f. 37.
Since the engineering and technical workforce could not be put on piece rates much ingenuity went into working out alternative incentive schemes. They were rewarded mainly on the basis of the degree of fulfillment of the production plan and cost reductions and penalized for the supply of substandard goods. Those whose work was reflected in the results of a unit below the level of a workshop were rewarded on the basis of results of both unit and workshop; those who contributed directly to the results of the workshop as a whole were rewarded by the results of both workshop and factory (GARF, 8418/22/34, f. 22).

The relative pay of engineers and technicians had an important influence on production. Engineers were paid on the basis of rates laid down in a handbook for the industry approved in 1932. By the second half of the 1930s it was already out of date. A significant proportion of the posts now arising had not been foreseen and the pay for others was falling behind that of manual workers. The same was happening to office workers. The aircraft industry leadership complained that “Valuable employees are transferring to manual employment and getting a 25 to 30 per cent pay increase, and the result is that production is being deprived of literate ledger clerks, accountants, and time keepers” (GARF, 8418/22/34, f. 28).

Table 8. Productivity and the Quality of Work in the Aircraft Industry, 1932 to 1937

<table>
<thead>
<tr>
<th>Year</th>
<th>Gross Value of Output per Manual Worker (rubles and plan prices of 1926/27)</th>
<th>Total Losses From Substandard Products at Prevailing Prices</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Thousand rubles</td>
<td>Per cent of gross output at cost</td>
</tr>
<tr>
<td>1932</td>
<td>6 862</td>
<td>39 586</td>
</tr>
<tr>
<td>1933</td>
<td>8 840</td>
<td>43 881</td>
</tr>
<tr>
<td>1934</td>
<td>9 936</td>
<td>60 824</td>
</tr>
<tr>
<td>1935</td>
<td>10 553</td>
<td>88 545</td>
</tr>
<tr>
<td>1936</td>
<td>13 493</td>
<td>108 145</td>
</tr>
<tr>
<td>1937</td>
<td>15 993</td>
<td>133 525</td>
</tr>
</tbody>
</table>

Source: RGAE, 8044/1/2750a, f. 1.

The year 1935 was one of rapid progress. Following it, as Table 8 shows, there was a significant breakthrough in both average productivity and losses from shoddy work.

The fact that engineers’ pay kept pace with that of the manual workers must have been largely due to the higher average seniority of the specialists compared with that of the workers among whom there was much higher turnover and who were therefore newly recruited to a much higher degree; this is shown in Table 9. Well over half the manual workforce in the aircraft industry had less than two years’ seniority and less than one third had more than three years. In contrast, almost one half of the specialist workers had three years’ seniority. This also helped them to maintain their relative pay.
Table 9. Manual Workers and Engineering and Technical Workers: Seniority on 1 November 1939

<table>
<thead>
<tr>
<th>Length of Service</th>
<th>Manual workers</th>
<th>Engineers and technicians</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Thousands</td>
<td>Per cent</td>
</tr>
<tr>
<td>0 to 6 months</td>
<td>58</td>
<td>22</td>
</tr>
<tr>
<td>6 months to 1 year</td>
<td>42</td>
<td>16</td>
</tr>
<tr>
<td>1 to 2 years</td>
<td>50</td>
<td>19</td>
</tr>
<tr>
<td>2 to 3 years</td>
<td>36</td>
<td>12</td>
</tr>
<tr>
<td>3 to 5 years</td>
<td>37</td>
<td>14</td>
</tr>
<tr>
<td>5 to 6 years</td>
<td>14</td>
<td>5</td>
</tr>
<tr>
<td>6 to 10 years</td>
<td>24</td>
<td>9</td>
</tr>
<tr>
<td>10 years and more</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>All workers</td>
<td>265</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: RGAE, 8044/1/2748, f. 2ob.

When earnings in the aircraft industry are compared with those available in other defence branches, it transpires (Table 10) that the aircraft workers were obtaining a small premium of around 5 per cent which was fairly stable and was present in all years except 1935 when other branches temporarily caught up; the following year the aircraft industry differential was restored. The aristocracy of the defence industry, however, was in the shipyards.

Table 10. Annual Average Earnings of Manual Workers in the Defence Industry, 1933 to 1938, by Branch (per cent of the aircraft industry)

<table>
<thead>
<tr>
<th>Year</th>
<th>Shipbuilding</th>
<th>Artillery and Shell</th>
<th>Munitions</th>
<th>Radio Equipment</th>
<th>Chemical Weapons</th>
<th>Armoured Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td>1933</td>
<td>110</td>
<td>94</td>
<td>76</td>
<td>97</td>
<td>92</td>
<td>97</td>
</tr>
<tr>
<td>1934</td>
<td>114</td>
<td>96</td>
<td>78</td>
<td>91</td>
<td>97</td>
<td>91</td>
</tr>
<tr>
<td>1935</td>
<td>118</td>
<td>100</td>
<td>86</td>
<td>96</td>
<td>111</td>
<td>94</td>
</tr>
<tr>
<td>1936</td>
<td>115</td>
<td>97</td>
<td>81</td>
<td>87</td>
<td>110</td>
<td>88</td>
</tr>
<tr>
<td>1937</td>
<td>118</td>
<td>96</td>
<td>79</td>
<td>92</td>
<td>103</td>
<td>91</td>
</tr>
<tr>
<td>1938</td>
<td>130</td>
<td>101</td>
<td>84</td>
<td>91</td>
<td>99</td>
<td>90</td>
</tr>
</tbody>
</table>

Source: RGAE, 8044/1/2750a, f. 80.
It is important to bear in mind that the position of different aircraft factories varied substantially. Those in Asia suffered the worst labour shortages. In the spring of 1937, for example, factory no. 126 (Komsomol’sk on Amur) had 2860 employees compared with an establishment strength of 3600; 200 of these were “former” people who had “socially alien” origins. The factory had no access to white bread. Its need for black bread was put at 25 tons per day, but only 16 to 18 tons were being baked so that long queues formed in consequence. The list of goods for July of which the employees had only fond memories is startling: pasta, none since 1 March; fresh fish, none since 1 June; sugar, none since 10 June “and it is not known when there will be” (GARF, 8418/12/143, f. 164-168). There was no flour or milk on sale, but since what date is not stated. Worse than these, the poor accommodation, lack of children’s foodstuffs, and absence of medical care in the factory settlement were leading to epidemics and high mortality among the children (GARF, 8418/12/143, f. 164).

It goes without saying that factory no. 1 was immune to this kind of deprivation. Even so, the factories on European territory had their own problems. The workers of the Rybinsk factory no. 26, for example, complained that they had received no smoked foodstuffs such as sausage for months, and no oil or fats for weeks. Much of the foods allocated centrally from Moscow were “lost” by the local supplier in Ivanovo (GARF, 8418/19/9, f. 42).

Factory no. 22, one of the oldest and largest aircraft plants, suffered from a persistent housing shortage. For 19,236 persons dependent on factory housing in April 1928 there were 72,833 square metres of space available, i.e. 3.8 square metres per person compared with a sanitary norm of 8 square metres. Nearly half of this population, 8874 people, lived in “piled-up wooden shacks of a temporary kind that have been in use for 10 to 12 years” (GARF, 8418/12/180, f. 15). A particularly acute problem was the 2,100 workers who had requested to be classified as in acute housing need. It would not be possible to meet their requests since from 1934 to 1938 the factory had not built a single housing unit (GARF, 8418/12/180, f. 1). For a while the factory management had managed the problem by hiring only family members of existing employees. By 1936, however, when the number of those not seeking additional housing space was down to 3,500, this source of recruitment was exhausted; moreover the factory faced the need to hire 2,000 more workers in order to fulfill a plan while the issue of how to accommodate them had not been considered (GARF, 8418/12/180, f. 21). In 1938 the factory’s production programme was doubled, requiring the further recruitment of 7,000 employees. There was no possibility of meeting this target without more housing (GARF, 8418/22/271, f. 11). Only at this point did the factory succeed in “carving out” 25 standard housing blocks and sites under construction “on the account of other ministries” (GARF, 8418/22/271, f. 6), i.e. by robbing Peter to pay Paul.

The same mechanism of exploiting the urgency of high-priority government assignments to solve morbid issues arising from everyday life was used by various factory managers. In 1938, for example, when it became urgent to bring the new I-153 fighter into serial production, the industry leadership succeeded in getting the Defence Commission to order the Moscow
city soviet to build three multi-story apartment blocks for factory no 1 to be ready not later than the third quarter of 1939 (GARF, 8418/22/266, f. 5).

5.4. Downtimes and Emergencies

The irregular pace of production of the aviation industry eventually led workers not only to adapt to their environment but to gain from maintaining the status quo. Here the leaders of factory no. 22 describe how the plan was fulfilled in 1938 (TsAODM, 217/1/98, f. 92):

Until the 15th of the month the assembly line stood still. In 15 [more] days we [had to] achieve the programme; that is why there was no final assembly going on, that is why everybody was on downtime. But in this situation someone had ‘caught a fish in muddy water’ because when the 20th came and it was clear that we would not make the programme the factory director came onto the shop floor and talked to the foremen, and then when he saw that nothing was happening he said: ‘Here’s so much money for you, now get stuck in.’ And they got stuck in.

On one hand the factory managers had to bow to the judgement of the skilled craftsmen who were the experts in how to “get stuck in.” On the other hand it is clear that the same experts were the ones who profited most from the situation. In addition to the respect they won from management, they also gained in overtime rates of pay. Corresponding to this was the spread of overtime that is seen in Table 11.

Table 11. Downtime and Overtime in the Aircraft Industry, 1938 and 1939

<table>
<thead>
<tr>
<th></th>
<th>1938</th>
<th>1939</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thousand hours:</td>
<td>385.4</td>
<td>465.5</td>
</tr>
<tr>
<td>Total worked</td>
<td>385.4</td>
<td>465.5</td>
</tr>
<tr>
<td>Overtime</td>
<td>16.0</td>
<td>27.3</td>
</tr>
<tr>
<td>Downtime</td>
<td>8.4</td>
<td>8.8</td>
</tr>
<tr>
<td>Per cent of total:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overtime</td>
<td>4.2</td>
<td>5.9</td>
</tr>
<tr>
<td>Downtime</td>
<td>2.2</td>
<td>1.9</td>
</tr>
</tbody>
</table>

Source: RGAE, 8044/1/2748, f. 2ob.

Aircraft industry leaders were especially worried by the rapid growth of overtime towards the end of this period (Table 12).

Table 12. Downtime and Overtime Per Worker in the Aircraft Industry, January to October 1939 (monthly average and per cent of total time worked)

<table>
<thead>
<tr>
<th></th>
<th>Overtime</th>
<th>Downtime</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quarter 1</td>
<td>5.8</td>
<td>3.6</td>
</tr>
<tr>
<td>Quarter 2</td>
<td>7.1</td>
<td>2.5</td>
</tr>
<tr>
<td>Quarter 3</td>
<td>7.8</td>
<td>2.4</td>
</tr>
<tr>
<td>October</td>
<td>14.4</td>
<td>3.2</td>
</tr>
</tbody>
</table>

Source: RGAE, 8044/1/2750, f. 17.

The efforts to accelerate production seem to have disrupted working patterns in that overtime and downtime began to rise simultaneously.

Overtime payments were not a large proportion of pay, however; of manual workers’ earnings in the first nine months of 1939, only 3.5 per cent
came from overtime; almost two thirds of earnings were made up by piece rates and bonuses based on piece rate norms (RGAE, 8044/1/2750, ff. 9-10).

It was hard for managers to restrain earnings from piece rates, which tended to grow rapidly. In 1939 the ministry was increasingly convinced of the necessity for an urgent review of work norms. Many workers were fulfilling out-of-date norms with ease and claiming large payments on this basis. At the same time the ministry was struggling to fulfill its production programme (Table 13). The revision of work norms is discussed further below.

Table 13. The Fulfillment of Production Plans and Work Norms in Aircraft Factories, January to October 1939 (per cent)

<table>
<thead>
<tr>
<th>Factory No.</th>
<th>Production Plan Fulfillment</th>
<th>Work Norm Fulfillment</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>86.0</td>
<td>208</td>
</tr>
<tr>
<td>21</td>
<td>73.1</td>
<td>172</td>
</tr>
<tr>
<td>22</td>
<td>97.2</td>
<td>159</td>
</tr>
<tr>
<td>153</td>
<td>73.9</td>
<td>139</td>
</tr>
</tbody>
</table>

RGAE, 8044/1/2750, ff. 10-11.

Long-service employees, the “labour aristocrats,” cohabited with a much larger number of migratory workers who contributed to very high turnover. At Factory no. 45, for example, with a workforce of 1,500, more than 1,000 employees left and were taken on in just 11 months of 1939 (RGAE, 8044/1/401, f. 8). Turnover, moreover, was on an upward trend (Table 14). While the high rate of hirings can be explained by the industry’s rapid expansion, the high rate of departures is a less favourable indicator.

Table 14. Turnover of Employees in Aircraft Factories, 1938 and 1939

<table>
<thead>
<tr>
<th></th>
<th>1938</th>
<th>1939</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thousands:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hired</td>
<td>108.7</td>
<td>151.1</td>
</tr>
<tr>
<td>Left</td>
<td>77.6</td>
<td>113.4</td>
</tr>
<tr>
<td>Per Cent of Employees:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hired</td>
<td>50.9</td>
<td>61.1</td>
</tr>
<tr>
<td>Left</td>
<td>36.3</td>
<td>45.9</td>
</tr>
</tbody>
</table>

Source: RGAE, 8044/1/2748, f. 2ob.

Sometimes, turnover was attacked by non-traditional means. Thus on 23 September 1938 decree no. 266ss/ov transferred factory no. 22 to a state of mobilization, meaning that the employees liable to conscription were counted as being on active service. They carried on as members of the trade union but could no longer take part in arbitration or grievance procedures that concerned labour discipline, departures, or transfers to other work. Those mobilized came instead under the jurisdiction of military tribunals and the Red Army code of discipline (GARF, 8418/23/386, f. 1.; GARF, 8418/23/952, f. 1). This resolved the problem of turnover. The method was soon extended to recruitment. On 23 November 1938 the defence ministry called up 2,500 skilled workers and transferred them to factory no. 22 (GARF, 8418/23/386, f. 4). By 21 March 1939 11,000 of the factory employees had the status of Red Army servicemen (GARF, 8418/23/386, f. 9).
There was a spoonful of tar in this honeypot, however. The mobilized worker could not leave, but nor could he be sacked. The result was a rapid decline in discipline (GARF, 8418/23/386, ff. 20-21). The mobilization also gave rise to a series of administrative idiocies. The local police would not grant residence permits to workers without passports, which those mobilized were required to deposit with the ministry of defence. This did not only impede the reception of newly recruited workers into the factory hostels but even threatened the expulsion of 202 factory employees who were already living there. If this could eventually be sorted out, things went worse with the penalization of absentees and shoddy workers who wore a uniform. As servicemen they could not be punished under the civilian labour code. At the same time the military prosecution service refused to get involved on the grounds that it had no legal basis to act (GARF, 8418/23/386, ff. 24-25).

Despite this the factory management considered that the advantage of putting a stop to voluntary turnover more than made up for the other defects of the new system. Defence Commission decree no. 108ss of 7 May 1939 empowered the factory management to fix overtime, subject to the minister’s agreement but not that of the trade union; the only concession to the mobilized workers was a percentage markup on the basic wage based on the duration of unbroken employment at the factory (GARF, 8418/23/386, f. 1).

As early as July 1939 the factory no. 22 director was requesting more contingents of mobilized workers (GARF, 8418/23/386, f. 4); this suggests that, at the very least, the management was adjusting to the new system. At the same time, however, the general tone of its reports indicates that worker discontent was rising and the management was still looking for ways to improve worker incentives. Evidently, even mobilized workers still needed something positive to work for. Thus a Defence Commission decree of August 1939 authorized the seniority premium created by the July decree to be calculated on workers’ actual earnings rather than their basic wage; this was of some importance since earnings usually exceeded wage rates by a substantial margin (Table 15).

Despite this, on 4 July 1940 the experiment was terminated and all the workers were returned to civilian status. Evidently, militarization had been judged ineffective.

Table 15. Pieceworker’s Basic Monthly Wage and Average Actual Monthly Earnings Based on 175 Hours Worked, May 1939 (rubles)

<table>
<thead>
<tr>
<th>Grade</th>
<th>Wage Rate</th>
<th>Actual Earnings</th>
</tr>
</thead>
<tbody>
<tr>
<td>II</td>
<td>220</td>
<td>322</td>
</tr>
<tr>
<td>III</td>
<td>266</td>
<td>405</td>
</tr>
<tr>
<td>IV</td>
<td>322</td>
<td>495</td>
</tr>
<tr>
<td>V</td>
<td>386</td>
<td>620</td>
</tr>
<tr>
<td>VI</td>
<td>459</td>
<td>750</td>
</tr>
</tbody>
</table>

Source: GARF, 8418/23/952, f. 4.

6. The Prewar Spurt

War preparations tended to militarize the management of industry. In June 1940 the Supreme Soviet presidium adopted its well known “Decree on
Transition to an 8-Hour Working Day and 7-Day Working Week and Prohibition of Voluntary Departure of Manual and Office Workers From Enterprises and Establishments” (IVMV 1974, vol. 3, p. 374). Serfdom and indentured labour had returned, although not only to the Soviet Union: Germany had enacted similar measures in April 1939. These provisions limited turnover but did not prevent it completely; in the aircraft industry it fell from 45 percent of average employment in 1939 to 34 per cent in 1940 (RGAE, 8044/1/2775, f. 20).

In the course of 1940 the pace of work was intensified in the aircraft factories (Mukhin 2004); managers gained the right to introduce overtime on their own authority and to introduce two or three shift working in workshops and entire factories. Plans for the last quarter of 1940 and the first of 1941 envisaged average overtime of two to three hours per worker (RGAE, 8044/1/674, f. 44). Increased overtime was often associated, however, with deterioration in the coordination of work. At factory no. 18, for example, downtime in the first quarter of 1941 stood at 5 per cent of total working time while overtime stood at 7.8 per cent (RGAE, 8044/1/674, f. 65). If the downtime could have been eliminated, the overtime could have been cut by two thirds.

While the overall capacity of the aircraft industry grew extensively in the last prewar years, the forcing of the pace had some adverse results. First was that, as new factories sprang up, the thin layer of skilled personnel was further diluted and labour productivity fell. This was the starting point for a whole series of further ramifications. Downtime per worker jumped from 37 hours in 1939 to 61.4 hours in 1940, leaving more than 3 per cent of working time idle (RGAE, 8044/1/2775, ff. 20-21).

The picture of management and skill shortages is conveyed by a sequence of anecdotes. On 4 December 1937 the Defence Committee ordered “factory no. 24 director Mar’iamov to be removed from the position of director as not coping with business. To appoint I.T. Borisov director” (GARF, 8418/12/142, f. 54). On 1 January 1939 a decree of the eighteenth chief administration of the ministry of defence industry ordered “deputy director [of factory no. 24] Borisov P.A. to be relieved of duties for repeated crude violation of budgetary and financial discipline and to be employed in less responsible work. To name factory no. 24 director Borisov for toleration of violation of financial and budgetary discipline” (TsMAM, 690/1/135, f. 5; there is no evidence of kinship between the two Borisovs but it is hard to imagine that the director was out of the picture when the deputy was engaged in “crude violation”). On 13 January the ministry of the defence industry resolved in decree no. 16/k “1. To remove comrade Borisov I.T. from the work of director of factory no. 24; 2. to appoint comrade Sokolov D.M. as director of factory no. 24, relieving him of work as director of factory no. 20” (TsMAM, 690/1/135, ff. 2, 8, 24). Finally, on 20 January, factory no. 20 was given a new director: I.T. Borisov. In short, the outcome of this series of revelations and reprimands was that a man found to be incompetent in charge of one factory was put in charge of another. Clearly the number of suitable candidates fell far short of the number of vacant posts.

The crisis extended to the workforce as whole. From 1939 there was massive compulsory recruitment of skilled but untrained workers into the aviation enterprises; these workers were to learn on the job, while engaged in
production on the shop floor. Many of them had earned 7 to 11 years’ seniority in their previous posts; they tended to resent their compulsory reclassification because it threatened loss of status and downgrading of their pay. To compensate for the compulsion involved these new workers were allowed to keep the seniority earned in their previous employments.

The older “cadre” factories were literally swamped by the new workers. In 1940 the industry as a whole took in 30,000 skilled but untrained workers (Samolotostroenie 1994, p. 200). Some work groups doubled in size. When workshop chiefs refused to take untrained recruits the director of factory no. 22 gloomily replied: “No one is going to give us trained assembly workers, riveters or mechanics” (TsAODM, 217/1/49, ff. 14-15). There were none to be had.

In some workshops the level of substandard products rose to 50 per cent. The situation was complicated by the fact that factories were supposed to train the new workers and raise output at the same time. The 1939 production plan for factory no. 22 was twice that of the year before (TsAODM, 217/1/49, ff. 3-4). The level of shoddy work in the factory in 1939 and 1940 was also nearly double that of 1938, the last prewar year (TsAODM, 217/1/96, f. 196; TsAODM, 217/1/96, f. 18). There was some improvement the following year, however. Of 439,000 trained graduates of the new system of State Labour Reserves, the government sent 50,000 to the aircraft, armament, and ammunition industries and to defence industry construction sites (TsSU 1972, p. 355).

The industry struggled to supply inexperienced recruits with instruments and equipment. Managers were at a loss: “In two days I have taken on 48 people, just fewer than I have existing workers … I went [to the instrument department] and I asked what they could give me − 10 hammers, no drills or pneumatic hammers, 5 electric hammers” (TsMAM, 690/1/135, f. 25); in short, three workers to a hammer. Inevitably, while employment rose average productivity fell.

An example is provided by a time-and-motion study of milling-machine operator Milekhin at factory no. 22 in February 1941 (TsMAM, 690/1/98, f. 6). In one and a half shifts Milekhin worked 262 minutes out of 660. Of the remaining time he spent 35 minutes setting up his machine, 35 minutes obtaining instruments, and 30 minutes idle, and he began to tidy up 27 minutes before the end of his shift. The uses of the remaining time are not specified. Melekhin lay at one extreme but of six workers studied in this way none worked more than 494 minutes and the typical downtime was 200 to 300 minutes.

There were also general observations on the deterioration of labour discipline. Twenty or thirty minutes before the dinner break queues formed in the canteens (TsMAM, 690/1/135, f. 9). Foremen were reluctant to notify timekeepers when workers were even half an hour late (TsMAM, 690/1/135, f. 23); to fire a trained colleague would hurt the work group more than the one dismissed. Established employees complained that the new workers had caused the work culture to decline because they regarded their new duties as unwanted and temporary. Factory no. 22 party committee members claimed (TsMAM, 690/1/135, ff. 25-99):

We made the rounds of three quarters of the work positions … at any machine you open the desk and there’s some bread and some dirty rags
and so on. You tell [the worker], surely he can’t eat the bread but he says ‘it’s all right, it’ll do.’ At the machines there’s wires and shards lying about, like with pigs. Some machines are broken because they treat them outrageously … Just about every bench is broken, the locks are broken, every chair has a chain to stop it being stolen, the vices are broken, there’s dust, filth, you can’t get past it …

There were frequent cases when tasks were specifically delayed to the evening so as to count as overtime; this practice also extended to the engineering and technical workers. Basic duties began to be paid as contract work, enabling technicians on a basic wage of 800 rubles to earn 1,000 to 2,400 ruble bonuses for assembling equipment (TsAODM, 217/1/96, f. 164). The urgency with which the industry’s and the country’s leaders wanted to bring new aircraft models into serial production had an decisive influence on the formation of incentives and side payments. In 1939, for example, the Defence Committee promised bonuses to leading specialists for successfully starting up new production lines as follows: 25,000 rubles each to the factory director, chief designer, and chief engineer; up to 15,000 rubles to the production chief, the serial production office chief, and the chief of production preparation; and up to 10,000 rubles to the chief despatcher, the quality section chief, and the supply section chief (RGAE, 8044/1/133, f. 175).

Subsequently the ministry leadership continued to pay close attention to management incentives. In February 1941 minister Shakhurin told Stalin that the current monthly pay of directors and chief engineers was 2000 rubles in aircraft and assembly factories and 3,000 rubles in aeroengine factories. Since workshop chiefs were able to take home 2,000 to 2,500 rubles including bonuses, he asked to fix the pay of a long list of directors and chief engineers at 2,500 to 3,000 rubles to (RGAE, 8044/1/698, f. 122). Subsequently attention turned to rewards at lower levels. In January 1941, for example, in connection with phasing out the SB bomber and starting up production of the Ar-2 and Pe-2 at factory no. 22, deputy minister Balandin authorized the factory to offer foremen bonuses for plan fulfillment up to 50 per cent of their basic pay (RGAE, 8044/1/684, f. 17).

Taking an overview, it appears that Soviet economic managers were no longer convinced of the power of repression to motivate effort, and were returning to cash as a stimulus.

It was said above that in 1939 the ministerial leaders of the aircraft industry put revision of work norms on the agenda. In 1940 they went from words to deeds. In January and early February 86 per cent of norms were reviewed; on average norms were raised by 38.7 per cent, implying a cut in piece rates by 25.8 per cent. As a result the proportion of norms that the workers overfulfilled fell from 91.8 to 43.9 per cent. Meanwhile, the share of piecework in overall working time fell marginally from 62 to 61 per cent (RGAE, 8044/1/2775, f. 21).

The pay structure for manual workers in the aircraft industry in 1941 had 8 grades with a 3.6:1 ration between the top and bottom grades (RGAE, 8044/1/647, f. 19), more or less the same as in 1938. Grade I was particularly important because it provided the base for the higher grades and the grade I scale varied considerably across factories (Table 16).
Table 16. Hourly Pay of a Grade I Manual Worker in the Aircraft Industry, 1941: Selected Factories (kopecks)

<table>
<thead>
<tr>
<th>Factory No.</th>
<th>Location</th>
<th>Pieceworker</th>
<th>Timeworker</th>
</tr>
</thead>
<tbody>
<tr>
<td>383</td>
<td>Moscow</td>
<td>78.75</td>
<td>70.00</td>
</tr>
<tr>
<td>449</td>
<td>Saratov</td>
<td>70.00</td>
<td>61.25</td>
</tr>
<tr>
<td>155</td>
<td>Khar’kov</td>
<td>78.80</td>
<td>65.60</td>
</tr>
</tbody>
</table>

Source: RGAE, 8044/1/647, ff. 20-23.

Such discrepancies were bound to influence turnover and managers exploited them to their own advantage. An extreme case is provided by factory no. 464, established in Riga on the basis of an existing facility but virtually without existing personnel. Appointed to head the factory the designer Antonov advertised locally for recruits, luring them with promises of high pay which he spread using mailshots and word of mouth. He was so successful that the Riga Arsenal complained to high authority about the aircraft builders’ poaching its best workers (RGAE, 8044/1/651, f. 130).

The situation was particularly bad in the aircraft works of the eastern regions. In an attempt to consolidate employment and curb the rising turnover on 23 November the Economic Council authorized the industry to boost the pay of specialists and office workers in these distant regions by the correction coefficients shown in Table 17; the coefficient rose from west to east.

Table 17. Pay of Engineering, Technical, and Office Workers of Aircraft Factories in Remote Regions: Correction Coefficients Introduced on 23 November 1940

<table>
<thead>
<tr>
<th>Factory Location</th>
<th>Correction Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 116 Semenovka, Primorski krai</td>
<td>1.8</td>
</tr>
<tr>
<td>No. 126 Komsomol’sk-on-Amur</td>
<td>1.7</td>
</tr>
<tr>
<td>No. 83 Khabarovsk</td>
<td>1.6</td>
</tr>
<tr>
<td>No. 99 Ulan-Ude</td>
<td>1.5</td>
</tr>
<tr>
<td>No. 125 Irkutsk</td>
<td>1.35</td>
</tr>
<tr>
<td>No. 153 Novosibirsk</td>
<td>1.2</td>
</tr>
</tbody>
</table>

Source: RGAE, 8044/1/408, f. 38 and, for locations, Dexter and Rodionov (2004).

While rewards were increased in the more distant factories, the ministry sought to restrain wage expenditures in those closer to the centre. In March 1941 there was a regular review of work norms at a number of factories that led to a general cut in piece rates (RGAE, 8044/1/674, f. 44). This increased the pressure on the workers; at factory no. 16 in the first quarter of 1941, for example, 18.6 per cent of pieceworkers failed to fulfill their norms (RGAE, 8044/1/674, f. 71).

Labour discipline not only did not improve as a result of such innovations but also remained unsatisfactory in the first months of the war despite new wartime legislation. On 29 September 1941 the factory no. 22 party committee reported that August had seen 42 instances of lateness and 66 of absenteeism compared with 29 and 13 respectively in July (TsAODM, 217/1/196, f. 52). In addition the report noted “aimless wandering around in working time, failure
to start and finish work on time, sleeping in working time, and failure to fulfill management instructions” (TsAODM, 217/1/196, f. 52).

7. A Factory’s Problems

These problems can be viewed in the microcosm of a single plant, the 1 May Factory no. 7 in Moscow, on the basis of documents of the factory party committee in 1939 and 1940. This was a newly converted factory but it was affiliated to one of the oldest aircraft works, factory no. 22.

Problem no. 1 in the eyes of the factory leadership was “storming.” To the party committee, “storming has been consuming the factory” (TsAODM, 217/1/156, f. 49 ob). As a rule the first days of the month saw no results at all (Table 18).

Table 18. Storming in Factory no. 7: Value of Output (per cent of monthly plan) in July to September 1939

<table>
<thead>
<tr>
<th></th>
<th>First 10 Days</th>
<th>Next 10 Days</th>
<th>Month, Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>July</td>
<td>1.1</td>
<td>7.1</td>
<td>100.0</td>
</tr>
<tr>
<td>August</td>
<td>1.9</td>
<td>35.7</td>
<td>106.1</td>
</tr>
<tr>
<td>September</td>
<td>2.1</td>
<td>9.4</td>
<td>100.8</td>
</tr>
</tbody>
</table>

Source: TsAODM, 217/1/156, f. 51.

The ministry shared this view. In his memoirs Shakhurin (1985, p. 94) wrote: “I became minister in January 1940, but in February the factories were still supplying the goods accepted in December 1939. Working like this the first two weeks of each month were spend clearing up what had been left undone in the previous month, and in the last ten days would begin a storm to fulfill the plan somehow or other. Roughly they would supply half of the total output in the last ten days – at best. In the worst case it would take still longer.”

At the 1 May Factory the workshop chiefs defined the cause of storming as arising from the lack of reserve stocks of finished goods carried over from one period to the next: “Storming happens because [we have no reserves of] finished goods. There is no carryover as such and so the workshops have to make their start each month from the first day and are working on the carryover up to the last day” (TsAODM, 217/1/156, f. 2). In other words, because production always started from nothing it was excessively vulnerable to disruption. The factory management, however, refused to take responsibility for it and blamed the workshop chiefs: “The workshop chiefs are to blame for storming. Who is it, one may ask, that doesn’t begin work on the first of the month, who is it that prevents additions to the carryover?” (TsAODM, 217/1/156, f. 3). At first glance the position of the workshop chiefs looks stronger: a workshop is an integral subunit of the factory and to operate it without interruptions needs coordination above. If materials were not supplied at the right time the workshop could scarcely “begin work on the first of the month.” The warehouse would respond to an order from the factory director, not the workshop chief. In short, coordinating supplies to ensure uninterrupted operations was a management responsibility; if the director failed, then storming was chiefly his fault.
The party committee leadership offered its own version of the root of the problem. “Departments [such as] production preparation and supply do not get worked up in advance about provisioning work in the first 20 days [of the month]. Business contacts don’t happen between workshop and department chiefs, and one workshop chief doesn’t care about the fate of another – this makes storming inevitable in the workshops where the production plan is finished off” (TsAODM, 217/1/156, f. 50). Interestingly, the party committee does not raise the issue of the lack of higher management coordination; rather, the workshop chiefs are blamed for not freely coming to a collective agreement. The same document notes that: “The machine workshop has never yet provided a full assortment to the assembly shop. The supply department is remote from production and does not live by its interests” (TsAODM, 217/1/156, f. 50 ob.). But if the individual workshops and departments should have been able to come together and coordinate their actions in a decentralized way, what was management for? Who, if not the director, was supposed to make each take account of the requirements of the others?

This leads us to problem no. 2: in the 1930s the term “workshop sectionalism” [tsekhovshchina] was applied to cases where the workshop leaders gave priority to the interests of their own section rather than to those of the factory as a whole. Where it took hold, the workshop leaders seceded from under the rule of the factory management and began to act as independent proprietors. It is hard to know what was typical, but the experience of factory no. 7 is certainly of interest: “… in the rifled cylinders workshop, for example, there is a leak in the roof; instead of putting a bucket under the leak, they have made a hole in the floor and let the water through into the store” (TsAODM, 217/1/156, f. 28).

Problem no. 3 was the disinclination to work for basic pay. Overtime and contract work were another matter. “… In the department of the chief mechanic, particularly, it is possible to complete work within normal hours but they try by all means to drag it out under a [sideline] contract or outside normal hours” (TsAODM, 217/1/156, f. 27 ob). Indirect evidence of workers’ reluctance to rely on basic pay is the growth in the number of Stakhanovite workers which, in factory no. 7, proceeded from below among the workers rather than from the party committee above.² Dispirited by this the party committee suggested that: “The growth of Stakhanovite numbers is going ahead haphazardly and spontaneously because of the workers’ clear material interest under piece rates.³ In the departments, where they work for basic pay, the workers limit themselves to minimal effort; naturally therefore there is a wide divergence between workshops and departments” (TsAODM, 217/1/156, f. 51). Table 19 illustrates the difference:

² The diffusion of the Stakhanov movement from above, through management encouragement and patronage, was widespread in large Soviet enterprises such as the Moscow Elektrozavod (Zhuravlev and Mukhin 2004, pp. 120-124).

³ At this point a hand has inserted “and the [illegible] consciousness of the workers” into the typescript. Perhaps it was feared that without this phrase the interpretation offered might be found politically unacceptable.
Table 19. Factory no. 7: The Number of Stakhanovites in 1939, by Month

<table>
<thead>
<tr>
<th></th>
<th>In Production</th>
<th>In Departments</th>
</tr>
</thead>
<tbody>
<tr>
<td>July</td>
<td>198</td>
<td>13</td>
</tr>
<tr>
<td>August</td>
<td>236</td>
<td>3</td>
</tr>
<tr>
<td>September</td>
<td>242</td>
<td>21</td>
</tr>
</tbody>
</table>

Source: TsAODM, 217/1/156, f. 51. “In Departments”: from the context, in the departments where the workers relied on basic pay.

Problem no. 4 was turnover. There were several causes. First, the management expected a high proportion of new recruits to fall out quickly and made little fuss over them. “We have high turnover at the factory, and the new recruits have no craft organization, the management does nothing for them, and they have no comradely associations at first. We need to gather the new recruits at meetings from time to time, explain the factory’s tasks, and surround them with comradely concern; then turnover will fall off,” or so it was suggested at a party meeting (TsAODM, 217/1/156, f. 28). Evidently there was a need for “comradely concern” to be material as well as moral; it seems that the most lucrative overtime and sideline contract payments were monopolized by the established workers and the new recruits were kept away from them. Party meetings perhaps alluded to this in veiled terms: “When directed to the workshops they do not meet with proper attention on the part of the workshop leaders. The bureaucratic reception of new recruits, the time they spend idle thanks to incompetence and disorganization of the workplace, and the ungratifying information about our workshop procedures push people into going absent or quitting voluntarily” (TsAODM, 217/1/156, f. 51 ob).

The factory party leadership offered other explanations for high turnover. Party secretary Likhonin observed (TsAODM, 217/1/156, f. 51 ob):

They often say it is ‘lack of housing’ but I say: we take people without carefully checking up on them. … 1. Anisimov I.P. Hostel superintendent. Joined 14 August [1939], not registered for residence. On 4 October the police required his dismissal. He did not even settle his [wage] account. 2. Bozhko V.V. Milling-machine operator. Joined 13 September, resigned 10 October for lack of work. Asked why he was hired, not known. 3. Dolgova I.G., joined 28 August as storekeeper in the welding workshop, resigned 21 September for lack of work. 4. Antonova M.D., joined as accounts inspector on 16 September, resigned 14 October for lack of housing.

But it seems unlikely that more careful checks could have changed the situation. These people were hired but the factory did not sort out their housing or right of residence, or left them idle on basic pay without the possibility of earning bonuses or supplements. Their voluntary or involuntary departure cannot have been a surprise.

Problem no. 5 was poor discipline, which blended from time to time with drunkenness. A June 1940 party meeting noted (TsAODM, 217/1/156, f. 48):

… cases of drunkenness among individual communists are becoming more frequent. They have even begun to drink the alcohol spirit in the factory store. The day before he was due to get his party candidate membership card, Lakov got drunk, came to work, and caused a minor fracas.
On 13 November on Zaretskii’s shift a lathe operator cut through the thread of a spindle. Zaretskii not only did not take steps against the guilty party but also did not inform the workshop chief. On 11 November foreman Alabin of the iron foundry workshop [let a casting go cold and solidify in the furnace] under pressure and did not take it up with the guilty party and even tried to make light of the facts. On 10 November at 4 a.m. Alabin was sleeping on his shift with those under him. Naturally the duty janitor left his post and went to sleep too. On 8 November the duty worker … Zhukov turned up for duty completely drunk and was allowed onto the shop floor. The communists are giving a bad example. Men´shov and Kosarev came to work with such a powerful smell of wine that it was impossible to go close to them.

It is difficult to tell what was cause here and what was effect. Whether alcoholism, a low level of work culture, or poor management lay at the root, the fact is that excessive drinking was a serious workplace problem.

Everything was compounded by problem no. 6: poor accounting. In the summer of 1940 it was said (TsAODM, 217/1/156, f. 61):

Despite the large accounting staff there is no progress. Warrants are issued without [stating] quantities and as a result materials are used at will, parts are given out without [checking] quantities, shoddy work is concealed, and all because there is no accounting. … We draw materials from the warehouse without analysis and the result is shoddy work.4 … There is none of the accounting we need in our workshops. There is no system in the accounting for the movement of products. The [planning and forecasting department] doesn’t know about the movement of parts, even the workshop that is allocated the parts doesn’t know either … The despatch of materials, you can say, is done by eye and isn’t checked on receipt even by the workshops.

This situation was perfectly consistent with workshop sectionalism. If management took no responsibility for coordination the mutual relations among workshops would soon naturally degenerate to anarchy.

8. Conclusions

The workforce of the Soviet aviation industry in the interwar years also tells the wider story of Soviet industrial workers. In the Civil War the aircraft workers struggled with a sharp deterioration in the conditions of life and loss of class status. Under NEP they struggled for their rights with the industry’s leadership and joined the party to promote their careers. They were more highly skilled than the norm, but suffered materially as a result of government neglect.

The 1930s brought winds of change. The rising number of production establishments spread the layer of skilled employees ever more thinly. There was success in raising average productivity only in the middle of the decade. Numerous faults that were inevitable under forced-march industrialization were blamed on sabotage by the engineers drawn from the “former” people.

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4 The same warehouse with the hole that another workshop had made in its ceiling. As the saying goes: “Don’t spit in the well.”
There was a wave of “specialist-baiting.” Despite this, the specialists of the old stamp remained dedicated to their vocation; they were content to live in “fleapits” so as not to have to renounce the cause of their life’s work, to build flying machines.

During the 1930s the aviation workforce was transformed. It became more “intellectual” if we measure this by the proportion of specialists to production workers. The specialists themselves also changed; there was a new, more pragmatic generation to whom the right to live in Moscow could be worth more than their profession.

During this period pay levels in the industry rose continually. This signifies the increased concern for the industry at the level of the government. But the Soviet authorities were more than willing to use repressive measures to force creative effort where they considered it necessary.

Despite the pay improvement most workers had less than two years’ seniority. By the end of the decade, however, a thin layer of “labour aristocrats” had become to form with high skill qualifications. Throughout the period the industry struggled with persistent problems like the low level of technological culture, the turnover of personnel, and “storming.”

On the eve of war the aircraft industry underwent explosive growth. This severely intensified its personnel problems. Again the layer of skilled workers was spread thinner. Mass transfers of skilled workers from other branches did not help; a skilled joiner could not take the place of a skilled rivetter. Turnover and “storming” increased; discipline declined and with it the level of technological culture. Workshop sectionalism also put in an appearance.

Nonetheless it was not all for nothing. These efforts laid the basis for the expansion of production in the first days of the war and, later, in evacuation. The aircraft industry’s workforce carried the virtues as well as the demerits of the whole Soviet working class. The victory in the war was not least due to the men and women who built aircraft.
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