State and Crafts in the Qing Dynasty (1644-1911)

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6. The Shipbuilding Workforce Employed by the State and Private Workshops and Enterprises

This chapter deals with the working and living conditions of the artisans and workers in the government shipbuilding institutions as well as the shipbuilders in the commercial and subsistence sector. The question is raised as to how the greater appreciation on the part of the central government of industry and commerce influenced the lives and professional outlook of the shipbuilders. Did the mechanization in this branch and the changed labour relations enhance the social respectability of the workers? As in the preceding chapters, a long-term perspective will be taken which starts in the late Ming. This is because the best information on work organization in an imperial shipyard originates from the Ming period. Most outstanding is the monograph on the late Ming official shipyard at Nanjing, *Longjiang chuanchang zhi* (1553), which draws on previous texts, the *Nanchuan ji* (An account of the Southern ships, 1541) and the *Caochuan zhi* (Records of River and Canal Shipping, compiled in 1501, enlarged in 1544). No comparably comprehensive descriptions on shipbuilding exist until the age of mechanization and quality control posed new exigencies for accountability upon the officials and engineers in the arsenals. Although strictly speaking, the Ming situation falls out of the focus of the present study, we refer to it here under the assumption that the problems of personnel and material administration resemble those in the Qing official shipyards. For the eighteenth and nineteenth centuries, official evidence of the *zeli* type includes the regulations and precedents on Fujian, Jiangsu, Hunan, and Zhejiang of ca. 1769, which can be complemented with the provincial regulations of Fujian (ca. 1874) and the Xiamen gazetteer of 1839.1 The *zeli*, however, concentrate on the cost of materials and the composition of ships in order to ensure accountability, as was common in other official craft branches, but include very little information on problems of labour and personnel administration. Given their strategic importance, it seems amazing that government shipyards are not mentioned in the general regulations and precedents of the Ministry of Public Works before the 1884 edition, which includes nineteen short clauses about ‘naval administration’.2

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1 ‘Union List’ nos. 1-5-4 to 1-5-6-3, *Fujian shengli, Xiamen zhi*.
2 *Qinding gongbu zeli*, Guangxu ed., chap. 72-75.
An Account from the Sixteenth Century

The Monograph of the Dragon River Shipyard (*Longjiang chuanchang zhi*) shows the decline of the hereditary artisan system that had been adopted by the Ming dynasty and the transition from this type of corvée labour to wage labour. Our question here is whether the conviction often expressed by Chinese historians that artisans preferred not to work for the government holds true.

In the early Ming system, craftspeople were subjected to a specific kind of household registration and had to render obligatory labour service at the capital for specific periods of time. In the course of the Ming dynasty, the enforcement of this rigid system declined. From 1485, artisans had the option to substitute monetary payment for their service, and in 1562 it was expressly forbidden to render labour service instead of monetary payment.4 The Monograph of the Dragon River Shipyard was written by Li Zhaoxiang, the director of the shipyard for several years in the 1550s, at a time when corvée obligations had not entirely come to an end but were declining. Li states that the workforce originally commanded for obligatory service at the shipyard consisted of 400 families from Zhejiang, Jiangxi, Huguang, Fujian, and Southern Zhili (i.e., Jiangsu) that were relocated to Nanjing between 1368 and 1424. Of these, only 245 remained in 1541, and less than 200 in 1551. The rest had fled and found work outside the wharf.5 Most of these remaining artisan families were poor: ‘only one in ten of them is not hard-pressed for food and clothing’. When a shipbuilding project was launched, they received no wages or food allowances but instead an advance payment that was later deducted from their wages at 20 percent interest.6 Some of them were given plots of unused shipyard land for farming in return for rent that had to be delivered in the form of the natural produce of hemp and tong-oil. These materials were needed for caulking the ships. The tenants did not grow these materials on their plots but had to acquire them on the market. Moreover, tenants were expected to participate in tasks like water pumping or dike maintenance on the grounds of the shipyard.7

The Monograph gives no information on daily, monthly, or piece wages. The norms for working time for constructing a number of ship types are

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3 Li Bozhong, Xu Jianqing, Fang Zhuofen et al.
4 Da Ming huidian, chap. 189, fol. 5b, 8a.
5 *Longjiang chuanchang zhi*, chap. 3, fol. 8a; Scheuring, *Drachenfluß-Werft*, p. 85.
6 Ibid., chap. 6, fol. 2b; Scheuring, *Drachenfluß-Werft*, pp. 135-136.
7 Ibid., chap. 5, fol. 1b-6a; Scheuring, *Drachenfluß-Werft*, p. 126 ff.
specified, including the total working days (gong) and labour costs. Assuming that all artisans received the same wage for one work day, this results in wages of around 0.03 silver tael per workday.\(^8\) The distinction between the work of a master and of an unskilled labourer is not made here. The text mentions that for odd jobs such as breaking up ships, marines from the nearby Xinjiangkou marine station were employed and paid for by the Ministry of War. However, this applied only to the construction of warships. The working costs for the imperial ships – those that the emperor and court used in Peking and Nanjing – had to be covered entirely by the Ministry of Public Works.\(^9\) Grain ships were not built at this site.

The author of the Monograph of the Dragon River Shipyard also complained that the estimated work days for the construction of ships often did not include the help of unskilled labourers, for example in hauling out the ships and setting them into the water after the repair work. These jobs should have been taken over by soldiers but often they did not come at all or not in the necessary numbers. Control officials, in order to ingratiate themselves with the Ministry of Public Works, did not account for such extra costs, and in consequence the artisans were often forced to work overtime without pay, which resulted in their impoverishment and in the deteriorating quality of the ships.\(^10\) Li Zhaoxiang therefore called for ‘compassion’ for the needs of the artisans and their families. At the same time, he repeatedly warned that artisans as well as merchants and lower-echelon officials were committing a variety of fraud and corrupt practices. Embezzling or ‘saving’ material or working time for one’s own advantage could involve mixing old (recycled) and new nails when only new nails should be used; boring holes in planks without nailing them but applying caulking mass on them as if nails had been used; sawing the boards too thinly to ensure that the stocks of timber would suffice; using new materials instead of recycling them; and superficial caulking. Generally, the author observed that hired unskilled labour worked hastily and less diligently than the soldiers employed for the same jobs.\(^11\)

Product quality was a constant concern of the leading officials on the shipyard. In 1528, one of the directors complained that the crews handled

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\(^8\) Longjiang chuanchang zhi, chap. 7, fol. 2a ff. This obviously was the uniform wage for skilled artisans employed by the Ministry of Public Works. Chow Kai-wing, Publishing, p. 53, fn 223, mentions the same daily wage for a construction worker, which was slightly lower than in the private sector, for which he quotes 0.033 tael per day.

\(^9\) Longjiang chuanchang zhi, chap. 1, fol. 25b; Scheuring, Drachenfluß-Werft, p. 48.

\(^10\) Ibid., chap. 6, fol. 8a/b. Scheuring, Drachenfluß-Werft, p. 145.

\(^11\) Ibid., chap. 6, Fuge zhi 學革志 ‘Consideration of improvements’, Scheuring, Drachenfluß-Werft, pp. 137-147.
the ships carelessly because they felt little responsibility for public property, and therefore the ships were sent for overhauls or breaking up before their term was due. Quality control of the finished ships was extremely important because if specialists inspected ships for imperial use, these could last for more than thirty years, whereas for battleships the usual term of breaking up was merely ten years. Officials should take care that artisans could not conspire with the controllers and pay them hush money if their products were found defective.\textsuperscript{12}

The director characterizes the artisans in the imperial shipyard as follows:

The artisan families, although they have been living in the [Southern] capital [Nanjing], for generations still are a rough and uncivilized lot. Even if their foremen have contact with the offices every day, they remain different from [the clerks] who work in the offices. If they are relentlessly controlled and shaken by intimidation, they will not report on their own if they have difficulties fulfilling their tasks. But if we treat them with mildness and severity, compassion and legal sanction [in the appropriate degree], make them fear us so they don't dare to cheat us, feel affection for us so they couldn't bear to cheat us, they would not let us down if anything unforeseen should happen, but would gladly come up with solutions, and success will be ours.\textsuperscript{13}

As can be seen from the 228 regular positions (Table 28), a considerable number of artisans were not located at the shipyard at all, and those few that worked there seem to have been employed for more decorative tasks. The larger ships certainly could not be built with a workforce as small as this. The other workers were probably hired labour.

This monograph of the Dragon River Shipyard also contains detailed lists stating how much labour (in man-days) was necessary to build specific ships. These quotas clearly show the division of labour in ship construction into as many as 33 different specializations.

The total man-days are quoted as 2,558.5 \textit{gong}.\textsuperscript{14} The overall labour costs are given as 76,785 tael. Divided by the total number of man-day, the resulting wages amount to ca. 0.03 tael per labour unit. Table 29 only shows the working time for the most expensive and lavishly decorated ship in the list. The text

\textsuperscript{12} Longjiang chuanchang zhi, chap. 1, fol. 9a, chap. 6. Scheuring, Drachenfluß-Werft, p. 30, 137-147.
\textsuperscript{13} Ibid., chap. 6, fol. 2a. Scheuring, Drachenfluß-Werft, p. 135-6.
\textsuperscript{14} However, when one adds up the posts, the result is 2,564.5 \textit{gong}. 
includes the working times for twenty more ship types in three construction series that span the years 1524 to 1553. The expenses and man-days for the largest battleship, the 400 unit\textsuperscript{15} flagship of the battleships, were only slightly lower (2,487.1 man-days and 74.61 tael). At the low end, fishing boats with work norms of 80 to 90 man-days for labour costs of 2.52 to 2.1 tael were also built. To give a rough impression of the wage income of a shipbuilder, if we assume an average rice price of 0.58 tael per \textit{shi} (about 70 kg) in the time span 1522-1566,\textsuperscript{16} a shipbuilder would have to work 19 days for one \textit{shi} of rice. This means he earned about 0.05 \textit{shi} or 3.5 kg per day. Assuming further a subsistence consumption of 171 kg (or 2.44 \textit{shi}) of rice per person per year in ‘Coastal Asia’,\textsuperscript{17} the shipwright in 1553 would have had to work for 185 days to feed a family of four only with their daily rice needs. 300 working days per year would earn about 15 \textit{shi} (1,050 kg) of rice. Thus, if work was abundant, shipwrights in the Dragon River Shipyard would be able to make ends meet, but if not, they would have to turn to other income sources besides wage labour on the yard, such as subsistence farming on the fields of the yard or family members somehow making up for the lack of wages.

Were these standard wages of 0.03 tael per day so low that everyone would be tempted to defect from the Dragon River Shipyard at the first occasion? Considering other urban skilled wages, for instance 0.033 tael for a construction worker in the private sector, 0.04 tael per day for a weaver, and 0.05 tael per day for a letter carver (with a daily work quota of 100 characters carved)\textsuperscript{18}, the government wage rate was certainly at the lower end. However, the working conditions at the government shipyard stated in the monograph may well have given the shipbuilders more reason than the moderate norm wages to consider whether it was worthwhile to stay on. Thus, the message of director Li Zhaoxiang is clearly that skilful personnel management might make the difference in keeping the labour force in the service of the state.

The Workforce in the Early and Mid-Qing Period

In the transitional period until around 1700, before the government shipyards were formally reestablished, government ships were constructed

\textsuperscript{15} The unit \textit{liao} corresponds to about 55 kg, thus 400 \textit{liao} are roughly 20 tons. See Scheuring, \textit{Drachenfluß-Werft}, p. 65, fn. 8.
\textsuperscript{16} Zhongguo huobi shi, p. 849, transl. Monetary History, p. 752.
\textsuperscript{17} Allen et al., ‘Wages, Prices, and Living Standards in China: In comparison with Europe, India, and Japan’, ‘Table 2: Subsistence Lifestyles’, ‘Coastal Asia’.
\textsuperscript{18} All wages from Chow Kai-wing, \textit{Publishing}, pp. 53-54.
at shipyards that were installed ad hoc and according to demand. After the establishment of government shipyards, the artisans were probably hired, as was the case in the late Ming. In Guangdong, about 30 foremen (touyi) were employed in the government shipyard at Anfu in Chaozhou prefecture. Their positions could be inherited by their offspring, but this was not the case for hired artisans. The other artisans were hired in the surrounding areas where shipbuilding was developed. This is not to say that shipbuilders were always employed and remunerated according to market conditions. Documentary evidence from the 1736 routine memorials of the Ministry of Public Works shows that the shipbuilders were occasionally requisitioned (paibo) to work for the state and rewarded in kind (‘rice, salt, and brushwood’) but not paid the full wages. The ministerial officials asked for approval to change this system and to account for the working wages in full when applying for shipbuilding. This particular case did not occur at a well-established government shipyard but during ad hoc activities when ferryboats in Shengjing, Manchuria had to be built. We note, however, the awareness of the ministry that even in such situations, wages should have been paid in money and not at depressed procurement prices.

During the Qianlong era, the government regulations for shipbuilding in Fujian (after 1769) explicitly state the wages of shipbuilders: ship carpenters, joiners, sawyers, caulkers, ironsmiths, tailors, painters and paint makers, rope makers, coir palm workers, rattan workers, character carvers, sturdy labourers (unskilled labour), all at 0.05 tael per gong (working day). This was the average ration accounted for feeding a soldier per day in the early Qing. The amazing fact here is that although we find a division of labour into more than ten craft branches and between skilled ‘master artisans’ (jiang) and unskilled labourers (fu), the wages still seem as undifferentiated as in the Ming. Extra payment or food rations may have been included but is not documented here.

20 Gongke tiben (Routine memorials of the Ministry of Public Works), vol. 1, 88, 2-84-1, Zaochuan gongcheng: Yiban chuanzhi 造船工程：一般船隻 (Shipbuilding: Civilian ships), Qianlong 1/6/10, routine memorial by Maizhu 邁柱, Minister of Public Works of the Secondary Capital Shengjing, et al.
21 ‘Wages paid for armament, military equipment, and shipbuilding workers, 1769 and 1816’.
22 Peng Xinwei, Zhongguo huobi shi, p. 849, transl. Monetary History, p. 752. See also Luo Ergang, Luying bingzhi, p. 344, who quotes a monthly wage of 1.5 taels for a cavalryman and 1 tael for a foot soldier of the Green Standard troops in the first year (1644) of the dynasty. Mark C. Elliott, The Manchu Way, p. 192, specifies a monetary wage and grain allowances for the stipend of the bannermen. The monetary part varied according to rank and location of service, with a typical monthly wage of 4 taels in the capital and 3 taels in provincial garrisons.
These regulations apply to all government shipyards of Fujian, namely Fuzhou, Zhangzhou, Xiamen, and Taiwan. A source from the Ming contains a more qualitative appraisal of the different skills of the workforce. The government ships used to exchange tribute with Liuqiu/Ryūkyū (present-day Okinawa) were built in Fujian, and the specific differences of shipbuilding in Fujian are mentioned in a text on the missions to Liuqiu. It claims that the Fuzhou shipbuilders painstakingly maintained the patterns of the regulations but were inflexible; the Zhangzhou and Quanzhou shipbuilders were good at choosing materials and built stable ships, but their workmanship was rough. As a modern naval historian might suppose, these general patterns were also true in the Qing. However, migration may have led to a certain integration of shipbuilding skills and priorities for construction. The Xiamen gazetteer states that since the official shipyard was newly established in 1736, it surpassed and gradually replaced the Quanzhou shipyard and attracted migrant shipbuilders from other regions in Fujian.

No explicit information is available as to how many artisans worked in one shipyard or of the size of the labour force in official and private shipbuilding. On the basis of evidence for the Ming and Qing periods, Li Bozhong has estimated a workforce of over 10,000 in the Jiangnan region for the grain ships and military ships in the government sector as well as for the merchant and fishing ships built in the private sector. For Jiangnan in the Qing era, he assumes a workforce of several tens of thousands that specialized in government shipbuilding and ship maintenance. For a rough estimate of the workforce of government shipbuilders in all provincial shipyards, we set out from Li Bozhong’s figures for Jiangnan. Since the maintenance cycle of grain ships lasted ten years, after which the ships were routinely broken up, the usable parts recycled and new material used for the rest, one-tenth of the fleet had to be rebuilt every year. The grain fleet of Jiangnan consisted of some 3,000 ships according to the 1812 quotas. Li Bozhong assumes 3,750 shipbuilders working permanently (300 days/year) to construct and maintain the annual reconstruction quota of one-tenth (300 ships), which is about 12.5 men per ship in the case of routine work procedures without particular peaks or lulls. For the entire grain fleet of 6,000 ships, this adds up to 7,500 shipbuilders who built the yearly norm of 600 ships.

23 Lai Zhengwei 赖正维, Ming Qing shiqi, pp. 80-82.
24 Xiamen zhi, chap. 5, p. 154.
25 Li Bozhong, Jiangnan de zaoqi gongyehua, p. 264.
26 See table ‘Quotas for grain transport ships in the grain providing provinces’.
27 Huidian shili, chap. 202, fol. 4a (Kangxi 13, 1674); chap. 935, fol. 5a (Yongzheng 1, 1723).
Likewise, Li Bozhong estimates that 5,000 shipbuilders constructed ten percent of the one-thousand sea ships (flat-bottom sand ships) – that is, around 100 ships every year – that were necessary for the experiment with sea shipments of tax grain in 1826. Since this project was organized and financed by merchants, this figure does not strictly speaking concern the government sector. However, here the ratio of 50 shipbuilders for one ship is of interest. Applied to the entire battleship fleet of roughly 2,400 ships (see chapter four, Table 20 ‘Quotas for coastal and fluvial guard and patrol ships of all sizes’), and setting out from the production figure of one-tenth of the fleet annually, the result is an overall figure of 240 ships x 50 shipbuilders = 12,000 shipbuilders permanently engaged in government naval construction.

Adding up the grain ship and the navy shipbuilders yields a total of roughly 20,000 workmen. Divided by the number of about forty official civilian and military shipyards recorded in the Collected Statutes, this results in a figure of about 400 workmen per government shipyard, which tallies with the original figure of labour obligations reported for the Dragon River Shipyard at Nanjing. By the mid-sixteenth century, only half of the artisans remained, but since the other labour was hired on demand, the figure of 400 seems fairly consistent, even if at particular peak periods a greater workforce must have been engaged in the government shipyards. Their work load at times was divided among several smaller local shipyards that may have been established temporarily.

The Dragon River Shipyard with an area of about 500,000 square metres was probably the largest shipyard worldwide; another contemporary reference shows that, for instance, the Fuzhou shipyard (or one of them)
measured only 7,000 square metres (10.5 mu) including the artisans’ living quarters.31

The government shipyards most probably remained the biggest employers in shipbuilding. It is as yet not possible to compare wages in the private shipbuilding sector to those of the government sector, since wage data are extremely rare. We have so far only localized one instance, a payment of 5,000 copper cash for caulking a leaking boat in Baling district in Hunan.32 Judging from the differences in the procurement prices of government ships and market prices (see chapter five, Table 24), ranging from twice to three times the amount for private ships, we can assume that the privately built ships were more carefully worked and more costly materials were used, and that wages may also have been higher. The government obviously paid subsistence wages to its workforce like those of the military, and in fact soldiers may have been employed for auxiliary jobs as in the Ming. One part of the positions in the government shipyards may have been hereditary, linking up to the tradition followed in the early Ming period, but the main workforce was hired. There are no indications that large shipbuilding enterprises existed before the late nineteenth century.33 Rather, clusters of smaller shipyards may have cooperated when building the larger seagoing ships, so that wage labour may have been quite restricted. Thus, family enterprises would have prevailed as in the supplying sectors of sail and net making.

The Workforce in Private Enterprises after the Opening of the Treaty Ports and in the Earliest Phases of Industrialization

After the Opium War and the opening of the treaty ports, the workforce engaged in shipbuilding increased where the demand was the greatest. At this point in time, foreign manufacturers also offered work opportunities. However, the mechanized production of steamships did not start

31 Shi Liuqiu lu san zhong [1606], mission of Xia Ziyang 夏子陽, p. 238 ‘shipbuilding’.
33 The samples for larger proto-capitalist or capitalist enterprises, depending on the definition, cited by Zhu Cishou, Zhongguo gudai gongye shi, pp. 789-804, include mining of iron and copper ores, metal smelting and refining; cotton processing; the Shaanxi timber industry; papermaking; salt wells in Sichuan, sugar production in Taiwan; tea curing; and flour mills; but not shipbuilding. Likewise, Myers and Wang, ‘Economic Developments’, p. 644, point out that by 1800, ‘few private organizations had achieved large-scale size and complexity’. 
immediately and everywhere. For several decades to come, the use of wind-propelled vessels also intensified, as the numbers of sailing ships entered and cleared at Shanghai during the years 1902-1941 (Figure 10) show. Rising from 6,379 entries and clearances in 1902 to a peak of 77,420 in 1935, the figure dropped sharply in 1937, when the Republican government was forced out of its capital Nanjing, and Shanghai was occupied by the Japanese, but in 1940 returned to 21,428. At the same time, the number of steamships in Chinese possession rose continuously, with setbacks during the French-Chinese War in 1884 and in the last decade of the Qing dynasty (Figures 11 and 12). On the Upper Yangzi, the turning point for transported tonnage occurred between 1919 and 1920, when the transport volume by steamship rose from 58,728 to 75,386 tons, while the tonnage of sailing ship transports sank from 74,289 to 40,757 tons. The last year with information on sailing ship traffic was 1925, when one sailing ship transported 20 tons of goods. At the same time, the figures of steamships in Chinese possession, first reported in 1882 at 30 and a tonnage of 22,111, had by 1921 risen to 1,592 ships with a transport capability of 183,286 tons (Figures 13 and 14).

From personal observation and statistical evidence, the Chinese Maritime Customs Inspector Worcester concluded that, at least up to 1935, wooden sailing ships had not yet disappeared. However, the junks that did circulate were smaller, and the profusion of ship types seen in the Shanghai harbour in the late nineteenth century existed no longer. Worcester stresses the case of the Fuzhou merchant ships, of which by the 1930s only eleven rapidly disintegrating specimens were left in Chinese waters, the most recent of them twenty years old.34 For a comparison to inland navigation, the 1922-1931 numbers and tonnage of steamships and sailing ships circulating on the Yu river in Guangxi shows that wooden sailing ships still were in use by 1931, even if their number had declined also on this rather minor traffic artery (Figures 15 and 16). In sum, the sailing ships that were still in use in the first half of the twentieth century were smaller and could mainly be found further inland.

Figures on the global situation of the steamships and sailing ships are controversial. French sources state that by as early as 1860, the number of sailing ships worldwide equalled those of steamships.35 The transport volume of steamships as a rule being larger than that of sailing ships, this information conflicts with the statement of a German expert who claimed that the net

34 Worcester, Junks and Sampans, p. 194, 197.
35 Cornet, Etat et entreprises, p. 19, referring to André Reussner, and Nicolas André, La puissance navale dans l’histoire, 1815-1914, p. 37.
volume of the worldwide sailing fleet equalled that of the entire steamship fleet only by 1892, and that by 1900 the steamship tonnage increased to twice the tonnage of sailing ships. He added that by 1907, 15 to 20 percent of all ships were sailing ships and 85 to 80 percent were steamships. In any case, not only had the number of sailing ships in China not declined by the end of the Qing dynasty, but the number of steamships was also increasing. Moreover, if steam technology was applied, the engines were often inserted in wooden rather than steel ships, which caused a more gradual transition from traditional ship carpentry to the manufacturing of metal ships.

As far as is known from written evidence before the mid-nineteenth century, the size of the workforce in private shipyards ranged from family businesses to enterprises that hired workers in the range of a dozen. In accordance with the increased shipbuilding activities, the reports about shipyards for traditional wooden ships show that those that employed a larger workforce date from the end of the nineteenth century. In Sichuan, in the district of Jiangbei ting in Chongqing prefecture on the Upper Yangzi, 40-50 shipyards for wooden boats employed 2,000 shipbuilders, and thus each had a workforce of 40 to 50 persons. They operated permanently and produced 700-800 wooden ships of 30 to 100 tons per year. However, in shipbuilding areas such as the Lake Tai region, smaller shipyards could form cooperative clusters that offered work opportunities for local shipbuilders beyond the scope of one single workplace. For one of the Sichuan shipbuilding centres, Wan(yuan) xian, the trade is described as a typical side business for farmers until the Republican era. By comparison, a recent account of a typical family business of shipbuilders in Zhoushan in Zhejiang province, which is currently in its fourth generation, describes a workforce during the period between 1925 and 1953 of one father and four sons who were joined by their wives, thus totalling nine persons in peak times. As for the South China region around Hong Kong, wooden sailing ships were a frequent sight up to the 1970s, and for inland water traffic, sailing ships gave way only gradually to engine-propelled craft.

36 Radunz, 100 Jahre, p. 134, referring to an undated paper by the Bremen mayor Johannes Rösing (1833-1909), Die Segelschifffahrt und ihre Zukunft, Bremen.
37 For evidence of the building of traditional sailing ships in Hong Kong in 1979, see Maitland, Setting Sails, pp. 57-61.
39 Ibid., citing the local gazetteer Wanyuan xianzhi 萬源縣志, chap. 3.
40 Xin Yi, Zheng Ming (eds.), Putuo chuantong muchuan zhizao jiyi, pp. 126-139.
41 Maitland, Setting Sails, p. 59.
According to Worcester’s description of a typical shipyard for Yangzi ships, the working time was from 8 A.M. until dark, with a break of one hour at noon and two hours during the summer months. The shipwrights were usually offered three meals a day by their master. Sawyers and caulkers formed ‘a different class’. Sawyers were initiated into their trade, which was not considered as highly skilled, from their childhood.

The supplying trades of sailmaking and net making were also specialized. Worcester reports for the 1930s that all nets used in the Ningbo fishing industry were manufactured in only two or three places, where the population mainly or exclusively relied on net production. As in the sailmaking trade, the entire family was engaged. While the sailmakers did not process the yarn or weave the sail cloth on their own, the net makers’ families processed the raw material hemp from the stalk to the finished product.

According to Worcester, all work in these handicraft shipyards was exclusively handwork, marking a strong contrast to the fully mechanized workshops of the government and foreign steamship manufacturers.

The Workforce of the Jiangnan Arsenal and the Fujian Navy Yard

Unlike the management of the government shipyards under the Ministry of Public Works, the concerns of the Jiangnan Arsenal and the Fujian Navy Yard were more in the domestic and international limelight. Therefore, the information on its workforce also stands out in clearer profile than the rather indirect conclusions we can gain for the previous periods.

The first big difference between traditional provincial shipyards and their mechanized counterparts was the size of their workforces. At the Jiangnan Arsenal, the workforce rose from about 200 Chinese workers (including 100 from Thomas Hunt and Company and 100 from two smaller Shanghai arsenals that had been retained, as well as eight foreign technicians) to 1,300 Chinese and 13 foreigners by 1869. In 1876 it consisted of ca. 2,000 Chinese workers. After 1890, the workforce increased to about 3,000.
From the monograph on the arsenal published in 1905, Chinese historians have extracted the following figures.

**Table 26  Number of workers in the Jiangnan Arsenal in 1905**

<table>
<thead>
<tr>
<th>Work type</th>
<th>Number</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skilled workers (工匠)</td>
<td>2,314</td>
<td>Including child labour (童工)</td>
</tr>
<tr>
<td>Unskilled workers for odd jobs (小工)</td>
<td>486</td>
<td></td>
</tr>
<tr>
<td>Porters (夫役)</td>
<td>40</td>
<td>Not engaged in production</td>
</tr>
<tr>
<td>Total</td>
<td>2,840</td>
<td></td>
</tr>
</tbody>
</table>


However, these workers were not all shipbuilders. At the time of stocktaking, no new ships had been built at the arsenal for twenty years. Nevertheless, the monograph lists the administrative and productive personnel of the ‘Steamship plant’ *lunchuan chang* as follows: one *weiyuan* (commissioner), two overseers (*sishi*), three foremen (*jiangmu*), 105 skilled workers (*gongjiang*), and 72 unskilled workers (*xiaogong*),\(^{46}\) who must have been employed for maintenance and repair services.

The arsenal was guarded by 100 patrol soldiers (*fanghuying*) and 270 artillery soldiers (*paoduiying*) whose task was not only to test the weapons but also to keep the workers under control.\(^{47}\) The 133 administrative positions that had accumulated over time were reduced to 80 between 1885 and 1890.\(^{48}\)

At the Fujian Navy Yard, the workforce rose from about 300 at its foundation in 1867 to 500 in 1869 and to as much as 3,000 at the peak of the construction process. Thereafter, the normal level was about 1,900, including 600 employed at the dockyard, 800 in the workshops, and 500 porters. Moreover, 500 soldiers guarded the premises and were also employed for unskilled manual labour, similar to the case of the Dragon River Shipyard 340 years earlier. The administrative staff was formed by about 150 members, most of whom came from the local gentry.\(^{49}\)

Both institutions initially encountered difficulties finding skilled labour. According to the 1975 history of the arsenal, at first skilled workers from the Hunt Shipyard were hired but also Qing army soldiers from the smaller

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\(^{46}\) Wei Yungong, *Jiangnan zhizaoju*, chap. 2, fol. 4b.

\(^{47}\) *Jiangnan 1975*, p. 19.


\(^{49}\) Pong, *Shen Pao-chen*, p. 209.
Shanghai ammunition and ordnance arsenals that had been merged with the Hunt Shipyard to form the Jiangnan Arsenal. After the arsenal moved to the bigger site in the southern suburbs of Shanghai, new recruitment methods were tried out. Recruitment officers travelled to exterior provinces and hired skilled workers, demobilized Anhui and Hunan soldiers, and children from orphanages. Working at the arsenal was not popular with the farmers who lived nearby. According to the 1975 history, they resented the fact that their land had been expropriated and worked at the arsenal only if they had gone bankrupt. The 1983 history identifies the fear of machine production and the strict military control of the workplace as reasons for local resentment.

Experienced workers were few at the time of the foundation and still by 1894, only eight percent of all Shanghai workers were employed in mechanized production. This constituted 3.84 percent of the workforce in the ‘modern industrial’ sector of the entire country. The skilled – and also unskilled – non-local workforce often came from Hong Kong and treaty port cities, especially Canton, Fuzhou, and Ningbo. In 1898, one of the streets in front of the arsenal was called ‘Guangdong Street’ because many Guangdong natives lived and worked there. The Fujian Arsenal initially also experienced a shortage of skilled workers. Blacksmiths and carpenters had to be hired from Shanghai and Hong Kong. Later, most workers could be recruited locally.

In the so-called sub-contractual system (baogongzhi), workers were recruited by intermediary agents, often foremen or low-level officials. The workers depended on the recruiters for their wages, and the recruiters were responsible for the workers’ personal conduct and work performance. In the arsenal, this method seems to have officially started in the early twentieth century, when about 70 percent of the workers were hired as sub-contractual labour and only 30 percent had a permanent position. One of the undesirable consequences of the sub-contracting system was that the intermediaries could abuse their power in many ways, and they often squeezed money out of the contract workers. This occurred in the Jiangnan Arsenal as well as in the Navy Yard after the demise of the first director Shen Baozhen. When considering the wage levels of these institutions, therefore, it is important to keep in mind that not the entire wage may have arrived in the hands of the workers.

51 Jiangnan 1983, p. 86.
52 Ibid.
53 Ibid., p. 87.
54 Pong, Shen Pao-chen, p. 208, 212.
55 Cornet, Etat et entreprises, p. 127.
56 Ibid.; Pong, Shen Pao-chen, p. 212.
Working Conditions and Wage Payment

At the Navy Yard in Fuzhou, all workers received contracts for five years. They worked a six-day week with few holidays, one each in spring and autumn and one week at New Year. A leave of 21 days was granted for mourning deceased parents – which was short in comparison to the hundred-day leave given to the students of the Navy Yard School for the same circumstances. The working hours were 8½ hours in winter, nine in spring and autumn, and ten in summer for the skilled workers, who on average received 7 to 21 tael per month.

Unskilled workers were paid 4.5 to 7 tael per month for an eleven-hour day. Further wage incentives were given to skilled labour recruited in Hong Kong and Shanghai. Foremen could earn 21 to 49 tael a month.

According to the 1975 history, wages at the Jiangnan Arsenal ranged on average between five to ten silver dollars (yinyuan) per month, which amounts to 3.75 to 7.5 tael. Skilled wages were about 7.5 tael, while unskilled and children’s wages were between 3.75 and 4.5 tael. Monthly salaries of officials varied from 200 Hunan tael for a director-general (zongban), 150 tael for a director (huiban), 80 tael for a coordinator (tidiao), and 25 to 30 tael for commissioners (weiyuan) and overseers (sishi).

On the basis of the 1904 account of the Jiangnan Arsenal, the 1983 history calculated some of the wages.

The 1975 history has a similar table based on the same source but with slightly differing daily rates in silver dollars: skilled workers 0.56 dollars; child workers 0.21 dollars; unskilled workers 0.176 dollars; porters less than 0.1 dollars. The slight difference is due to the fact that the wages were notated as lump sums for the different departments of the enterprise and that the disbursed currencies and rhythms of wage and salary payment differed. Foreign specialists were paid monthly in pound sterling (yingbang) and Chinese administrative commissioners in silver tael. Foremen, skilled workers, and child workers received daily wages in silver dollars (yangyuan), and unskilled labourers in copper cash.

Arsenal wages in 1904 were about average for factory work in Shanghai, where skilled carpenters, smiths, and dock workers (qugong) earned between

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57 The following information about wages, working times, and labour organization are all from Pong, Shen Pao-chen, pp. 210-212, who collected them from several sources which show variances in the range of 20 to 40 percent.
58 Jiangnan 1975, p. 20.
59 1.0363 Hunan tael corresponded to 1 standard treasury tael.
60 Jiangnan 1975, p. 33.
61 Ibid., p. 30.
62 Wei Yungong, Jiangnan zhizaoju, chap. 2, fol. 3a.
0.6 and 0.85 silver dollars per day. The ‘child labour’ force (*tonggong* or *youtong*) is explained as a group of ‘apprentices’ (*yitu*), but in the view of Chinese historians it actually was exploitative child labour. Conclusive evidence about the age at which children started working is not available. One old arsenal worker cited in the 1975 history said that his father joined the arsenal at the age of ten. In 1904, about 300 child workers and 400 unskilled workers were employed. The 1975 history states that the conversion between various types of silver dollars (big and small) when the wages were paid out was to the advantage of the officials at the expense of the wage earners. Unskilled labourers were paid in debased cash of low value. Thus, deductions from the wage rates stated in the sources were frequently made. One director in 1903 reported as one of his achievements that during his tenure the wages were paid out in full without deductions; this implies that before then, wages were cut. As in Fuzhou, the working week had six days. Until 1890, the Jiangnan Arsenal workers had an eight-hour day, but thereafter the norm was nine hours.

Accounts both of the Fujian Navy Yard and the Jiangnan Arsenal stress the huge differences between the Chinese wages and the salaries of the foreign specialists. In Fuzhou, the wages of the foreigners between 1868 and 1874 ‘constituted the largest item of maintenance’: 12,000 tael per month out of total operation costs of between 50,000 and 80,000 tael, while the labour costs for about 2,000 Chinese were 10,000 tael per month. Assuming there were about 50 French and English experts, their average salaries would

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### Table 27 Daily wage rates at the Jiangnan Arsenal in 1904

<table>
<thead>
<tr>
<th>Designation</th>
<th>Average daily wage (silver dollar <em>yinyuan</em>)</th>
<th>Conversion to tael (calculation by author)</th>
<th>Rice value (<em>shijin</em>, 0.5 kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreign technician</td>
<td>11.433</td>
<td>8.57475</td>
<td>357.28</td>
</tr>
<tr>
<td>Managers (administrative) overseers</td>
<td>1.773</td>
<td>1.32975</td>
<td>55.41</td>
</tr>
<tr>
<td>Foremen</td>
<td>1.746</td>
<td>1.3095</td>
<td>54.56</td>
</tr>
<tr>
<td>Skilled workers</td>
<td>0.652</td>
<td>0.489</td>
<td>20.38</td>
</tr>
<tr>
<td>Child worker</td>
<td>0.207</td>
<td>0.15525</td>
<td>6.47</td>
</tr>
<tr>
<td>Unskilled workers</td>
<td>0.166</td>
<td>0.1245</td>
<td>5.19</td>
</tr>
</tbody>
</table>


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63 *Jiangnan* 1975, p. 20.
64 Ibid., p. 31, 33.
have been about 240 tael. Likewise, the Jiangnan Arsenal salaries ranged between 160 and 270 tael per month. By comparison, the nominal wages in Fuzhou were slightly higher than those in Shanghai.

**Work Discipline and Living Conditions**

Since the Jiangnan Arsenal and the Fujian Navy Yard stood under the overall control of the Ministry of War and produced exclusively for defence, military discipline was enforced on the work sites. In retrospect, Shen Baozhen's administrative and educational achievements as director of the Fujian Navy Yard between 1868-1875 stand out clearer than those of his colleagues in Shanghai, the Shanghai Circuit Intendants Ding Richang (1823-1882) and Ying Baoshi, and the Directors Han Dianjia, Shen Baojing, and Feng Jinguang. In his study on this administrator, David Pong argues that while Shen had internalized traditional elite values, for instance a disdain for physical labour and exercise, he nevertheless sought to introduce elements of Western learning even in the curricula for the apprentices and the workers and decidedly advocated a general revision of the official educational system. Shen Baozhen vigorously enforced discipline at the shipyard, the schools, and the workers' living quarters. These dormitories at first were overcrowded, but soon more houses were built to provide for more space and to improve hygiene. Movement between the dormitory wards was forbidden at night, and within the wards, drunkenness, gambling, opium smoking, and rowdiness were all heavily sanctioned.

This type of management reflects a Confucian authoritarian approach and also a scholar-gentry bias against the lower classes. At the same time, while Shen was in control, he tried to enforce the same discipline on all employees of the shipyard, including the mid and low-level administrators, in order to prevent corruption. Punishments could be draconian: one man was tried and executed for stealing brass in 1869.

What did this mean for the workers in the shipyard? Paternalistic attitudes and disregard of physical labour on the part of administrative elites were common in the mid-nineteenth century. Disciplinary enforcement certainly was not unknown in the army and military production sites. Nonetheless, protection against corruption can only have been welcome. Compared to

68 Ibid., p. 209.
the Shanghai Arsenal, wages at the Fujian Navy Yard were relatively high. Finally, the young workers had the opportunity to pursue vocational training and basic education in the apprentice classes. The idea that some of the apprentices should receive more intensive training to raise them above the level of foremen probably came from the foreign consultants rather than the Chinese directors, but the fact that they agreed to such reforms shows a degree of openness on the part of the Chinese administrators. The presence of foreigners and the necessity to learn from them in their own languages, although disturbing to orthodox elites outside the shipyard, may have been an attractive benefit for some of the younger workforce.

Reports and assessments of the Jiangnan Arsenal are quite somber, especially with regard to the workforce and the living conditions. The 1975 and 1983 histories are certainly prejudiced against the administration and on some points are rather exaggerated in their indignation. Hardly any contemporary or present-day military production site worldwide would allow its workers come and go without security controls, and harsh punishment in case of disobedience was not exceptional to this industry. The authors’ claims of arrogance on the part of the officials towards the workers are plausible; it may well be that the officials – or at least some of them – regarded the workforce as mere ‘corvée labourers in official service’ (zai guan renyi), as the 1975 history charges.69 However, it was perfectly clear to the officials that they had to pay these workers, especially the skilled among them, if they were to stay on. That work accidents often occurred and were insufficiently or not at all insured was again a common contemporary phenomenon worldwide in the early industrial phases, which by then was just beginning to be addressed by the labour movements in Western countries. Nevertheless it shows little consideration for the workforce if no invalidity insurances were provided for workers but only for the administrative staff who died on duty.70

Moreover, we must take into account the reports on corporal punishment, the exploitation of workers – especially young children – and most of all the poor and cramped housing conditions in the arsenal dormitories with a mere 100 bays (jian) of housing for 1,300 workers in low, dark, and moist rooms in the vicinity of the Huangpu River.71 After some time, the obligation to live in these dormitories was lifted, but for many workers, the housing

70 Ibid., p. 34, cites the case of one official of the lowest rank (sishi, overseer) who died on duty. His family received a compensation of 2,000 tael. If workers died on duty, the Arsenal only covered the costs of a simple coffin and a low sum for funerary expenses.
71 Jiangnan 1975, pp. 20-21. The measure of the bay (jian) length varies between 2.5 m and 5.5 m; each room for thirteen workers each can hardly have been more than 30 square meters.
outside the arsenal did not offer much of an improvement. Sometimes these facilities were even worse, with no access to clean water or sanitation. Moreover, between 1870 and 1905, rice prices increased by 66 percent and coal prices by 38 percent, while wages stagnated. As a result, some of the unskilled labour and porters could never afford to marry and have a family. In the case of families, all members had to work to support themselves – a fact that on its own cannot be considered an indication of exploitation in the contemporary context, even if the 1975 history implies this.72

Strikes and workers’ protests in the Jiangnan Arsenal were triggered by the long working hours and the brutal treatment workers received from officials and overseers. The first recorded strike occurred in 1883, and between 1905 and 1927, about ten strikes were resolved.73 In view of the unfavourable conditions, the number of strikes may seem to be low, but the workplace was heavily guarded and protesters were more likely to be heavily punished than in other industries. At the Fujian Navy Yard, at least during Shen Baozhen’s term of administration, no strikes were reported.74

The Fujian Navy Yard may have been a better organized workplace in its initial phase with a more enduring leadership, slightly higher wages, and better housing facilities. The military drill and discipline may have been stricter here, but since the orientation towards shipbuilding and the acquisition of skills was clear from the beginning, also for apprentices, technical learning may have been easier to accomplish in this institution.

Conclusion

From the perspective of the artisans, the observed periods witnessed change and acceleration in much more drastic ways than in the centuries before. The Ming-Qing transition brought about the legal abolition of corvée labour. As a rule, labour was hired in the government shipyards, but for building the ships of the naval forces, soldiers were probably engaged as unskilled workers, as in the late Ming. The scant evidence we possess suggests that building ships for the government was not well paid. Clearly the prices for

72 See ibid., p. 31, for a case where an Arsenal worker raised vegetables after work and sold them to increase the family income, while his 14-year old son also worked in the Arsenal and his daughter made stockings.
73 Cornet, Etat et entreprises, p. 138.
74 The only report of unrest at the shipyard dates from 1899, when a contest of skills between the Chinese and foreign workers flared up into a riot. Chinese workers were wounded, and a strike followed. Li Yunjun, Wan Qing, p. 786, Nov. 28.
government ships were procurement costs at a rate much lower than those on the free market. The question remains whether this price difference was mainly due to the prices for materials, which had been rising since the late Ming, or whether it was also affected by the artificially low wages paid by the government.

The rise of steam navigation in China proceeded at a fairly slow pace, while trade volumes increased much faster due to China’s rising participation in the world market. Traditional wooden sailing ships were built by private shipyards for at least one or two more decades after the fall of the Qing dynasty. In the area of mechanized production of steamships, artisans turned into industrial workers. We may wonder whether that was a desirable process for those personally involved. Initially, the wages and working hours seem to have been more acceptable; but inadequate housing and the strict military control of work on the sites, at least in the Jiangnan Arsenal, must have made work unattractive. The situation deteriorated rather than improved after the arsenal was managed as a private enterprise. Nevertheless, this was a place for learning mechanized production on the job as well as for receiving a more formalized education. Moreover, working conditions for apprentices in the private sector, judging from the accounts given in Reed’s work on early printing machinery production, do not seem to have been much better.\footnote{Reed, \textit{Gutenberg}, p. 147.} The Shanghai Arsenal was an important institution for spreading technological know-how, despite difficult working conditions. It is no coincidence that in the early days of the printing machine industry – in which Shanghai became leading in the early twentieth century\footnote{Ibid., p. 134.} – mechanics who had previously worked at the arsenal started to develop machines rather than just concentrating upon repair and maintenance.\footnote{Ibid., p. 146.}

Shipbuilding between the seventeenth and early twentieth centuries passed through two phases of more rigorous control by the central government and the gradual takeover by regional and merchant elites: between the 1650s and the 1830s, and between the mid-1860s and the end of the dynasty. In the second, much shorter phase, government shipbuilding served as a kind of catalyst that eventually spread new knowledge and skills into sectors that were beyond the direct influence of the government. Thus, even if government institutions could not promote economical production and could not keep up with the latest technology, they were actively behind the launch of modernization in shipbuilding and in the supply of raw materials in China.
Throughout his work *Setting Sails*, Derek Maitland stresses the continuity in the construction of junks up until the late 1970s. The illustrations for the book were taken by photographer Nik Wheeler, who kindly provided several of his pictures and granted permission to reproduce them.
Figure 8  Compartments within the hull construction

Photograph: Nik Wheeler, reproduced with permission. See also Maitland, Setting Sails, p. 60.
Figure 9  The caulking procedure

Photograph: Nik Wheeler, reproduced with permission. See also Maitland, Setting Sails, p. 61.
## Appendix

### Table 28  Regular positions in the imperial Dragon River Shipyard, Nanjing, 1553

<table>
<thead>
<tr>
<th>Number of staff</th>
<th>Chinese</th>
<th>Transcription</th>
<th>Translation</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>廊長</td>
<td>xiangzhang</td>
<td>Group leaders¹</td>
</tr>
<tr>
<td>45</td>
<td>作頭</td>
<td>zuotou</td>
<td>Foremen²</td>
</tr>
<tr>
<td>38</td>
<td>內官監匠</td>
<td>neiguanjian jiang</td>
<td>Artisans for the Eunuch Bureau³</td>
</tr>
<tr>
<td>4</td>
<td>御馬監匠</td>
<td>yumaijiang jiang</td>
<td>Artisans for the Imperial Stables⁴</td>
</tr>
<tr>
<td>3</td>
<td>丁字庫匠</td>
<td>dingziku jiang</td>
<td>Artisans of the T-shaped storehouse⁵</td>
</tr>
<tr>
<td>2</td>
<td>寶船匠</td>
<td>baouchuanjiang jiang</td>
<td>Shipbuilders of the Treasure Ship Shipyard⁶</td>
</tr>
<tr>
<td>3</td>
<td>酒醋麴庫匠</td>
<td>jiucumianju jiang</td>
<td>Artisans in the Imperial Wine and Vinegar Press and Noodle Store⁷</td>
</tr>
<tr>
<td>37</td>
<td>後湖水夫</td>
<td>houhu shuifu</td>
<td>Sailors of the Posterior Lake⁸</td>
</tr>
<tr>
<td>20</td>
<td>看料匠丁</td>
<td>kanliao jiangding</td>
<td>Artisan-guardians for the material storage⁹</td>
</tr>
<tr>
<td>15</td>
<td>更夫</td>
<td>gengfu</td>
<td>Night watchmen</td>
</tr>
<tr>
<td>4</td>
<td>橋夫</td>
<td>qiaofu</td>
<td>Bridge guards</td>
</tr>
<tr>
<td>1</td>
<td>腳頭</td>
<td>jiaotou</td>
<td>Foreman of the porters</td>
</tr>
<tr>
<td>1</td>
<td>船戶</td>
<td>chuanhu</td>
<td>Shippers</td>
</tr>
<tr>
<td>1</td>
<td>佃戶</td>
<td>dianhu</td>
<td>Tenants</td>
</tr>
<tr>
<td>16</td>
<td>上作頭</td>
<td>shangzuotou</td>
<td>Superior foremen,¹⁰ working as:</td>
</tr>
<tr>
<td>3</td>
<td>蓬作</td>
<td>pengzuo</td>
<td>Sailmakers</td>
</tr>
<tr>
<td>1</td>
<td>旗作</td>
<td>qizuo</td>
<td>Flag maker</td>
</tr>
<tr>
<td>1</td>
<td>油畫作</td>
<td>youhuazuo</td>
<td>Painter and paint maker</td>
</tr>
<tr>
<td>1</td>
<td>皷作</td>
<td>guzuo</td>
<td>Drum maker</td>
</tr>
</tbody>
</table>

¹  Group leaders: The artisans were divided into four groups (xiang) according to their specific branch: 1) Makers of wooden parts, oars, and ropes; 2) Shipwrights, smiths, and ropemakers for heavy ropes; 3) Caulkers; and 4) Mat and sailmakers. Each group was divided into ten units (jia), and each of the ten units originally consisted of ten families. Each group was supervised by a group leader, who was chosen among them on a rotational basis for three months. Many of the artisans quit, however, so that the actual figures are given as 245 in 1541 and below 200 in 1551. See Scheuring, Drachenfluß-Werft, p. 84.

²  Foremen were chosen from the families that rendered more than one member’s labour.

³  Artisans for the Eunuch Bureau: Shipyard artisans who worked for the eunuchs in the palace and formed ceremonial vessels. The shipyard paid their wages.

⁴  Artisans for the Imperial Stables: Shipyard artisans who produced mangers and drinking buckets for the Imperial Stables.

⁵  Artisans in the T-shaped Storehouse built wooden containers for fish oil used in caulking.

⁶  Although the storehouses of the Treasure Ship Shipyard were dilapidated, two artisans were commanded to work there.

⁷  The artisans in the Imperial Wine and Vinegar Press and Flour Store were hired out, like their colleagues who were sent to the Imperial Stables.

⁸  This was a popular odd job for shipyard artisans because work was lighter than in the yards.

⁹  Artisan-guardians for the material storage: Originally the artisans worked as guardsmen, too, but this assignment was stopped in 1508, and people from outside were hired for the security service.

¹⁰  The Superior foremen were directly subordinated to the Ministry of Public Works and probably responsible for special tasks, such as interior decoration.
<table>
<thead>
<tr>
<th>No.</th>
<th>Craft branch</th>
<th>Transcription</th>
<th>Translation</th>
<th>Working units (man-days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>船木作</td>
<td>chuanmu zuo</td>
<td>Shipwrights</td>
<td>780</td>
</tr>
<tr>
<td>2</td>
<td>錾作</td>
<td>zuo</td>
<td>Sawyers</td>
<td>225</td>
</tr>
<tr>
<td>3</td>
<td>裝修作</td>
<td>zhuangxiu zuo</td>
<td>Interior decorators</td>
<td>310</td>
</tr>
<tr>
<td>4</td>
<td>雕鑾作</td>
<td>diaoluan zuo</td>
<td>Wood carvers</td>
<td>58</td>
</tr>
<tr>
<td>5</td>
<td>錾作</td>
<td>zuo</td>
<td>Sawyers</td>
<td>74</td>
</tr>
<tr>
<td>6</td>
<td>舵作</td>
<td>nianzuo</td>
<td>Caulkers</td>
<td>300</td>
</tr>
<tr>
<td>7</td>
<td>鈍灰，糊麻，扯鑽</td>
<td>chunhui, qima, zhizuan</td>
<td>Lime grinders, hemp cutters, nail hole drillers</td>
<td>43.5</td>
</tr>
<tr>
<td>8</td>
<td>鐵作</td>
<td>tiezuo</td>
<td>Ironsmiths</td>
<td>130</td>
</tr>
<tr>
<td>9</td>
<td>上鐵作</td>
<td>shang tiezuo</td>
<td>Superior smiths</td>
<td>27.5</td>
</tr>
<tr>
<td>10</td>
<td>蓬作</td>
<td>pengzuo</td>
<td>Mat makers</td>
<td>91.5</td>
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<tr>
<td>11</td>
<td>索作</td>
<td>suozuo</td>
<td>Rope makers</td>
<td>74</td>
</tr>
<tr>
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<td>shang suozuo</td>
<td>Superior rope makers</td>
<td>1.5</td>
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<tr>
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<td>纏作</td>
<td>lanzuo</td>
<td>Truss makers</td>
<td>29.5</td>
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<tr>
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<td>竹作</td>
<td>zhuzuo</td>
<td>Bamboo winders</td>
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</tr>
<tr>
<td>15</td>
<td>油漆作</td>
<td>youqi zuo</td>
<td>Painters, paint makers</td>
<td>133</td>
</tr>
<tr>
<td>16</td>
<td>五墨作</td>
<td>wuhei zuo</td>
<td>Paint makers</td>
<td>32.5</td>
</tr>
<tr>
<td>17</td>
<td>鋪鑾作</td>
<td>zhuangluan zuo</td>
<td>Curtain makers and interior decorators</td>
<td>8</td>
</tr>
<tr>
<td>18</td>
<td>抹金作</td>
<td>mojin zuo</td>
<td>Gilders</td>
<td>4</td>
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<tr>
<td>19</td>
<td>旋作</td>
<td>qizuo</td>
<td>Flag makers</td>
<td>6</td>
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<tr>
<td>20</td>
<td>鼓作</td>
<td>guzuo</td>
<td>Drum makers</td>
<td>6</td>
</tr>
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<td>21</td>
<td>瑟絃作</td>
<td>like zuo</td>
<td>Shell polishers</td>
<td>23.5</td>
</tr>
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<td>繡作</td>
<td>yingzuo</td>
<td>Tassel makers</td>
<td>2.5</td>
</tr>
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<td>旋作</td>
<td>xuanzuo</td>
<td>Winch makers</td>
<td>5</td>
</tr>
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<td>No.</td>
<td>Craft branch</td>
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<td>Translation</td>
<td>Working units (man-days)</td>
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<td>--------------</td>
<td>---------------</td>
<td>-------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>24</td>
<td>染作</td>
<td>ranzuo</td>
<td>Dyers</td>
<td>103</td>
</tr>
<tr>
<td>25</td>
<td>裁縫作</td>
<td>cafeng zuo</td>
<td>Tailors</td>
<td>9.5</td>
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<td>擺錫</td>
<td>boxi zuo</td>
<td>Tin casters</td>
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<td>shuangxian zuo</td>
<td>Leather workers</td>
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<td>缝作</td>
<td>taozuo</td>
<td>Silk ribbon makers</td>
<td>4</td>
</tr>
<tr>
<td>29</td>
<td>穿椅作</td>
<td>chuanyi zuo</td>
<td>Hammock chair makers (?)</td>
<td>6</td>
</tr>
<tr>
<td>30</td>
<td>桶作</td>
<td>tongzuo</td>
<td>Vat makers</td>
<td>12.5</td>
</tr>
<tr>
<td>31</td>
<td>銅作</td>
<td>tongzuo</td>
<td>Copper smiths</td>
<td>21.5</td>
</tr>
<tr>
<td>32</td>
<td>鐘銅作</td>
<td>xiangtong zuo</td>
<td>Gong and bell makers</td>
<td>14</td>
</tr>
<tr>
<td>33</td>
<td>鎮作</td>
<td>zhuzuo</td>
<td>Metal casters</td>
<td>5</td>
</tr>
</tbody>
</table>


Scheuring translates this as ‘Hängestuhlbauser’ (*Drachenfluß-Werft*, p. 159).

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**Table 30**  Shipping tonnage of the China Merchants’ Steam Navigation Company and the China Navigation Company (founded in 1872 by Butterfield and Swire)

<table>
<thead>
<tr>
<th></th>
<th>China Merchants’ Steam Navigation Company</th>
<th>China Navigation Company</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of Ships</td>
<td>Tonnage</td>
</tr>
<tr>
<td>Fleet during 1877</td>
<td>33</td>
<td>23,967</td>
</tr>
<tr>
<td>Additions, 1877-93</td>
<td>16</td>
<td>15,378</td>
</tr>
<tr>
<td>Losses and Wrecks, 1877-93</td>
<td>9</td>
<td>6,759</td>
</tr>
<tr>
<td>Dismantled, 1877-93</td>
<td>11</td>
<td>7,128</td>
</tr>
<tr>
<td>Sold, 1877-93</td>
<td>3</td>
<td>2,174</td>
</tr>
<tr>
<td>Fleet during 1893</td>
<td>26</td>
<td>23,284</td>
</tr>
</tbody>
</table>

Figure 10  Number of sailing ships entered and cleared in Shanghai, 1902-1941


Figure 11  Number of steamships in Chinese possession, 1882-1921

Figure 12  Tonnage of steamships in Chinese possession, 1882-1921


Figure 13  Numbers of steamships and sailing ships on the Yangzi in Sichuan, 1891-1932

Figure 14  Tonnage of steamships and sailing ships on the Yangzi in Sichuan, 1891-1932


Figure 15  Number of steamships and sailing ships on the Yu River in Guangxi, 1922-1931

Source: Yan Zhongping, Zhongguo jindai jingjishi tongji ziliao xuanji, p. 236. The ships circulated on the Yu River 郁江, a tributary to the Xijiang 西江, between Nanning in West Guangxi and Wuzhou in East Guangxi.
Figure 16  Tonnage of steamships and sailing ships on the Yu River in Guangxi, 1922-1931

Source: Yan Zhongping, Zhongguo jindai jingjishi tongji ziliao xuanji, p. 236.