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## Seeking employment during Japan's early industrialisation: new engineering graduates and their struggles before 1900

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### Abstract

This article examines the social background of engineers in Meiji Japan by analysing their employment-seeking activities and their role in fostering industrial development. In particular, it focuses on the graduates from the Imperial College of Engineering (ICE) in Tokyo. One of the most prestigious schools for technical education, the ICE was established by the Meiji government in 1871 and opened in 1873. In traditional Japanese society, the handicraft manufacturing sector was held in low regard. The difficulties that graduates faced while the industry was still developing serve as a stark reminder of the widespread contempt and disdain for manufacturing that existed in Japan before the new profession of engineer gained traction. By scrutinising the memoirs of these engineers, this study shows that new engineering graduates faced barriers to employment in industry due to the low social prestige of those working in manufacturing in the private sector and the conflict with traditional workers, as well as the fact that private companies could not afford to employ engineers in the early years of industrialisation.

**Keywords:** Imperial College of Engineering; Japan's early industrialisation; Meiji Japan

### Introduction

Technical schools were established a few years after the Meiji Restoration, which occurred in 1868; subsequently, graduates appeared in society as engineers and gradually replaced traditional foremen in manufacturing. Eminent sociologists Hans Gerth and C. Wright Mills formulated the idea of the replacement of 'occupations' in 'stratification and institutional orders' and discussed this phenomenon in terms of proximity to centres of power.<sup>1</sup> Engineers—the new occupation examined in this study—can be recognised in terms of their theory as replacing traditional artisanal workers because of their proximity to the Meiji government's policy of rapidly introducing Western technology.

The significance of school for obtaining a job varies from country to country. Educational sociologist Ronald Dore has described the 'late-development effect', arguing that the later modernisation occurs, the faster the transition to demands for an academic qualification for job entry. Once the profession of engineers emerged, the conferring and acquiring of qualifications at school before employment was established in Japan much more rapidly than in Britain.<sup>2</sup>

<sup>1</sup> H. Gerth and C. W. Mills, *Character and Social Structure: The Psychology of Social Institutions* (New York, 1953), p. 330.

<sup>2</sup> R. P. Dore, *The Diploma Disease: Education, Qualification, and Development* (Berkeley and Los Angeles, 1976), p. 42. In Britain, a regular route for training engineers existed separately from universities. Therefore, the British

However, the status of engineers who graduated from universities in Japan was not immediately established. For example, historian of technology Shōichi Ōyodo examined the Kōseikai, a group formed in 1918 by leading engineers, and found that engineers and industrial managers were struggling to raise the status of engineers in government and commerce, which were led by the juristic elite.<sup>3</sup> Furthermore, historian Aaron Stephen Moore discusses how Japanese engineers were eager to improve their status by promoting technology in developing colonies in China and Korea as late as the inter-war period.<sup>4</sup>

Early Japanese university-educated engineers could not apply their knowledge and skills immediately after graduation. In terms of production skills, the traditional foremen who were in charge of construction sites had the upper hand. Furthermore, before the Meiji Restoration in 1868, there was a prejudice against occupations involving manufacturing. As a result, becoming an engineer was not initially an aspirational profession in Japan. This article explores the difficulties faced by early graduates and how they overcame them.

### Target and method

This article discusses the relationship between technical education and industrialisation by examining the employment-seeking process of engineering graduates of the Imperial College of Engineering (ICE) in Tokyo—one of Japan's earliest institutions of higher technical education.<sup>5</sup> To support and promote Japan's industrialisation, the Meiji government established the Ministry of Public Works in 1870. This was an essential institutional development. At that time, the Ministry of Public Works relied on hiring foreign engineers to whom it paid exorbitant salaries. Training Japanese engineers to replace foreign engineers became a solution to reduce costs. When the modern Western-style education system was introduced into Japan, some ministries began to develop rapid training programmes.

In 1871, the Ministry of Public Works established a systematic educational institution named Kōgaku-ryō (Engineering Board) for training engineers. The school opened in 1873 and was renamed Kōbu-dai-gakkō (the ICE) in 1877. The first 23 students majored in one of seven engineering courses and graduated in 1879 after completing a six-year programme.<sup>6</sup>

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tradition of emphasising practical experience and neglecting theory hindered the development of engineering education at universities. Educational historian Shin Hirose argues that a strong tradition of on-the-job training in Britain continued until before World War II. See S. Hirose, *Igirisu gijutsusha yōsei-shi no kenkyū* (Tokyo, 2012).

<sup>3</sup> S. Ōyodo, *Kindai Nihon no kōgyō rikkokuka to kokumin keisei* (Tokyo, 2009).

<sup>4</sup> A. S. Moore, *Constructing East Asia: Technology, Ideology, and Empire in Japan's Wartime Era, 1931–1945* (Stanford, 2013), specifically pp. 64–101.

<sup>5</sup> The introduction of technical education in Japan was led by the government. The main trend was to prioritise the education of high-level engineers and delay the education of those at the intermediate level and below. One of the representative schools for intermediate technical education was Seisaku-gaku Kyōjō (Manufacturing School), which was established by the Ministry of Education in 1874 and closed within three years because it offered only simple 'lay practice'. See M. Wada, 'The fall of the Imperial College of Engineering: from the Imperial College of Engineering (Kōbu-dai-gakkō) to the Faculty of Engineering at Imperial University, 1886', in *Accessing Technical Education in Modern Japan*, (eds.) E. Pauer and R. Mathias (Kent, 2022), pp. 161–88. Other examples include Tokyo Shokkō-gakkō (Tokyo Vocational School, later the Tokyo Institute of Technology), founded in 1881 by the Ministry of Education, and a private technical school, Kōshu-gakkō (later Kōgakuin University), established in 1887.

<sup>6</sup> The seven courses were civil engineering, mechanical engineering, telegraphy, architecture, practical chemistry, mining, and metallurgy. These were influenced by the wide range of departments established in the Ministry of Public Works. The course of naval architecture was added in 1882. It is conceivable to consider the differences among these fields but, due to the limited number of memoirs written by graduates in each field, it was not possible to address them in this article.

When the Ministry of Public Works was abolished in 1885, the ICE was transferred to the Ministry of Education. One year later, the ICE was further transformed into the College of Engineering of the Imperial University.<sup>7</sup> By 1886, 493 students had been admitted to study at the ICE; among them, 211 graduated from the school and another 100 graduated from the Imperial University.<sup>8</sup> Engineers who entered the ICE and finished the programme there or at the Imperial University constitute the main subjects of this study.

Numerous previous studies have examined the relationship between technical education and industrial development in Meiji Japan. Educational sociologist Ikuo Amano, business historian Ryōichi Iwauchi, and historian of technology Hoshimi Uchida conducted statistical analyses on the employment structure of engineers.<sup>9</sup> The educational backgrounds and promotions of engineers were analysed by business historian Naofumi Nakamura for the railway industry and by historian Seiji Tsunekawa for electrical engineering and civil engineering.<sup>10</sup> My earlier study of the ICE also provides a critically renewed evaluation for operation systems.<sup>11</sup>

Based on this rich previous scholarship, this article examines the previously neglected job-seeking difficulties faced by ICE graduates. It analyses published memoirs by engineers to reveal their employment-seeking process, especially when they first entered the job market as fresh graduates. Since handicrafts and manufacturing occupations were held in low esteem in Japanese tradition and these early engineering graduates possibly faced similar prejudice. Their memoirs provide invaluable clues to trace their inner struggles to overcome social difficulties. For example, one of the major primary sources in this study is *Kyū Kōbu-dai-gakkō shiryō, furoku* (*Historical Materials on the Former Imperial College of Engineering, Supplement*)—a collection of memoirs by 17 graduates from the ICE that was published in 1931. As part of the compilation of the 50-year history of the University of Tokyo, ICE alumni who were alive at the time were asked to describe their experiences. I have verified its factual reliability.<sup>12</sup>

In addition, by surveying the early university-educated engineers who entered the private sector, I collected an exhaustive list of books dealing with the employment situation up to 1900. I referred to a list of 684 engineers who had graduated from engineering schools and worked for companies by 1905, compiled by business historian Hidemasa Morikawa, and a catalogue of about 300 biographies or autobiographies of engineers who were associated with companies among graduates by the end of the 1920s, compiled by historian of technology Hoshimi Uchida.<sup>13</sup>

<sup>7</sup> The Imperial University (Teikoku-daigaku) was originally called the University of Tokyo and, when it merged with the ICE in 1886, it became the Imperial University. It then became Tokyo Imperial University with the establishment of the second Imperial University in Kyoto in 1897. In 1947, it was renamed the University of Tokyo.

<sup>8</sup> M. Wada, 'Kōbu-dai-gakkō ni okeru kagaku-ka no ichizuke', *Kagakushi kenkyū* 39.2 (2012), pp. 55–78, at p. 71.

<sup>9</sup> I. Amano, 'Sangyō kakumei-ki ni okeru gijutsu-sha no ikusei-keitai to koyō-kōzō', *Kyōiku shakaigaku kenkyū* 20 (1965), pp. 156–73; R. Iwauchi, 'Kindai nihon ni okeru gijutsusha no keisei', *Keiei-shi-gaku* 7.3 (1973), pp. 32–63; H. Uchida, 'Japanese technical manpower in industry, 1880–1930: a quantitative survey', in *Industrial Training and Technological Innovation*, (ed.) H. F. Gosel (New York, 1991), pp. 112–35.

<sup>10</sup> For example, N. Nakamura, *Nihon tetsudō-gyō no keisei* (Tokyo, 1998); S. Tsunekawa, 'Meiji Nihon ni okeru shoki denki gijutsu-sha no bunseki', *Kagakushi kenkyū* 42.225 (2003), pp. 20–30; S. Tsunekawa, 'Meiji-ki Nihon no doboku jigyo o sasaeta gijutsu-sha-shūdan to sono tokuchō', *Kagakushi kenkyū* 44.235 (2005), pp. 177–90.

<sup>11</sup> For example, M. Wada, 'The role of the Ministry of Public Works in designing engineering education in Meiji Japan: reconsidering the foundation of the Imperial College of Engineering (Kōbu-dai-gakkō)', in *Accessing Technical Education in Modern Japan*, (eds.) Pauer and Mathias, pp. 88–113.

<sup>12</sup> For a detailed review of the reliability of the book, see M. Wada, 'Kōbu-dai-gakkō dobokuka no jicchi kyōiku: Ishibashi Ayahiko no kaisō-roku kara', *Kagakushi kenkyū* 53.269 (2014), pp. 49–66.

<sup>13</sup> H. Morikawa, 'Meiji-ki "Kōka-daigaku" sotsu kaisha gishi no risuto', *Keiei shirin* 11.2 (1974), pp. 103–23; H. Uchida, 'Gijutsu-sha denki mokuroku', *Keiei to rekishi* 6 (1983), pp. 35–44.

Memoirs can, of course, contain errors and biased information; subjects may exaggerate their past unfavourable situations. To increase the credibility of testimonies, it is necessary to refer to multiple memoirs and collate them with other information. Many of the memoirs were written late in the lives of the engineers as autobiographies rather than contemporaneously or as biographies by other people involved in the field. It can be assumed that the people who publish autobiographies have attained a fairly successful position and are likely to have an optimistic view of their lives. It should be noted that successful people tend to overstate the difficulties that they have overcome in the past, as is often the case in popular autobiographies. On the other hand, many engineers would not have recorded cases in which they did not consider themselves successful, and it is possible that the experiences of such individuals were even worse than the stories presented here.

### Economy and employment opportunities

When considering employment for graduates of educational institutions, we must look at their relationship with the economy, as these factors are generally correlated. After the long-term recession that began in 1880, the short period between 1886 and 1889 witnessed a sustained ‘boom of enterprise’. Capitalist companies were successively born in response to the government’s financial policy. However, the reaction to the enterprise boom soon led to a depression lasting from 1890 to 1891.<sup>14</sup> Subsequently, the second and third enterprise booms, triggered by economic expansion, occurred during the Sino-Japanese War (1894–95) and Russo-Japanese War (1904–05).<sup>15</sup> Historians refer to this series of industrial expansions from 1886 to the early 1900s as Japan’s ‘industrial revolution’.<sup>16</sup>

Technological innovation also occurred during this period. In his examination of industrial modernisation between 1870 and 1900 with a focus on the spinning sector, Teijirō Muramatsu, a historian of technology, points out the shift from traditional tool-based production processes to mechanical production as an industrial revolution in the spinning industry. He analyses three factors contributing to raising the recognition of the spinning industry among historians of technology as a benchmark for the Japanese industrial revolution. These are as follows: (1) traditional skills were able to play an active role, albeit for a short period; (2) concurrently, the use of Western technology to import entire plants and establish factories failed miserably, contrary to expectations; and (3) finally, there was a collaboration between Japanese engineers (many of whom had studied in the West) and modern industrial capitalists.<sup>17</sup>

Enterprise development and innovation are associated with the expansion of the technical workforce. Table 1 shows the number of engineers by sector in Japan from 1880 to 1920, as reported by the economic historian Hoshimi Uchida. It is important to note the chronological public–private relationship in this table. First, the total number of engineers was 86 in 1880. Initially, they all worked in the public sector. The only sector

<sup>14</sup> N. Takamura, ‘Matsukata defure kara kigyō bokkō e’, in *Kigyō bokkō*, (ed.) N. Takamura (Kyoto, 1992), pp. 1–15.

<sup>15</sup> M. Tanimoto, “‘Sangyō kakumei’ to ‘zairai-teki keizai hatten’”, in *Nihon keizai-shi*, (eds.) M. Sawai and M. Tanimoto (Tokyo, 2016), pp. 143–245, at p. 146.

<sup>16</sup> Japan’s industrial revolution was the process of establishing a capitalist economy that encouraged an increase in the number of companies. It should be noted that, during this period, technology transplanted from the West and traditional manufacturing were progressing in parallel. Economic historian Takafusa Nakamura shows that, even in 1909, cottage-industry production still accounted for half of all industrial production. See T. Nakamura, *Nihon keizai: Sono seichō to kōzō*, 3rd edn (Tokyo, 1993), p. 80. For a history of research on Japan’s industrial revolution, see N. Nakamura, ‘Reconsidering the Japanese industrial revolution: local entrepreneurs in the cotton textile industry during the Meiji era’, *Social Science Japan Journal* 18.1 (2015), pp. 23–44.

<sup>17</sup> T. Muramatsu, ‘Nihon no sangyō kakumei’, in *Gijutsu-shi*, (ed.) T. Yamazaki (Tokyo, 1961), pp. 39–68, at p. 42.

**Table 1.** Total employment of engineers in Japan, 1880–1920

Engineers		1880	1890	1900	1910	1920
Government	Pioneers	61	72	–	–	–
	University graduates	25	183	474	1,075	1,795
	Technical college graduates	–	45	263	1,160	1,999
	Total	86	300	737	2,235	3,794
Private sector	Pioneers	–	17	54	34	–
	University graduates	–	131	385	846	3,230
	Technical college graduates	–	34	389	1,963	7,138
	Total	–	182	828	2,843	10,368
Total	Pioneers	61	89	54	34	–
	University graduates	25	314	859	1,921	5,025
	Technical college graduates	–	79	652	3,123	9,137
	Total	86	482	1,565	5,078	14,162

Note: Pioneers are those who became engineers before technical schools were established in Japan, including those who learned from foreigners hired to work in Japan or who studied abroad. University graduates include those graduating from the engineering departments of the Imperial University in Tokyo (est. 1886) and its predecessor schools, as well as the Imperial Universities in Kyoto (1897), Tohoku (1907), and Kyushu (1911). Technical colleges include higher technical colleges established after 1900, including Tokyo (originally est. 1881) and Osaka (1896). Source: H. Uchida, 'Japanese technical manpower in industry, 1880–1930', in *Industrial Training and Technological Innovation*, (ed.) H. F. Gosel (New York, 1991), pp. 112–35, at p. 117.

that responded to Westernised technology was that of government-run enterprises. Second, the number of engineers was limited, even as late as 1890, with fewer than 500 engineers. The proportion of engineers working in the private sector increased rapidly; 182 engineers worked in the private sector compared with 300 in government departments. Third, the proportion of engineers working in the public and private sectors reversed in 1900. The proportion of engineers in the private sector continued to increase until 1920. These statistics show that the number of engineering graduates steadily increased. However, during this period, there were major waves of boom and bust affecting employment opportunities. The difficulties and struggles of individual engineers in their employment-seeking process remain unclear—an issue on which this article attempts to shed new light.

### Educating engineers and the transition of educational policy

This section provides an overview of the changing policies implemented by the Ministry of Public Works to educate and employ engineering students, which explains why the graduates had to seek jobs instead of being hired by the governmental sectors. Since the ICE was established by the Meiji government with the aim of replacing costly foreign engineers, the Ministry of Public Works planned to employ ICE graduates. For example, the 'Lessons and Rules of ICE' (*Kōgaku-ryō gakka narabi sho-kisoku*), revised in February 1874, begins with Article 1: 'Kōgaku-ryō is under the jurisdiction of the Ministry of Public Works and is a school that educates industrial officers who serve in the Ministry.'<sup>18</sup> Article 9 stipulates that the students should 'serve the Ministry after

<sup>18</sup> *Hōrei zensho* (Meiji 7 nen), p. 1234. If this rule could not be met due to a student dropping out, etc., the guarantor had to repay the expenses up to that point.

graduation'.<sup>19</sup> For graduates of the ICE to be hired by the private sector or other government departments, it was necessary to lift the restrictions on service.<sup>20</sup>

However, the ministry soon realised that this would lead to an excess of engineers being employed by the ministry. In anticipation of an increase in the number of graduates from the ICE, the ministry introduced an on-leave employment system as early as October 1875 as a countermeasure against oversupply. The Minister of Public Works Hirobumi Itō (1841–1909) reported to the Minister of Grand Council of State Sanetomi Sanjō (1837–91) on the ministry's policy as follows:

Businesses have busy and off-peak periods. As to offering on-leave employment to technical officers during off-peak periods, during the on-leave period, the staff attends to the main office on a daily basis and handles miscellaneous tasks. This is because, among other things, the rules on the length of service for students at Kōgaku-ryō and other proficient personnel when they become technical officers make it difficult for them to be released from their posts.<sup>21</sup>

A business historian, Yō Nakanishi, interpreted the rule as a measure to prevent wastage and the loss of valuable technical personnel.<sup>22</sup> This rule might have been introduced on a temporary and supplementary basis, given that the private sector was not fully developed.

However, the Ministry of Public Works, which had jurisdiction over the ICE, suffered budget cuts before the first students graduated in 1879.<sup>23</sup> From a financial perspective, the ministry changed its policy of educating ICE students at government expense as early as 1877. The first 13 students out of 46 were allowed to enter the school through private funding in April 1877, while about 50 students each year received government stipends.<sup>24</sup> After 1878, the school allowed only privately funded students to enrol, except for a few excellent government-sponsored students each year.<sup>25</sup>

In May 1882, the Ministry of Public Works also exempted government-sponsored students at the ICE from service for seven years because it could no longer guarantee employment for students in the ministry. According to the official record, the reason for the change in this policy was the increasing yearly number of graduates.<sup>26</sup>

However, despite these revisions, there were no significant changes in the employment destinations of the new graduates from 1879 to 1885. To take graduates from the Course of Chemistry at the ICE as an example, as shown in Table 2, 25 graduates were employed in government departments and seven were employed by the Ministry of Public Works

<sup>19</sup> *Ibid.*, p. 1237.

<sup>20</sup> If they moved to the private sector, they were required to pay a penalty of 700 yen, but the Ministry of Public Works seems to have been flexible about this. For example, Minoji Arakawa, a second-year graduate from the Course of Mining at the ICE, was exempted from paying a penalty when he went to a private railway company from the Ministry of Public Works. See Kyū Kōbu-dai-gakkō shiryō hensan-kai (ed.), *Kyū Kōbu-dai-gakkō shiryō, furoku* (Tokyo, 1931), p. 60. Another example is the case of Tsunehisa Fujii, a fifth-year graduate from the Course of Chemistry, who was recruited by the Ministry of the Army. See T. Hayashi, '6 gatsu hatsuka kōbu shokikan dai-gakkō kagaku sotsugyō-seito Fujii Tsunehisa saiyo no gi ni-tsuki kaitō', June 1883, Ref. C09121042200, at the Japan Center for Asian Historical Records. However, in many cases, no records have remained and the effectiveness of this rule is not clear.

<sup>21</sup> H. Itō, 'Gijutsu no mono hishoku mōshitsuke sōrō-setsu gekkyū sonohoka-tō no gi', October 1875, Ref. A07090164800, at the Japan Center for Asian Historical Records.

<sup>22</sup> Y. Nakanishi, *Nihon kindai-ka no kiso katei, chū* (Tokyo, 1983), p. 460.

<sup>23</sup> T. Muramatsu, 'Kindai gijutsu no ishoku to ikusei', in *Gijutsu-shi*, (ed.) Yamazaki, pp. 1–38, at p. 22.

<sup>24</sup> Kyū Kōbu-dai-gakkō shiryō hensan-kai (ed.), *Kyū Kōbu-dai-gakkō shiryō* (Tokyo, 1931), p. 121.

<sup>25</sup> *Ibid.*, pp. 104, 133.

<sup>26</sup> Ōkura-shō (ed.), *Kōbu-shō enkaku hōkoku* (Tokyo, 1889), p. 806. The career paths of the graduates of the college are mentioned in Wada, 'Kōbu-dai-gakkō ni okeru kagaku-ka no ichizuke'.

**Table 2.** Job after graduation for chemistry students at the ICE

First workplace	Numbers of graduates by year							Total	
	1879	'80	'81	'82	'83	'84	'85	Graduates	Ratio (%)
Ministry of Public Works (ICE)	4 (1)		2 (2)		1 (1)			7	28
Other government departments	1	1	1		1	3	1	8	32
Local government departments	1	2		1	1			5	20
Schools		1					1	2	8
Private industry		1				1		2	8
N/A				1				1	4
Total	6	5	3	2	3	4	2	25	

Note: 'Schools' here refers to schools other than colleges and universities. Source: M. Wada, 'Kō bu-dai-gakkō ni okeru kagaku-ka no ichizuke', *Kagakushi kenkyū* 39.2 (2012), pp. 55–78, at p. 60.

(including four by the ICE) as teachers. Other major employers included additional central government departments, such as the Ministry of Agriculture and Commerce and the Ministry of Finance, and local government departments. Only two graduates were employed in the private sector. In other words, 88 per cent of graduates became public officials, working in schools and local government departments.

It is worth asking whether privately funded students were employed in the private sector; unlike government-sponsored students, they were not obliged to serve in the Ministry of Public Works. In the ICE Course of Chemistry, all 19 students in the first five graduating classes were studying at the government's expense, while the six students who graduated in the sixth and seventh years were all privately funded. The seven-year service rule did not apply to these six students. Nevertheless, privately funded students also found work with the government. Masachika Shimose worked at the Bureau of Printing in the Ministry of Finance, Toratarō Kawanami at the Mint, Toshishige Hosokawa at the Bureau of Railway Work in the Ministry of Communications, Kichijirō Ishikawa at the Navy School, and Saburō Ogata at the Mint.<sup>27</sup> The results indicate that public departments were still the leading employment destinations for ICE students, at least in chemistry.<sup>28</sup>

The Ministry of Public Works frequently took measures to address the oversupply of engineers, but the difficulties faced by these graduates were foreseen even before the establishment of the ICE. Yoshiaki Yasunaga (1855–1918), secretary of the Society of Engineering and a graduate of the second cohort of the Course of Mechanical Engineering, presented an anecdote on Yōzō Yamao (1837–1917) and the founding of the school at a meeting held in 1891:

When the ICE was established at Toranomom (in 1873), opponents of the establishment of the college attacked it, saying, 'There is still no industry in Japan to be engaged in. Even if we build a school and educate people, what will they be able to do?' The former Minister of Public Works Yōzō Yamao, who led the construction of the school at the time and is now President of this society, said, 'Even if there is no industry to engage in now, if you create people, they will find industry'.

In his address, Yasunaga further states: 'It is regrettable that our country's industry has not developed in line with the rate of increase in the number of members (of the society).'<sup>29</sup> He notes that, as of January 1891, when this meeting was held, the number of engineers had increased but had not yet met the expectations of the developing industry. He concluded his address by stating that the growing membership of the society was a sign that industry would flourish. The trend towards a booming economy had begun a few years before this statement was made in 1891, but there was still a sense of stagnation among engineers, and demand for engineers in industry was still low.

### Difficulties of graduates

There is testimony suggesting that, before the industrial revolution in Japan, a company could not prepare a job worth paying the higher salary of an engineer. A chemical engineer called Santei Utsumi (1868–1919) tells an anecdote regarding early manufacturing:

<sup>27</sup> Wada, 'Kōbu-dai-gakkō ni okeru kagaku-ka no ichizuke', pp. 60–61.

<sup>28</sup> It should be noted that the chemical industry may have been slower to develop than other industrial fields. For example, one article reports a chemical company founded in 1877 with involvement of a prominent chemist, Jōkichi Takamine (1854–1922), who was one of the first graduates from the ICE. The report notes that he would lead the chemical industry, which has lagged behind other industries. See 'Zakki, Tokyo jinzō hiryō kaisha', *Kōgakkai-shi* 77 (1888), pp. 456–57, at p. 457.

<sup>29</sup> 'Zakki, Kōgakkai ichigatsu no tsūjō-kai to shin-nen-enkai', *Kōgakkai-shi* 110 (1891), pp. 103–6, at pp. 104–5.



When Minister Sasaki visited the Onoda plant on his tour of Kyushu in 1883, he was surprised with the bold policy of not even having an engineer. He recommended that Utsunomiya, Chief Engineer in the Ministry, be invited to inspect the plant; however, Mr. Kasai hesitated, fearing that the cost of inviting an eminent chief engineer would be enormous. Later, the Minister sent Utsunomiya to inspect the plant by order of the government, and Utsunomiya was said to have praised it as perfect, with no faults to be pointed out.<sup>30</sup>

Salaries for engineers recruited into the private sector would have been based on the salaries of the government offices where they worked, indicating that the private sector, at least in the chemical industry, could not afford the labour costs for engineers at that time.

Beginning in 1883, ICE students could not find work in industry immediately following graduation. Hikomatsu Iwasaki (1859–1911), who was educated at the government's expense and who graduated from the Course of Mechanical Engineering, finished school in May 1883. He was suddenly exempted from the obligation to serve and left free to pursue any employment. However, the demand for mechanical engineers was very low at the time and he suffered greatly when he could not find a job after graduation. He was eventually recruited by the Ships Bureau of the Navy through a personal contact. In 1884, he was called to work on a Hokkaido project in the Ministry of Agriculture and Commerce and henceforth worked in the railway sector.<sup>31</sup>

University graduates' difficulties in finding work due to the underdevelopment of industry continued until 1895. Chōkurō Kadono (1867–1958) enrolled in the ICE in 1885, the year before the closure of the school; he was part of the 13th cohort and graduated from the Course of Civil Engineering of the Imperial University in 1891. He reflects on seeking work in his memoirs:

A government-sponsored student was obliged to serve the workplace designated by the government for a period equivalent to the time of receiving the benefit [of state support], that is, for seven years in my case. This was a form of reserved employment. However, there was no workplace for me, who had mastered railway engineering, in the current state of government enterprises at that time. Then, I was released without serving, although I had been receiving government support. In short, I lost my job as soon as I graduated [in 1891]. ... (I went to the United States after that.) Soon after I returned to Japan from the United States [in 1896], I was asked to work in many places. It was society, not me, that had gotten better.<sup>32</sup>

There are some testimonies about graduates' starting salaries in the memoir collections. While graduates of the contemporary University of Tokyo concurrently earned a degree regardless of their grades and were given a starting salary of 50 yen by the government, graduates of the ICE were placed in a lower position. In the public sector, ICE graduates first earned a maximum of 30 yen.<sup>33</sup> According to the testimony of Takeo Iwata (years of birth and death unknown), who graduated from the Course of Telegraphy at the ICE in 1880, this was because the Minister of Public Works, Yōzō Yamao, believed that it would be harmful and useless to give large sums of money to

<sup>30</sup> S. Utsumi, 'Waga-hō no Porutolando semento seizō-gyō', *Kōgyō kagaku zasshi* 15.169 (1912), pp. 257–82, at p. 263.

<sup>31</sup> Tetsudō seinen-kai honbu (ed.), *Iwasaki hakushi tsuikairōku* (Tokyo, 1911), pp. 15–16.

<sup>32</sup> C. Kadono, *Hei-hei bon-bon kujūnen* (Tokyo, 1956), pp. 19–21.

<sup>33</sup> *Kyū Kōbu-dai-gakkō shiryō, furoku*, p. 115.

young graduates.<sup>34</sup> As a result, the salaries of the graduates from the ICE, which was under Yamao's jurisdiction, were cut. However, it may be that Yamao's policy aimed to encourage graduates of the ICE to work in the private sector by keeping salaries low while they were in government in order to foster private-sector industry.<sup>35</sup>

The period from 1886 to 1889 was known as the 'private enterprise boom' and the number of engineers employed in the private sector increased as the economy improved. For example, Kōran Sugahara (1859–1940) graduated from the Imperial University in 1886 and began to receive 120 yen a month when he moved to the private sector in 1888, having previously received 35 yen a month at the government's Railway Bureau. Engineers in the railway sector generally received a salary increase of more than 20 per cent when they moved to the private sector.<sup>36</sup> Kyōzō Kikuchi (1859–1942), who graduated from the Course of Mechanical Engineering at the ICE in 1885, worked in the public sector; however, in 1887, he was invited to work in the spinning industry and moved to the private sector on the condition that he be allowed to study abroad at the expense of the company.<sup>37</sup>

### Conflicts with traditional workers

When graduates from the ICE found employment in the public sector, they did not have immediate opportunities to take a leading role in their workplaces. Conflicts arose with the traditional foremen. Kamesaburō Yoshimoto (1861–?), who graduated from the Course of Civil Engineering at the ICE in 1884, reported his experience:

At that time (when I graduated), business and industry were in a very sluggish period. Rather than being invited (by industry), the graduates of each department were reluctantly assigned to businesses in the Ministry of Public Works. Of course, we were far from being admitted as useful; we were sent to trivial jobs as mere fledging technicians .... This was miserable.<sup>38</sup>

Let us consider the factors that prevented engineers from easily finding jobs. First, there was the issue of the labour system in enterprises. Factories were forced to control the production process indirectly through their *oyakata* (foremen). As labour historian Kiyoshi Yamamoto pointed out, the foreman contractor system was a common practice in the iron industry in the 1890s. It was the foreman who made decisions and had the following rights: (1) to hire and fire workers under his command so as to organise his own *kumi* (team); (2) to add apprentices; (3) to train the workers within the *kumi*; (4) to undertake the work and control the process and schedule; (5) to pay the workers; and (6) to make a profit.<sup>39</sup> Under the foreman contractor system, craftsmen entered into an official employment contract with the company, but the foreman had the right to appoint and dismiss all craftsmen in the factory. Thus, there was no room for

<sup>34</sup> *Ibid.*, pp. 34–35. For comparison, the starting salary for a police officer was 4 yen in 1874. See Shūkan Asahi (ed.), *Nedan-shi nenpyō: Meiji, Taishō, Shōwa* (Tokyo, 1988), p. 91.

<sup>35</sup> Nakamura argues that the late entry of ICE graduates into the railway industry put them at a disadvantage compared with other engineers, which ultimately encouraged them to enter the private sector. See Nakamura, *Nihon tetsudō-gyō no keisei*, p. 152.

<sup>36</sup> *Ibid.*, pp. 152–54.

<sup>37</sup> N. Nitta (ed.), *Kikuchi Kyōzō-ō den* (Osaka, 1948), pp. 57–59. Studying abroad was considered a privilege that promised a high status afterwards.

<sup>38</sup> *Kyū Kōbu-dai-gakkō shiryō, furoku*, pp. 88–89.

<sup>39</sup> K. Yamamoto, *Nihon ni okeru shokuba no gijutsu, rōdō-shi: 1854–1990* (Tokyo, 1994), p. 173.

professionally trained modern engineers in the manufacturing industry where traditional production processes persisted.<sup>40</sup>

This foreman-dominated atmosphere remained in factories after 1900 and company management would not have been able to hire many young engineers who had just completed school. Engineer Gonpei Kuwada (1870–1949) recalls his difficulties while he was at the private Kawasaki Shipyard from 1903 to 1910:

In the beginning, after I joined, it was difficult to manage. For example, even if the supervisor of the shop orders a craftsman to work, he will not start without the permission of the foreman. If he starts without permission from his master, he would have a hard time at a later date, or his tasks would be changed for mechanical reasons or something. The young engineers who had just graduated from universities had no way to do anything and were quietly patrolling the factory.<sup>41</sup>

In addition, senior craftsmen tended to be extremely secretive about the skills they had acquired to protect their profession. In contrast, because school-educated engineers had learned to look at things rationally and scientifically, they saw that it would be necessary to thoroughly improve equipment first to increase production. In the case of Tōyō Bōseki, which led the spinning industry in Japan, its official history states that ‘before and during the First World War, there was a juxtaposition between senior craftsmen who worked in the field and younger mechanical engineers from schools. They often competed with each other for superiority and were unable to work together in alignment’.<sup>42</sup> The change from the traditional method of working craftsmen to a rational factory management system was completed after World War I. In addition to a series of improvements to the equipment, the previously secretive skills of craftsmen were gradually disclosed, allowing them to cooperate.

Those with higher education levels tended to be less willing to work in the private sector. Eiichi Shibusawa (1840–1931), widely known as the ‘father of capitalism in Japan’, laments the low status of the private sector at the time in his memoirs: ‘the general atmosphere was still the same as in feudal times. All who studied aspired to be officials, and the highest honour was to become an official.’<sup>43</sup> On this topic, he presented an episode that occurred in 1884. In a gas company that Shibusawa helped to manage, he received an informal agreement to employ an engineer from the Imperial University. However, when the engineer discovered that the gas company owned by Tokyo Prefecture was intended to be operated as a private business, he turned down the job:

He said, ‘I have studied because I want to have honour. There is no honour in the private sector. Therefore, I regret to inform you that I am refusing to engage in private business, as this would be contrary to the purpose of my studies.’ This was not only the case of this type of thinking; the majority of people in general at that time thought the same way, and therefore the commercial and industrial traders were very much disrespected.<sup>44</sup>

<sup>40</sup> What I discuss here is the relationship with foremen as it affected the employment of new graduates, not the impact of foremen and productivity. In the case of iron making, in which a large number of skilled workers were essential, foremen played an important role in securing human resources in a factory. See Y. Tōjō, ‘Shoki seitetsu-gyō to shokkō shakai’, in *Kigyō bōkkō*, (ed.) Takamura, pp. 201–32.

<sup>41</sup> G. Kuwada, *Kuwada Gonpei, jiden* (Kyoto, 1958), pp. 66–67.

<sup>42</sup> Tōyō Bōseki kabushiki kaisha and ‘Tōyō Bōseki shichijū-nenshi’ henshū iinkai (eds.), *Tōyō bōseki shichijū-nenshi* (Tokyo, 1953), p. 179.

<sup>43</sup> E. Shibusawa, S. Onuki, and Y. Takahashi, *Seien kaikoroku, jō* (Tokyo, 1927), p. 432.

<sup>44</sup> *Ibid.*, pp. 432–33.

Mining Engineer Tomoaki Kuwada (1848–?) recalls an atmosphere in which engineers avoided employment in the private sector in around 1889:

I went back into civil service [from the private sector] in the fall of 1886, but after three years, I finally went back [again] into the private sector, as government work did not suit my temperament. At that time, the predominance of the government over the people was still dominant, and it was considered a disgrace for men to be involved in private business. However, I believed that there should be no discrimination between the public and private sectors in technology. Rather, I thought it did more for the good of the state to establish a private business that others were less willing to engage in. I defied the chief officers' attempts to dissuade me and took the initiative to enter the private sector as an engineer in the newly founded Hokkaido Mining Company.<sup>45</sup>

A man such as Kuwada, who was held back by other engineers around him but who ambitiously embarked on a private business, was exceptional at the time.

Moreover, a group of engineers shunned employment in industry. Makoto Sengoku (1854–1941), a mining engineer who graduated from the ICE in 1880, lamented that industry was sluggish. One of the reasons he gives in an article published in 1882 is the old practices towards industry:

The malady of demeaning those who earn their living with their hands—real industries and agriculture—is gaining momentum by the day. If an aristocrat studied industry, it would be a shame to his dignity, so that even officials with a background in industry would be considered undignified. Even if ordinary people are involved in an industry, the public does not value their achievements. Finally, the lack of momentum has led students to choose law, medicine, or commerce over engineering as their choice of academic discipline. This is one of the reasons for industry's poor performance.<sup>46</sup>

There are also many anecdotal accounts of young men who studied at higher-education institutions of the time who disliked engineering.<sup>47</sup> A physicist, Aikitsu Tanakadate (1856–1952), had intended to enter the ICE at the end of 1873. However, he was disappointed in the courses offered at the college, such as constructing a lighthouse and bridge and laying electrical wires. Instead, he was interested in courses related to national politics.<sup>48</sup> A prominent political scholar, Sakuzō Yoshino (1878–1933), who had been a lecturer of the Faculty of Engineering at Tokyo Imperial University and later became a professor of the Faculty of Law at the same university, recalled that engineering students wished to find honour through politics rather than through science and engineering.<sup>49</sup> Dairoku Kikuchi (1855–1917), president of Tokyo Imperial University in 1898 and Minister of Education in 1901, stated that many boys wished to be officers and avoided

<sup>45</sup> T. Kuwada, 'Haran chōjū no gojū-nen: Mushiryoku ni shūshi sita tankō-gyō', *Sekitan jihō* 2.11 (1927), pp. 1018–23, at pp. 1020–21.

<sup>46</sup> M. Sengoku, 'Kōgyō fushin no gen-in o ronzu', *Kōgaku-sōshi* 1.5 (1882), pp. 199–205, at pp. 200–1.

<sup>47</sup> I have discussed the ethos of samurai origin that influenced the formation of Japanese engineering in my master's thesis. See M. Wada, 'Engineering Education and the Spirit of Samurai at the Imperial College of Engineering in Tokyo, 1871–1886' (unpublished master's thesis, Virginia Polytechnic Institute and State University, 2007).

<sup>48</sup> S. Nakamura, *Tanakadate Aikitsu sensei* (Tokyo, 1943), p. 25. In the end, Tanakadate did not pursue political science and eventually became a professor of physics at Tokyo Imperial University.

<sup>49</sup> S. Katsuta, *Katsuta Shuichi chosakushū*, 5, *gakkō-ron, daigaku-ron* (Tokyo, 1972), p. 295.

practical occupations.<sup>50</sup> Henry Dyer (1848–1918), the first principal of the ICE, also observed samurai tendencies among the students at the school. He insisted that ‘[t]he engineer is the real revolutionist’, but felt that ‘every Japanese student seems a born politician’.<sup>51</sup> Dore suggests that warriors and rulers—the two main roles of samurai in the Tokugawa period (before 1867)—were still regarded as the most honourable occupations in the Meiji era.<sup>52</sup>

Early engineers shunned the private sector and engineering because of the class from which they came. Some students were torn between their identities as engineers in modern society and as samurai in the society in which they had grown up. A majority of early university students were from *shizoku* (former warriors) families, which constituted one-fifteenth of the population. When the ICE chose 11 out of 23 first-year students in 1879 and sent them to Britain the following year, 10 belonged to the *shizoku* and only Rinzaburō Shida (1856–92) was from the *heimin* (commoners) class.<sup>53</sup> Other institutions showed a similar trend. More than 80 per cent of the students in the science and engineering fields at the Imperial University were from the *shizoku* class in 1890.<sup>54</sup> According to a survey conducted by *Dainihon hakushiroku* (*Who’s Who in ‘Hakushi’ [Doctoral Degrees] in Great Japan*) and published in 1930, 74 per cent of 100 doctors in engineering were from the *shizoku* class, 7 per cent from the *heimin* class, and 19 per cent were unknown.<sup>55</sup>

In around 1887, in the middle of the Meiji era (1868–1912), university graduates all sought jobs in the government. However, after the Meiji era ended, a tendency emerged among graduates of both government and private schools to avoid government careers and seek employment in companies and banks. Tomitarō Karasawa, a historian of education, explains this tendency as a response to a change in the hierarchy of students’ origins. The majority of university graduates in the Meiji era were children of former samurai and the younger sons of wealthy farmers. In particular, education in Japan in the early years of the Meiji era developed primarily between samurai teachers and students. However, in the late Meiji era, the socio-economic situation changed. The proportion of the warrior class decreased while the proportion of urban merchants and intellectuals increased.<sup>56</sup>

In *Daigaku to jinbutsu* (*Universities and Figures*), published in 1914, Shūdō Nishikiya tells the stories of university graduates and analyses the businessmen among the graduates of the Imperial University. He notes that 1893 or 1894 was when the atmosphere among graduates seeking employment in the private sector changed. Then he continues: ‘However, many were those who had once risen to high positions in government and then resigned at the invitation of the private sector. In the last four or five years, there has been a phenomenon of students going straight into the private sector after graduation.’<sup>57</sup>

<sup>50</sup> M. Yoshida, *Zusetsu, gijutsu to Nihon kindai* (Tokyo, 1977), p. 188.

<sup>51</sup> H. Dyer, *Introductory Address on the Training and Works of Engineers in Their Wider Aspects* (Glasgow, 1905), p. 20; and H. Dyer, *Valedictory Address: To the Students of the Imperial College of Engineering* (Tokyo, 1882), p. 5. After studying civil and mechanical engineering at the University of Glasgow, Henry Dyer came to Japan in 1873 when he was 24 as the first principal of the ICE. He published many works on Japan and engineering education, including *Dai Nippon, the Britain of the East: A Study in National Evolution* (London, 1904). Much research has been done on Dyer. For example, see N. Miyoshi, *Henry Dyer: Pioneer of Engineering Education in Japan*, (trans.) T. Sarada and A. Sarada (Kent, 2004). Most of Dyer’s writings are available in N. Miyoshi (ed.), *The Collected Writings of Henry Dyer: A Collection in Five Volumes* (Kent, 2006).

<sup>52</sup> Dore, *Diploma Disease*, p. 44.

<sup>53</sup> *Kyū Kōbu-dai-gakkō shiryō*, p. 137.

<sup>54</sup> S. Nakayama, *Teikoku daigaku no tanjō* (Tokyo, 1978), pp. 102–3.

<sup>55</sup> Muramatsu, ‘Kindai gijutsu no ishoku to ikusei’, p. 33.

<sup>56</sup> T. Karasawa, *Gakusei no rekishi* (Tokyo, 1955), p. 163.

<sup>57</sup> S. Nishikiya, *Daigaku to jinbutsu* (Tokyo, 1914), p. 109.

In other words, according to Nishikiya, in around 1909 or 1910, students of the Imperial University reversed their evaluation of private companies and government departments in terms of place of employment. He states: ‘Even so, looking at the situation as it is, the managers of each factory must be engineers from a university by all means!’<sup>58</sup> He ironically points out here that plant managers and other people in representative positions were required to be Imperial University graduates, although the number of graduates from other technical colleges, such as higher technical schools in Tokyo and Osaka, had increased. Here, we can see that the educational background of engineers was important in Japanese society. Nevertheless, the story also suggests that industry had grown to a point at which it could pay engineers well enough.

The content of the subjects taught at the university differed from the state of the developing industry and it was not possible to respond immediately to demand from the field. The private sector also failed to understand how to use engineers effectively. Masatoshi Ōkōchi (1878–1952), a lecturer and professor at Tokyo Imperial University from 1903 to 1925, pointed out the problems with industrial education at universities in around 1910. In his view, the educational content of engineering was too biased towards design. He suggested adding various academic courses necessary for the administrative and managerial affairs of a factory. He also urged a shift in the company’s understanding of engineering education and noted: ‘In principle, the higher the degree, the less immediately useful they are, especially for university graduates.’<sup>59</sup> He further argued that university graduates were, however, meaningful for long-term company development. From the above claim, it can be inferred that many troubles existed among companies, capitalists, and engineers, with complaints and requests for consultation coming to Ōkōchi. His claim further indicates that it was not until the end of the Meiji era that private companies began to realise that highly educated engineers were not always ready to work in factories upon graduation. In other words, in the early stage of industrialisation, university-educated engineers were treated in the same way in the manufacturing process as traditional workers who were immediately incorporated into practical work in the factories.

## Conclusion

In the early years of industrialisation in Japan, the number of engineers steadily increased. However, they struggled against and only gradually overcame the difficulties of Japanese society’s traditional labour system, its disdain for the private sector vis-à-vis the public sector, and its contempt for industry. The process of Japanese industrialisation introduced technology from the West, which led to the emergence of a new profession: engineering. Therefore, the difficulties faced by engineers in seeking employment in the private sector also conflicted with the training and personnel recruitment practised in the traditional Japanese manufacturing industry.

In a society in which industry is still developing, the position of engineers is precarious. The replacement of foreign engineers by Japanese engineers within the Ministry of Public Works, the objective of the establishment of the ICE, was achieved early on. The Ministry of Public Works, which had jurisdiction over the ICE, attempted to address the transitional situation concerning the oversupply of engineers. In other words, the Ministry of Public Works released engineers to the private sector by changing its original training policy.

<sup>58</sup> *Ibid.*, p. 8.

<sup>59</sup> M. Ōkōchi, ‘Kōgyō kyōiku shiken’, *Tōyō gakuzei zasshi* 31.392 (1914), pp. 210–24, at p. 220.

Despite differences among engineering fields, as the booming economy led to higher salaries, engineers no longer avoided the private sector. However, the tendency of students to enter the private sector directly after graduation did not become common before 1900. Therefore, the public sector in Meiji Japan can be seen as the cradle of modernisation regarding engineer training in a developing industrial society with a lingering tradition of disdain for manufacturing. There may also have been differences across engineering fields. Nevertheless, the examples presented here illustrate difficulties in seeking employment and indicate a general trend experienced by early engineers working in industry.

**Conflicts of interest.** None.

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