Check for updates

Received: 28 June 2022 | Revised: 1 September 2023 | Accepted: 29 October 2023

DOI: 10.1002/smj.3567

SPECIAL ISSUE ARTICLE

SMS | Strategic Management Journal

WILEY

Resource allocation and growth strategies in a multi-plant firm: Kanegafuchi Spinners in the early 20th century

Shotaro Yamaguchi[1] | **Serguey Braguinsky**[1,2,3] | **Tetsuji Okazaki**[4] | **Takenobu Yuki**[5]

[1]Robert H. Smith School of Business, University of Maryland, College Park, Maryland, USA

[2]NBER, Cambridge, Massachusetts, USA

[3]ISER, Osaka University, Osaka, Japan

[4]Faculty of Economics, University of Tokyo, Tokyo, Japan

[5]Faculty of Economics, Tohoku University, Sendai, Japan

Correspondence
Serguey Braguinsky, University of Maryland, Robert H. Smith School of Business, College Park, MD, USA.
Email: sbrag@umd.edu

Funding information
National Science Foundation, Grant/Award Number: 2022440

Abstract

Research Summary: Using detailed plant- and individual-level data from a major Japanese cotton spinning company in the early 20th century, we examine the within-firm allocation of skilled human capital in conjunction with investment in physical capital, accompanying the firm's evolving strategic priorities. We show that the firm leveraged unit-level two-way complementarity between managerial talent and strategically important plants when the task was achieving large-scale output and positioning for a competitive cost advantage. The task of conducting product differentiation, however, ushered in "three-way complementarity," where educated engineering human capital and capable managers needed to be bundled with specialized physical capital. A deeper dive into the "nano-economics" of resource allocation reveals that educated engineers experiencing product differentiation in pioneering plants were reallocated to other plants also pursuing product differentiation.

Managerial Summary: Effectively allocating critical resources, such as skilled human capital, across establishments in alignment with strategic priorities is a key managerial issue. Through an in-depth case study of a major Japanese cotton spinning company in the early 20th century, we illustrate how the company shifted the resource allocation policy in response to different strategic management priorities. Initially, the company assigned managerial talent to larger plants requiring operational improvement, leveraging a competitive cost advantage for a standard product. Yet, as the company transitioned toward product differentiation via new production technologies, skilled engineers and plant managers were allocated together to a few selected plants initiating product differentiation. Engineers' experiences in product differentiation in those selected plants were diffused to other plants also pursuing product differentiation through their reallocations.

KEYWORDS

engineering human capital, growth strategy, managerial human capital, phases of strategic management, resource allocation

1 | INTRODUCTION

At least since Penrose (1959), scholars have recognized that a firm's growth is driven by "the changing productive opportunity … influenced by its available resources." (Penrose, 1959, p. 29). Skilled human capital is a critical resource determining the firm's competitive advantage (Campbell et al., 2012; Coff, 1997), and its scarcity and non-scale-free nature (i.e., not allowing for simultaneous use in distinct fields) are what make its appropriate allocation so important (Levinthal & Wu, 2010; Wu, 2013).

The allocation and reallocation of the human-capital resource are important not only for diversified firms in multiple industries but also for single-industry firms (Ahuja & Novelli, 2016; Chauvin & Poliquin, 2020). Different establishments require different kinds and levels of human capital resources (e.g., managerial vs. engineering human capital) because establishments can be heterogeneous in how they are operated (Bloom et al., 2019; Chew et al., 1990) and which strategy they implement (Govindarajan, 1989; Williams & Mitchell, 2004). But few studies have unpacked human-capital (re-)allocations across heterogenous establishments within the same industry.

Relatedly, resource (re-)allocation is often discussed in the context of entry into and exit from markets (Dickler & Folta, 2020; Helfat & Eisenhardt, 2004; Lieberman et al., 2017;

Sakhartov & Folta, 2014). However, much of the extant literature has considered resource allocation processes in a given "snapshot"—that is, how firms reallocate given resources under given market conditions—rather than in conjunction with how firms evolve. The relative scarcity of studies focusing on the long-term resource allocation dynamics limits our understanding of an important interplay between resource allocation and resource building. Even as firms allocate the resources they already have, a particular way in which those resources are allocated can also lead to building new resources and capabilities, and thus influence key strategic decisions (Maritan & Lee, 2017). We also know little about the endogenous process that leads firms to catalyze and develop capital-skill complementarity in different growth phases (Crocker & Eckardt, 2014; Stadler et al., 2022)—that is, how firms bundle different kinds of resources, such as physical and human capital, to achieve particular complementarity according to changing strategic priorities and unit-level strategies.

In this paper, we answer the call to bring resource allocation to the forefront of strategic management research by elucidating the dynamics of a single firm's resource allocation policies as it relates to its evolutionary process entailing three phases of strategic management (hereafter, "strategy phases," for short). Specifically, we address the following research questions: how does a firm allocate different kinds of skilled human capital resources in conjunction with its investment in physical capital and across heterogeneous establishments? How do such allocation processes evolve in response to changing strategic priorities, and how do they lead to the expansion of the firm's capabilities?

We leverage historical and nanoeconomic methods in strategy research (Braguinsky & Hounshell, 2016). Rather than treating both the firm's strategy and its resource base as given, we aim at bringing the evolution of the firm's strategic priorities, coupled with the accumulation of its capabilities and resource base, into the study of resource allocation in line with the agenda in Maritan and Lee (2017). Our data, coming from exceptionally rich internal archival records spanning about two decades of the history of Kanegafuchi Spinners (hereafter, Kanebo, after its Japanese acronym), allow us to accomplish this objective. Kanebo was one of the early private entrants into Japan's cotton spinning industry and became one of the "center of gravity" firms by the late-1900s (Agarwal et al., 2020). Through our observation period, Kanebo had grown from a single-plant, standard-product firm to a 16-establishment company with a highly diversified product portfolio, while shifting its strategic focus multiple times, from output scaling and cost advantage to product upgrading (differentiation) and both vertical and horizontal diversification, to the strategy that combined scale expansion with further product differentiation.

We eschew the conventional theory-testing approach and take an abductive approach with a deep dive into the historical context. In doing so, we lay out the dynamics of the external environment and industry attributes that influenced Kanebo's strategic priorities and subsequent resource allocation policies in three strategy phases. The insights from this exercise are particularly relevant to the cognizance of the boundaries of some accepted theories and the potential extension of those theories. We discuss theoretical implications in detail in the concluding section, but to guide the reader, we highlight upfront here two insights that emerge from our examination of the historical data.

One insight is related to the transition from growth based on cost advantage to growth based on product differentiation. Such a transition appears to be an aspiration of firms in many emerging markets in China, India, Brazil, etc., which entered the market initially as cheap suppliers following the proliferation of global outsourcing, but it often remains elusive (Wan & Wu, 2017; Wang et al., 2023). Kanebo represents a relatively rare case where such a transition happened successfully. At the beginning of the 20th century, Japan's cotton spinning industry faced a shakeout. This allowed Kanebo to acquire poorly operated establishments and pursue the cost-leadership strategy leveraging its superior managerial resources. In the process, however, it faced the danger of being left behind in the industry competition increasingly centering on product differentiation, so after the mid-1900s, Kanebo gradually started transitioning to product innovations based on new technologies. In this paper, we open the "black box" of this successful climb up the value chain by showing *how* Kanebo accomplished it through acquiring, building, and allocating managerial and human capital resources.

Another insight concerns the emergence of capital-skill complementarity. At least since Griliches (1969), it has been widely accepted in the literature that as (physical) capital accumulates, the demand for skilled labor increases because of stronger complementarity between capital and skilled labor as opposed to unskilled labor. However, during Kanebo's first strategy phase, where it pursued a cost-advantage strategy, we find no evidence of complementarity between capital and skilled engineers. Such complementarity emerged only after Kanebo started new-technology-driven product upgrading in a few pioneering plants. We can thus examine in "real time" the endogenous process of implementing capital-skill complementarity within the firm, which turns out to be linked to the adoption of new technologies and new types of capital. This point has not been discussed in detail in the literature that largely rests on cross-sectional settings and exogenous technological change.

We also find that the transition to the product innovation strategy and the corresponding adoption of new technologies required the firm to allocate not just skilled engineers but also better managers to the units tasked with implementing the new strategy. While separate literature strands have examined "two-way" complementarities between each type of resource (e.g., managerial and lower-level human capital; technologies and engineering human capital) (Choudhury et al., 2020; Crocker & Eckardt, 2014; Holcomb et al., 2009; Lazear et al., 2015; Ray et al., 2023; Stadler et al., 2022), less attention has been paid to how better managers and skilled engineers are bundled together with physical capital—the "three-way complementarity" (between capital, skilled engineers, and managers) we find in our data—especially as it relates to the implementation of product innovation and differentiation strategy.

In the rest of the paper, we first describe the context and data of our study. We then examine the evolution of resource allocation within Kanebo over 20 years in three strategy phases. The key focus is how the firm procured its managerial and engineering human capital and allocated them across plants in concordance with evolving strategic priorities against the backdrop of evolving industry landscape. In the final section, we discuss several theoretical takeaways, practical implications, and potential pathways for future research.

2 | HISTORICAL CONTEXT AND DATA

2.1 | Background: Kanebo, a Japanese cotton spinning firm in the late 19th-early 20th century

As in most countries, Japan's industrialization started with mechanized cotton spinning. The industry struggled under government protection early on but achieved remarkable growth starting from the late 1880s, once the government abandoned its intervention, leading to large-scale entry by private firms (Braguinsky & Hounshell, 2016). Among those, several leading firms grew into "centers of gravity" in the industry by attaining high levels of production and managerial efficiency, acquiring and restructuring the production systems of other, less efficient firms, and initiating product upgrading and diversification (Agarwal et al., 2020; Braguinsky et al., 2015, 2021a).

Kanebo was one of those early private entrants. When its first plant in Tokyo started operating in 1889, it had a capacity of over 30,000 spindles, making it the largest startup in the nascent industry at the time of launch. This overambitious initial size, as well as its location far away from the Osaka region, which was the center of industrial activity at the time, nearly resulted in bankruptcy. In 1893, Kanebo sought and received help from the Mitsui group, one of the largest business groups in Japan. The new ownership restructured the company's top management team and built a second, Hyogo plant in the Osaka area (see Figure 1 for the geography of Kanebo plants). Mitsui also dispatched two university-educated professional managers from its network to manage the two plants. One of those, Sanji Muto (1867–1934), initially picked up to lead the second (Hyogo) plant, was promoted and put in control of all plant operations in 1900. Since then, Muto became the de facto head of Kanebo operations even though he was formally appointed CEO only in 1908. As such, he was the key figure behind Kanebo's strategic expansion during the period covered by our data.

2.2 | Data

We use Kanebo's internal records to trace plant-level appointments of middle managers and engineers in charge of plant operations from 1898 to 1918. Company records also detail plant-level allocation of skilled blue-collar workers trained at Kanebo's vocational school launched in 1906. We complement these internal records with external sources: notably, alumni registries of Imperial Universities and Technical Colleges, which we previously used to create an industry-wide database of college-educated engineers (available from Braguinsky et al., 2021b). This database allows us to identify the allocation of *all* educated engineers employed by Kanebo, including those in more junior positions, not in the company's internal records. Those career data of university graduates also allow us to add information about the careers of middle managers and educated engineers before and after Kanebo employed them. The resulting individual-level panel data consists of 511 semiannual observations on 35 plant managers and 2314 semiannual observations on 176 engineers in various positions, with information about their educational backgrounds, prior job experience, and future careers.

Apart from the data on human capital allocation, Kanebo's internal records provide us with longitudinal plant-level information on the types of products, inputs and outputs, scale and type of production machines, the number of workers employed in each plant, their average wages,

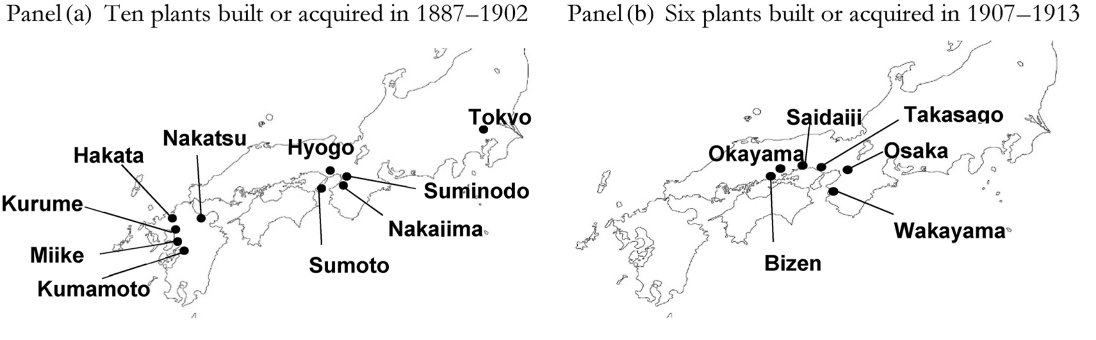

FIGURE 1 Location of Kanebo's plants.

and turnover. The records also contain plant-level, semiannual balance sheets and income statements, as well as capital (spinning machines) capacity. We used machine capacity data matched with Kanebo's machine orders in Braguinsky et al. (2021b) to observe plant-level decisions to purchase and install different types of machines designed for producing different kinds of products. Most importantly, we can identify spinning machines for producing simple, low counts of cotton yarn ("low-end" machines) or higher counts and further processed (doubled and gassed) yarn ("high-end" machines) as well as looms to diversify downstream into weaving. Thus, we can distinguish, at an establishment-semiannual level, between capital expansion aimed at scaling the standard product and that aimed at producing high-count yarns and downstream diversification.[1]

The resulting plant-level panel dataset consists of 465 semiannual observations on the maximum of 16 plants. Table 1 lists the plants in our sample, together with their origins (built vs. acquired) in Column 4, original capital capacity and its expansion (Columns 5–7), and whether and when they were assigned to implement the product differentiation strategy during our observation period (Columns 8 and 9).

Finally, we utilize rich qualitative information, including notice letters disseminated from Kanebo's general manager—Sanji Muto—to plant managers (Shihainin Kaisho, 1902–1918), Muto's biography as well as company history (Kanebo, 1988). We describe the details of each data source in Appendix B, Supporting information and document the qualitative and narrative evidence in Appendix C, Supporting information.

3 | GROWTH STRATEGIES AND RESOURCE ALLOCATION

3.1 | Overview of Kanebo's resource allocation strategy

How did the firm build and allocate resources to address changing strategic management priorities? We begin with a broad overview of Kanebo's strategic priorities as it faced changing conditions in the industry. Table 2 summarizes the changes in Kanebo's strategies in three strategy phases, which also reflect three different stages in the evolution of Japan's cotton spinning industry. The first strategy phase, from the late 1890s until about 1905 (Phase I), marks the end of the large-scale entry period (which started in the early 1890s) and a severe shakeout where about 60% of incumbent firms exited. During this phase, Kanebo scaled its production through the "buy" growth strategy (horizontal acquisitions; Capron & Mitchell, 2012), aiming to increase production efficiency and achieve cost advantage in the production of simple, low-end yarns (i.e., yarns of counts 20s and below; Yuki, 2014).

As the industry entered the consolidation stage, Kanebo's strategic priorities shifted. Starting in 1906, it began product innovation and downstream diversification (Phase II). Some industry-leading firms had already employed this strategy, while Kanebo still focused on acquisitions and cost advantage. To stay among industry leaders, Kanebo needed to do the same. Acquisitions

[1]The yarn count expresses the thickness of the yarn, and its number indicates the length of the thread relative to the weight. Higher-count yarn is thinner than lower-count yarn and sells at a higher price per pound. Producing higher-count (finer) yarn requires better quality raw cotton as well as different machines and superior technology than lower-count (coarser) yarn. High-count yarn is often improved further by more processing, known as doubling and gassing, which were quite technologically challenging for the fledgling Japanese cotton spinning mills. Following previous work (e.g., Braguinsky et al., 2021a), we define "high-count" yarn as that of counts higher than 20s. In what follows, we also distinguish two subcategories within the "high-count" category–"high-end" yarn refers to counts 52s and higher, while "middle-end (middle-range) yarn" refers to counts from 21s to 51s.

TABLE 1 Summary of Kanebo's plant history from the 1880s to the 1910s.

(1) Plant	(2) Year started operating/ acquired	(3) Built or acquired	(4) Acquired firm	(5) Initial capacity of spindles	(6) Capacity in 1918-2	(7) Capacity change (%)	(8) High-count yarn production	(9) Downstream integration
Tokyo	1889	Built	-	28,920	78,040	169.8	1908-2	1912-1
Hyogo	1896	Built	-	40,000	97,296	143.2	1913-1	1905-2
Suminodo	1899	Acquired	Kashu Spinners	10,368	10,752	3.7	-	-
Nakajima		Acquired	Kunijima Spinners	10,368	19,184	85.0	-	-
Sumoto	1900	Acquired	Awaji Spinners	10,368	37,276	259.6	1909-1	1909-1
Miike	1902			31,104	30,720	−0.01	1902-2	-
Kurume		Acquired	Kyushu Spinners	14,760	15,528	5.2	-	-
Kumamoto				10,368	10,752	3.7	-	-
Nakatsu		Acquired	Nakatsu Spinners	10,368	10,752	3.7	-	1909-2
Hakata		Acquired	Hakata Kenmen Spinners	11,136	11,904	6.9	1910-2	1910-2
Takasago	1909	Built	-	22,420	37,440	67.0	-	-
Okayama	1911	Acquired	Kenshi Spinners	13,376	14,528	8.6	-	Pre-acquisition
Wakayama				11,136	11,136	0	-	-
Bizen				36,668	43,884	19.7	Pre-acquisition	-
Saidaiji				7936	11,072	39.5	1912-2	Pre-acquisition
Osaka	1913/1915[a]	Acquired and completed[a]	Asahi Spinners & Weavers	28,456	31,756	11.6	Pre-acquisition / 1915-1	Pre-acquisition / 1915-1

Note: "Capacity change" shows the change rate from the initial capacity to the capacity in 1918-2. The columns "High-count yarn production" and "Downstream integration" show the timing (year-half period) when high-end machines or looms (for textiles) were actually installed in a plant, while cells without dates mean that high-count production or downstream integration was never conducted until the end of our sample. Only cotton spinning plants are listed in the table, while those specialized in silk are not. Two other acquisitions are not listed in this table: Shanghai Spinners (19,840 spindles) integrated into the Hyogo plant, and Nihon Kenmen Spinners & Weavers (20,708 spindles) integrated into the Sumoto plant.

[a]Osaka plant was contemplated by Asahi Spinners & Weavers, which also placed machine orders; however, it was acquired by Kanebo in 1913, before the machines arrived, so that the construction of the plant and the installation of machines were completed already under Kanebo ownership. The plant started operating in 1915.

TABLE 2 Kanebo's changing strategic management priorities.

	Phase I (1890s–1905) "Buy" growth strategy	Phase II (1906–1910) "Build" growth strategy	Phase III (1911–1918) Balanced strategy
Number of plants	2 original plants + 8 acquired plants	10 existing plants + 1 newly built plant	11 existing plants + 5 acquired plants
Industry landscape	• Large-scale entry, then shakeout; some firms already starting product upgrading and diversification	• Emergence of industry-dominant "center of gravity" firms with diversified product portfolios	• Continued consolidation of the industry but also new entry by diversified firms trigged by the WWI boom
Competitive strategy and product type	• Cost-leadership • Simple, homogeneous yarns	• Product upgrading and diversification in a few pioneering plants	• Simultaneously pursuing product differentiation and cost-leadership strategies

were put on hold, and cost reduction was no longer the top strategic priority. Instead, the firm transitioned to the "build" strategy by making large investments in product upgrading and added textile-producing facilities to some of its spinning mills to diversify downstream.

While product upgrading and adding downstream facilities came at a cost, by the beginning of the 1910s, Kanebo emerged as a "center of gravity" firm with a strong internal resource base in terms of managerial and engineering/skilled worker human capital. Evidence suggests that these resources were important for Kanebo to pursue a balanced growth strategy, consisting of both renewed scale expansion through acquisitions and expanded product differentiation in newly acquired plants (Phase III). Implementing the product-differentiation strategy at newly acquired plants required the reallocation of experienced managers and engineers to facilitate knowledge transfer from the plants that pioneered product upgrading and diversification. In what follows, we describe in detail the investment, resource acquisition, and allocation decisions corresponding to each strategy phase and empirically examine the allocation patterns concerning human-capital and plant characteristics.

3.2 | Cost-leadership strategy, resource acquisition, and within-firm resource allocation

Kanebo's competitive strategy in the first strategy phase (the late 1890s–1905) was to increase output scale and achieve cost advantages for standard, "low-end" (i.e., yarns of counts 20s and below) products. This contrasts with some other future "center of gravity" firms that embarked on product upgrading and diversification already in the 1890s. One potential reason could be the differences in the composition of top management teams (TMT). Firms that pioneered product upgrades and downstream integration (i.e., producing textiles) employed educated engineers at the helm (Agarwal et al., 2020). Kanebo, in contrast, at this time had university-educated professional managers in its TMT but not engineers. Together with the opportunity provided by the industry shakeout, which started at the turn of the 20th century, the TMT human capital may have been behind Kanebo's initial strategic choice to quickly forge ahead by acquiring production facilities of struggling competitors. In his essay, "On the Large Mergers of Cotton Spinners," the company's general manager, Sanji Muto, went as far as to suggest that all Japanese cotton spinners should merge into a single trust:

> "*The fundamental spirit of 'Trust' [large-scale mergers—authors]… consists of merging separate businesses of the same kind to achieve capital concentration and sedulous management to lower production costs and prices, and thereby to increase capital profits and wages of workers working in production as well as provide cheaper goods for the public.*"
>
> (Muto, 1901, p. 7; authors' translation)

This grand design never materialized, but Kanebo went on an acquisition spree.[2] Most firms acquired by Kanebo had recently installed machines but were struggling because of poor management (Braguinsky et al., 2015). The primary task was thus to improve the way the acquired plants had been operated.[3] Kanebo's original Tokyo plant was also in need of new management.

Table 3 summarizes the backgrounds of plant managers and chief engineers (15 and 18 unique individuals, respectively) in Kanebo plants from 1900 to 1905.[4] As seen in Row 2, no managers from acquired plants were retained, reflecting the need to radically overhaul operations by appointing new leadership to implement the company's strategy (see Appendix C1.1 and 1.2, Supporting information). However, having increased the number of plants from 2 to 10 in just a few years, Kanebo did not have a deep enough pool of managers inside the firm. The "At Kanebo pre-1900" row in the left panel of Table 3 shows that plant managers who had been with the company before 1900 comprised only 31% of the observations. Thus, most necessary managerial resources had to be procured from outside the firm.[5]

In procuring new managerial human capital, utmost attention was given to specialized education. Graduates from the higher education system were scarce resources during that era, and most firms had no managers with higher education (Agarwal et al., 2020). In Kanebo, however, as seen from Table 3, plant managers had formal higher education, with degrees in economics or business in 81% of all observations (11 out of 15 unique individuals).[6] The largest source is Keio University, the first private university in Japan and the only one that provided managerial education, which was also Muto's alma mater. The Mitsui group also played an important role in providing managerial human capital. During that period, Mitsui was Kanebo's ultimate owner, and Muto himself had been appointed to Kanebo from the Mitsui network. Muto's alumni and Mitsui network accounted for 31% and 27% of the observations on plant managers, respectively. In contrast to the decision to revamp managerial human capital, Kanebo often retained the technological expertise of chief engineers from acquired firms, presumably because the supply of highly skilled engineers was pretty scarce (47% of observations are on chief engineers without higher education).

Some reallocations of managerial talent already happened in this period, especially related to promoting and giving more responsibilities to managers with demonstrated success. As

[2]The series of acquisitions started in late 1899 and continued through late 1902. See Table 1 for the details.

[3]Muto repeatedly notified plant managers that the acquired plants lacked efficient operations and experienced staffs, so they needed to be resolved urgently (see Appendix C1.1–1.4, Supporting information). He also gave substantial discretion to plant managers in day-to-day operations while laying out some specific tasks in terms of improving worker retention, saving on various operational costs, and implementing quality controls (Appendix C2.1–2.6, Supporting information).

[4]In Table 3, we primarily focus on the number of observations as opposed to the number of unique individuals to take into account how long the managers were being assigned.

[5]We do not have information on the exact previous experience for 44% of the observations on plant managers, but there is no indication that any of those had worked at Kanebo prior to 1900.

[6]It is possible that some managers among those for whom we do not know the education background also had higher education, so the proportion in Table 3 is conservative.

TABLE 3 Managers and chief engineers of Kanebo's plants, 1900–1905.

	Plant managers			Plant chief engineers		
	No. of observations	Share	Excl. unknown	No. of observations	Share	Excl. unknown
All	108	1.00		93	1.00	
Retained from acquired plants	0	0.00		29	0.31	
Education						
Keio University (economics, etc.)	62	0.57	0.71	0	0.00	0.00
Imperial University (engineering)	0	0.00	0.00	17	0.18	0.20
High Commerce Schools	19	0.18	0.22	0	0.00	0.00
High Technical School	6	0.06	0.07	26	0.28	0.30
Graduation cohort: 1900 or later	0	0.00	0.00	13	0.14	0.15
No formal education				44	0.47	0.51
Unknown	21	0.19		6	0.06	
Previous experience						
Worked with Muto	33	0.31	0.54	3	0.03	0.03
At Kanebo pre-1900	33	0.31	0.54	19	0.20	0.22
Mitsui network	29	0.27	0.48	2	0.02	0.02
Industry experience	50	0.46	0.82	74	0.80	0.85
Competitor experience	12	0.11	0.20	38	0.41	0.44
Unknown	47	0.44		6	0.06	

Note: The unit of observation is the individual-semiannual period. The number of individuals in charge of a plant in at least one semiannual period is 15 managers and 18 chief engineers. Previous experience types are not mutually exclusive, so the total does not sum up to 100%.

Kanebo acquired five additional plants in 1902, the company immediately reallocated two managers who had successfully restructured previously acquired plants to the two largest and most important among the newly acquired plants (Miike and Kurume). A similar reallocation to another newly acquired plant happened 2 years later. Two other managers, initially in charge of acquired plants, were promoted to manage the company's main plants in Tokyo and Hyogo, apparently in recognition of their accomplishments at acquired plants. As already mentioned, although technically not an acquisition, the Tokyo plant was in dire need of restructuring.[7]

[7]The plant manager in charge of this restructuring, Masazumi Fuji exemplifies all of the above. Fuji was a graduate of Keio University and overlapped with Muto at Mitsui bank in 1893–1894. He joined Kanebo as a middle manager in 1897 (Mita Shogyo Kenkyukai, 1909). He was relocated to the Tokyo plant after managing the Suminodo plant acquired in 1899. Once in charge, he implemented a slew of managerial innovations, from improving machine maintenance and working conditions to such small but important things as leveling the plant floor to avoid wasting lubricating oils (cf. Bloom et al., 2013; Kinugawa, 1939, pp. 476–483). Fuji was rewarded by being promoted to the company Board of Directors in 1907.

We now employ regression analysis to examine how managers' characteristics, such as education, experience, and networks, were associated with allocation to plants by their capital capacity size and by whether the plant was newly added and thus in need of integration into the company's culture and practices. Motivated by the evidence in Table 3, we employ three key characteristics of plant managers as the dependent variable: (i) the dummy equal to one if the manager had higher education and zero otherwise; (ii) the dummy equal to one if the manager was drawn from Keio University alumni network and zero otherwise; and (iii) the dummy equal to one if the manager had prior experience managing a different plant at Kanebo and zero otherwise. We also add (iv) the dummy equal to one if the manager was subsequently promoted to the Kanebo board of executives and zero otherwise. The idea is that plant managers who later became executives might have already embodied the firm's managerial practices better than other managers when they were appointed.[8] While we use the full observation periods in the regressions (1899–1918), we include the interaction terms of plant characteristics and phase dummies to highlight the dynamics. The estimation equation is as follows:

$$y_{jt} = \alpha + \beta_1 \text{log\_cap}_{jt} + \beta_2 I_{\{\text{new\_plant}\}jt} + \beta_3 \text{log\_cap}_{jt} \times I_{\{\text{phase 2}\}} + \beta_4 I_{\{\text{new\_plant}\}jt} \times I_{\{\text{phase 2}\}} + \beta_5 \text{log\_cap}_{jt} \times I_{\{\text{phase 3}\}} + \beta_6 \text{I}_{\{\text{new\_plant}\}jt} \times I_{\{\text{phase 3}\}} + \zeta_t + \varepsilon_{jt},$$

where y_{jt} are the four dummies above, capturing the characteristics of managers allocated to plant j in the semiannual period t,[9] log_cap_{jt} is plant capacity (the logged number of spindles installed in plant j in the semiannual period t), $I_{\{\text{new\_plant}\}jt}$ is the dummy equal to one for the first 5 years of a newly added (built or acquired) plant and zero otherwise,[10] $I_{\{\text{phase 2}\}}$ is the dummy equal to one for the period from 1906 to 1910 and zero otherwise, $I_{\{\text{phase 3}\}}$ is the dummy equal to one for the period from 1911 to 1918 and zero otherwise, ζ_t is the semiannual time fixed effects, and ε_{jt} is the error term.[11]

The estimation results are presented in Table 4.[12] Note that the baseline coefficients in the first two rows capture the associations between the allocated managers and plant characteristics in the first strategy phase (1899–1905), while the estimated coefficients in the remaining interaction terms represent the differences in the associations between later phases and the initial phase. During the first phase, larger plant size was positively associated with the likelihood of

[8]Experience managing a large or a new plant could have contributed to developing the capability that later led to promotion or could have simply raised the visibility of the manager. Though such reverse causality is a possibility, it is enough for our purposes that future promotion is at least partially correlated with firm-specific managerial human capital.

[9]Since some plant managers were appointed midway through the semi-annual period, we use weighted dummies based on the length of periods. For example, if the replacement of an educated manager occurred in a given plant in May 1902, the "educated plant manager" variable becomes 1/3 for the first half of 1902.

[10]We include the first 5 years of the Tokyo plant in the category of "new plants" because Muto faced an even bigger challenge in integrating the Tokyo plant into his management system than the plants just acquired from other firms. The results remain qualitatively similar if Tokyo plant is excluded from new plants.

[11]We do not include plant fixed effects unless explicitly stated otherwise, because our focus is on the allocation of heterogeneous individuals across heterogeneous plants.

[12]We employ the linear probability model, but logit specifications yield similar results. The correlations across education, prior plant managing experience, and future promotion are not large and even sometimes negative, so they capture different aspects of managerial human capital (see Appendix Table A1, Supporting information). We also conducted sensitivity analysis using the first year and the first 3 years for new plants (see Table A2, Supporting information), and the results were similar.

TABLE 4 Allocation of managerial talent to plants by size and to newly added plants.

Variables	(1) Educated plant manager	(2) Of which: Keio alumni	(3) Experienced plant manager	(4) Future-promoted manager
Baseline: 1899–1905 period				
Logged plant capacity (no. of installed spindles)	0.121 (0.103)	0.337 (0.112)	0.584 (0.062)	0.280 (0.152)
1 (First 5 years of a new plant)	−0.106 (0.125)	0.027 (0.195)	0.623 (0.102)	0.284 (0.213)
Logged plant capacity × 1906–1910 period	0.052 (0.114)	−0.274 (0.222)	−0.241 (0.088)	0.282 (0.403)
1 (First 5 years of a new plant) × 1906–1910 period	0.237 (0.133)	−0.170 (0.206)	−0.405 (0.124)	−0.117 (0.253)
Logged plant capacity × 1911–1918 period	−0.092 (0.128)	−0.485 (0.162)	−0.252 (0.065)	0.150 (0.291)
1 (First 5 years of a new plant) × 1911–1918 period	0.259 (0.173)	0.322 (0.225)	−0.705 (0.234)	0.017 (0.298)
Constant	−0.013 (0.496)	0.501 (1.293)	−3.343 (0.870)	0.017 (0.298)
Observations	452	452	452	452
R^2	0.087	0.150	0.363	0.321
Half-year FE	Included	Included	Included	Included
Mean DV	0.800	0.611	0.628	0.403
p-Values				
Logged plant capacity	0.258	0.009	<0.001	0.087
1 (First 5 years of a new plant)	0.408	0.893	<0.001	0.202
Logged plant capacity × 1906–1910 period	0.656	0.237	0.015	0.495
1 (First 5 years of a new plant) × 1906–1910 period	0.094	0.422	0.005	0.650
Logged plant capacity × 1911–1918 period	0.483	0.009	0.002	0.613
1 (First 5 years of a new plant) × 1911–1918 period	0.156	0.173	0.009	0.956

Note: Estimation method: OLS. Robust standard errors clustered at the plant level in parentheses.

the manager possessing each of the four characteristics above. Most of the magnitudes are economically significant; for instance, the coefficient in Column 3 shows that doubling the number of spindles increases the estimated likelihood of the plant manager having previous experience managing another Kanebo plant by 93.7% of the mean (58.4 percentage-point increase with the mean of 62.8%; *p*-value <0.001), while it increases the likelihood of the manager being drawn from Keio University alumni network by about 55.2% manager being subsequently promoted by 69.5% of the mean ($p = 0.087$). The weakest association is seen in the higher education dummy (Column 1), but this may be because 80% of all the plant managers in our sample had higher education anyway.

In contrast, the estimated coefficients on the new plant dummy show that not all characteristics of plant managers were equally important for integrating them into the company culture. Indeed, controlling for plant size, the only attribute strongly associated with appointments to newly acquired plants is prior experience managing another plant at Kanebo (Column 3): the likelihood of an experienced manager assigned to a newly added plant was almost twice as the mean compared to other plants ($p < 0.001$). This underscores the importance of transplanting Kanebo's managerial practices through reallocations of managers with prior experience in managing a Kanebo plant. We also examine whether the integration process of newly added plants prioritized the allocation of high-level engineering talent and do not find a clear relationship (see Table A3, Supporting information). Integrating new plants did not seem to require allocating more engineering talent to such plants.

What were the outcomes of the cost-leadership strategy in this first phase of Kanebo's strategic management? Figure 2 depicts Kanebo's profit rates, calculated as the return on capital employed, compared to the rest of the industry. As can be seen, implementing the acquisitions strategy with initially limited managerial resources entailed a serious loss of profitability—the company churned negative profits in the second half of 1900 as it consummated the first three acquisitions while also restructuring the Tokyo plant, and profits fell again in 1902–1903 following the acquisitions of five more plants. The struggles were mainly due to inconsistent quality and inefficiencies in acquired plants (see Appendix C1.1–1.4, Supporting information). As noted above, the company dealt with these issues by appointing new managers recruited from Muto's own personal and Mitsui network.

Some other outcomes associated with strategies in the first strategy phase are presented in Figure A1, Supporting information. The first two panels depict the dynamics of the cost efficiency of production—the ratio of operating expenses to output and the ratio of wage expenses (total plant-level wage bill) to output measured in weight units (pounds), adjusted to the 20s count as in Braguinsky et al. (2021a). The data are aggregated by three categories of plants: Kanebo's own Tokyo and Hyogo plants, the three plants in the Kansai region acquired in 1899–1900, and the five Kyushu plants acquired in 1902 (see Figures A2 and A3, Supporting information for each plant separately). The figures show a rapid decrease in both operating expenses to output and wages to output ratios across all plants, but especially in post-acquisition acquired plants, with almost full convergence by 1904 (see also Yuki, 2014).[13] Figure A4, Supporting information shows that the decline in wage expenses to output ratio (in Figure A1 Panel B, Supporting information) did not come from decreasing wages but resulted from improved productivity accompanied by *increasing* wages. Improvements in managerial practices are also reflected in large reductions in worker turnover (quit) rates, which was a serious problem as it hindered human capital accumulation.[14] Panels C,D in Figure A1, Supporting information show an average decrease rate of over 50% (see Figure A5, Supporting information for each plant separately).

[13]For example, the pre-acquisition rates of operational and wage expenses in the acquired plants in Kyushu were 53.2% and 35.9% higher than in the original plants, respectively, while those gaps decreased to 16.0% and −0.002% after acquisition.

[14]Recognizing this, Muto repeatedly urged plant managers to improve worker retention (see Appendix C3.1–3.7, Supporting information).

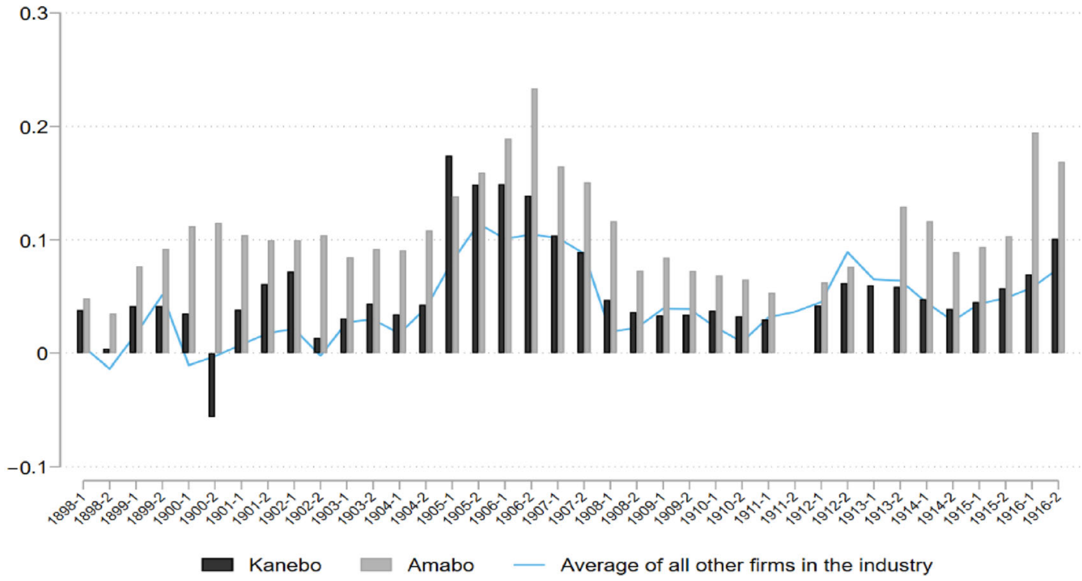

FIGURE 2 Profitability of Kanebo, Amabo, and the average of all other incorporated firms. The graph plots the dynamics of return on capital employed (ROCE) for Kanebo, Amabo, and the average of all other incorporated firms in the industry. ROCE = net profit/(shareholders' paid-in capital + retained earnings + borrowed capital [including from banks and other sources and the amounts outstanding of corporate bonds and promissory notes]). Data are missing for Kanebo and Amabo for the second half of 1911 and for Amabo in the first half of 1913.

The reduction in costs and worker turnover led to the recovery of the company's profitability. As can be seen in Figure 2, while the industry-average profitability also rose sharply during the Russo-Japanese War of 1904–1905 (due to military demand for cotton yarn to be used in the production of uniforms, etc.), Kanebo's profits were much higher than the industry average in 1905–1906 and even briefly surpassed Amagasaki Spinners ("Amabo"), the most profitable firm in the industry during almost the whole period of our analysis. Amabo, however, had a very different product portfolio, consisting mostly of high-count yarns.[15] Once the military demand for coarse yarns subsided, Amabo outpaced Kanebo and others again. Such competitive pressure was one factor that led Kanebo to abruptly change its strategic focus starting in 1906.

3.3 | Investment in product upgrading and diversification and changes in resource allocation

From a report to shareholders, we know the exact timing of the decision to shift Kanebo's strategy to the new strategy phase focused on product upgrading:

[15]Recall that we define "high-count" yarns as those of counts 21s and higher. Amabo's main product was the 42s-count doubled yarn, belonging to the "middle-range" category within high-count yarns, further processed by doubling (twisting).

> "*The 39th regular shareholders' meeting held in Tokyo… July 17, 1906… Concerning the Construction of Gassed Yarn Mill: Planned number of spindles—33,712; Construction site—[address in Tokyo]; Construction budget—1,250,000 yen.*" [*Construction plans for other plants are outlined next, then the report continues*] "*The above multiple construction plans are to be implemented gradually, with consideration of the financial situation of the firm… However, the construction of the Gassed Yarn Mill was deemed feasible to implement right away, based on the company's current financial flows. Accordingly, this project will proceed without delay.*"
>
> (Kanebo Report to Shareholders, No. 40, authors' translation)

Following this decision, on October 25, 1906, Kanebo placed orders with the Platt Brothers of Oldham for machines (with a total capacity of 33,712 spindles, as stipulated in the company report above) designed to produce cotton yarn of counts 60s–80s, appropriate for further processing by doubling and gassing (Braguinsky et al., 2021b). This decision was a complete break from the type of machines installed in the previous strategy phase.[16]

The key driver for this shift of strategic priorities was the recognition by Kanebo's professional managers of unexploited profitable opportunities in the markets for high-count and more processed yarn and mechanized weaving. Even as the gassed-yarn mill in Tokyo was under construction, Kanebo kept moving in this direction; in February 1908, the firm placed three orders for high-end machines for the Sumoto plant that tripled and drastically upgraded its capacity. Looms were also added to this plant to diversify downstream. In 1909, Kanebo's flagship plant in Hyogo added a new weaving facility with power looms to diversify downstream, and so did the two formerly acquired plants in Kyushu.

Investing in new capital and technologies was just the first step. The new strategy phase focusing on product differentiation ushered in a new era with respect to procuring and allocating technologically savvy human capital. The letter sent by Muto to plant managers in 1908, requesting their full cooperation with the task of launching the new gassed-yarn plant, speaks to this understanding as well as to the sense of urgency (see also Appendix C4.1, Supporting information):

> "*Tokyo mill No. 3 [the gassed-yarn mill] will start installing machines from March… However, we have not yet been able to secure the necessary number of female operators. …Therefore, we would like to move [experienced] operators from other plants… We are rushing the Tokyo mill No. 3 because the profitability of gassed yarn is high. I would like all plant managers to understand this goal…*"
>
> (Shihainin Kaisho, February 02, 1908; authors' translation)

To address the dearth of skilled operators, Kanebo set up its own vocational school in 1906 that sought applicants from all of Kanebo's plants and trained them in technical skills under a 1-year program.[17] An even bigger need was for engineers with the ability to handle new

[16]For the sake of completeness, we should mention here that Kanebo did some experimentation with high-count yarn production in its Tokyo plant in the first half of the 1890s and even placed a small order for two machines (800 spindles total) to produce counts up to 50s back in 1893. Those trials went nowhere at the time (Braguinsky et al., 2021a).

[17]The curriculum included classes of mixing, blowing, carding, first spinning, fine spinning, and finishing (bundling), and the use of machines. The detailed guidelines disseminated to plant managers for its launch are described in Appendix C5.1, Supporting information. Appendix C5.2, Supporting information shows that the curriculum was constantly updated in response to the deficiency of necessary skills.

machines, deliver the blending of various new types of raw cotton required to produce high-end yarn, and organize the production process under new, more complex technologies. Meeting this need was facilitated by the nation-wide rapid growth in the supply of educated engineers.[18] As the supply of educated engineers (both from Imperial Universities and Technical Colleges) increased, leading cotton spinning firms seized this opportunity, absorbing disproportionately many of those compared to other firms in the industry and thereby increasing their competitive advantage (Agarwal et al., 2020).

Helped in part by the strength of its ownership and TMT, Kanebo was one of the firms that took full advantage of new opportunities in the labor market for educated engineers. Figure A6, Supporting information presents the dynamics of the number of university- and technical college-educated engineers employed by Kanebo (Panel A) as well as skilled workers who graduated from Kanebo's vocational school (Panel B). There were no university-educated engineers assigned to any plant until 1902 (although one such engineer worked at the company headquarters), and only a few technical college graduates. Both numbers started increasing rapidly as the firm-initiated product differentiation in the second phase of its strategic management. During 1906–1910, Kanebo more than tripled the number of degreed engineers it employed, mostly by hiring new graduates of Imperial Universities and Technical Colleges. Also, almost 250 newly minted skilled workers (graduates of Kanebo's vocational school) were employed by 1910. Figure A7, Supporting information compares the number of university-educated engineers—the most technologically skilled human capital available in Japan at the time—per plant with the pioneering company Amabo and the average of all other firms in the industry. Starting from 1906, when it decided to pursue the product differentiation strategy, Kanebo rapidly caught up with Amabo in employing university-educated engineers and far outpaced the industry average.

Procuring engineering human capital was followed by its deliberate allocation to the right places. For instance, until the company chose it to be the second plant tasked with upgrading and diversifying its product portfolio, the Sumoto plant had no university-educated engineers and only one to two technical college-educated engineers. After that decision, however, the company immediately allocated two university-educated and four technical college-educated engineers to this plant.

To examine more systematically the allocation of skilled engineers to different plants according to their roles in implementing new technologies and to separate the effect of new technologies from the size effect, we estimate regressions where the dependent variable is the number of educated engineers at time t, while the explanatory variables are the dummy equal to one if the plant had new machines (high-end spinning frames and/or looms) installed by time t and zero otherwise as well as the (logged) total plant capacity at time t. We include plant fixed effects in this estimation (alongside semiannual time fixed effects), as the goal is to examine within-plant changes in skilled human capital allocation as new machines were added. Table 5 presents the estimation results.

Estimation results in the first column indicate that controlling for capacity increase, once a plant receives new machines, the number of university-educated engineers increases on average to more than 2.5 times the baseline (p-value = 0.044). Doubling the number of spindles is also

[18]The total number of university-degreed engineers in mechanical engineering (the predominant specialization among those employed in cotton spinning) increased nation-wide from 202 in 1901 to 594 in 1910, and to 1075 graduates in 1918. Similarly, the number of technical college graduates in mechanical engineering increased from 635 to 1962 over 1901–1910 and reached 3656 by 1918, while the total number of technical college graduates in dyeing and weaving increased from 143 in 1901 to 647 by 1910 and reached 1472 graduates by 1918. The number of graduates were obtained from Imperial Universities' and Technical Colleges' graduation lists (*Ichiran*—see Appendix B, Supporting information).

TABLE 5 Complementarity between new machines and engineering human capital, 1906–1910.

Variables	(1) University-educated engineers	(2) Technical college-educated engineers
1 (New machines)	0.883 (0.384)	1.738 (0.676)
Logged plant capacity	0.624 (0.399)	−1.435 (1.144)
Constant	−5.773 (3.878)	15.197 (11.227)
Observations	204	204
R^2	0.650	0.724
Half-year and plant FEs	Included	Included
Mean DV	0.551	1.422
p-values		
1 (New machines)	0.044	0.028
Logged plant capacity	0.149	0.238

Note: Estimation method: OLS. Robust standard errors clustered at the plant level in parentheses. "New machines" are high-end spinning frames and/or looms.

associated with more than doubling the number of university-educated engineers at the mean, while the estimate is less precise (p-value = 0.149). Column 2 shows a similar association of new machines with the increase in the number of technical college-educated engineers, but capacity increases are now, if anything, associated with fewer such engineers. We interpret these results as indicating that capital-skill complementarity emerged with the arrival of new machines requiring high-level engineering skills.

Turning to the allocation of managerial resources, Table A4, Supporting information, presents the characteristics of plant managers during the second strategy phase, comparing plants implementing the product differentiation strategy and those that were only producing low-end products and not (yet) part of implementing the new strategy. During this time, plant managers were frequently transferred across plants, as indicated by the one but last row of Table A4, Supporting information (turnover events in 70% of all observations in both plant groups).

We can see notable differences in the allocation of plant managers between the two groups. First, all managers (re-)assigned to plants with specialized machines had formal education, whereas this share was 73% of the observations in other plants. Furthermore, 85% in product-differentiation plants came from the Keio University alumni network, as opposed to just 45% in other plants. Recall that some Keio alumni who were especially trusted were assigned to the largest plants in the first strategy phase emphasizing scaling and cost advantage. However, Table 4 Column 2 shows that the association between plant size and the manager from the Keio alumni is considerably lower in this new phase, with the estimated increase of just 6.3% points (33.7–27.4) or 10.3% of the mean due to doubling plant size. Thus, in the second strategy phase, the best managerial talent was allocated to plants implementing the product differentiation strategy rather than large-sized plants. Similarly, 37% of observations on managers in plants implementing the new strategy came from the Mitsui network, compared to just 9% in other plants (the last row in Table A4, Supporting Information).

Previous experience managing Kanebo plants was also critical for selecting managers for product-differentiating plants—in 78% of observations on such plants, managers had worked for Kanebo prior to 1906, compared to just 20% in other plants.[19] Thus, managers overseeing the implementation of the product differentiation strategy were selected from among those who were both educated and had prior managerial experience at Kanebo. For instance, as Masazumi Fuji (see Footnote 7 above) was promoted from the manager of the Tokyo plant to the company board of executives in 1907, he was replaced by the manager who had overseen the largest plant among those Kanebo acquired from Kyushu Spinners in 1902 (also a Keio University graduate). Another experienced manager with a Keio University degree who had overseen a plant Kanebo acquired in 1899 was relocated to manage the Sumoto plant in 1907, right before it started upgrading its capacity.

These findings raise a possibility that product differentiation strategy may have required not just capital-engineering-skill complementarity but a "three-way complementarity," also involving managerial human capital. To examine this further, Table 6 presents results from regression estimations where the dependent variables in Columns 1–3 are the plant manager's capability (proxied here by the manager having both formal education and previous experience managing another plant), the number of educated engineers in a given plant-semiannual observation, and the interaction of these two variables (capturing the resource bundle comprised of a capable manager and educated engineers), respectively. Columns 4–5 show the results of similar estimations for internally trained workers at the vocational school. The independent variable of interest is the dummy equal to one if the plant had new machines as an indication of implementing the product-differentiation strategy. The estimation equations include plant capital capacity, location, and half-year fixed effects.[20] Panel A presents the estimation results for Phase II, while Panel B is for Phase III.

The results in Panel A show that plants with new machines installed were 42.9 percentage-point more likely to have a capable manager (84.1% of the mean; $p = 0.126$; Column 1) and 66.6 percentage-point more educated engineers (43.4% of the mean; $p = 0.075$; Column 2) than those without such machines. Most tellingly, the coefficient on the new machines dummy in Column 3, where the dependent variable is the bundle of capable managers and educated engineers, implies that plants with new machines had around 2.3 times more educated engineers ($= e^{1.195}–1$; $p = 0.088$), in conjunction with a capable manager. Similarly, Column 5 shows that plants with new machines had around four times more internally trained workers in conjunction with a capable manager, although the estimate is less precise ($= e^{1.6}–1$; $p = 0.186$) because of a small number of observations (the data on the allocation of vocational school graduates are available only starting from 1908).

The specifications in Columns 3 and 5 use the weighted dummy variable for a capable manager and the count variables for the number of engineers or internally trained workers. The product of these variables may not correctly capture three-way complementarity because if the manager does not have either higher education or prior experience (i.e., the manager dummy is zero), the dependent variables are always zero, regardless of the number of engineers or internally trained workers. To alleviate this potential concern, Table A5, Supporting information, presents a simple two-by-two tabulation of the number of observations by plants with and

[19]This is once again in contrast with the estimation results in Table 4 above. While Phase I saw experienced managers allocated to larger plants, the coefficient on the interaction term between Phase II and the manager's experience managing another Kanebo plant in Row 3, Column 3 of Table 4 is negative and offsets almost half of the magnitude of the baseline coefficient (for Phase I) in Row 1 of the same column (p-value = 0.015).

[20]Plant location fixed effects account for geographic proximity related to the ease of introducing new machines. There are four regional categories: Tokyo (a single plant), Kansai (seven plants), Kyushu (five plants), and Okayama (three plants).

TABLE 6 Bundling of managers and educated engineers/skilled workers in product differentiation: "three-way complementarity."

Variables	(1) Educated and experienced plant manager	(2) Log (no. of educated engineers)	(3) Log (educated and experienced plant manager × no. of educated engineers)	(4) Log (no. of internal vocational school graduates)	(5) Log (educated and experienced plant manager × no. of internal vocational school graduates)
Panel A. Phase II: period 1906–1910					
1 (New machines)	0.429 (0.257)	0.666 (0.335)	1.195 (0.633)	−0.101 (0.296)	1.600 (1.126)
Logged plant capacity	0.159 (0.244)	0.263 (0.219)	0.449 (0.496)	0.600 (0.279)	1.451 (0.948)
Constant	−1.191 (2.361)	−1.233 (2.038)	−3.837 (4.737)	−2.501 (2.700)	−13.196 (9.014)
Observations	103	103	103	43	43
R^2	0.430	0.711	0.704	0.519	0.690
Mean DV	0.510	1.567	0.964	3.417	1.979
p-Values					
1 (New machines)	0.126	0.075	0.088	0.740	0.186
Logged plant capacity	0.530	0.257	0.387	0.0574	0.157
Panel B. Phase III: period 1911–1918					
1 (New machines)	0.390 (0.259)	0.912 (0.230)	1.460 (0.603)	0.440 (0.126)	1.814 (0.995)
Logged plant capacity	0.245 (0.156)	0.509 (0.217)	0.679 (0.367)	0.657 (0.153)	1.184 (0.600)
Constant	−2.115 (1.452)	−3.753 (2.071)	−6.394 (3.370)	−3.166 (1.495)	−10.636 (5.522)
Observations	248	248	248	248	248

TABLE 6 (Continued)

Variables	(1) Educated and experienced plant manager	(2) Log (no. of educated engineers)	(3) Log (educated and experienced plant manager × no. of educated engineers)	(4) Log (no. of internal vocational school graduates)	(5) Log (educated and experienced plant manager × no. of internal vocational school graduates)
R^2	0.358	0.644	0.578	0.757	0.498
Mean DV	0.566	1.868	1.258	3.636	2.256
p-Values					
1 (New machines)	0.154	0.001	0.029	0.00329	0.088
Logged plant capacity	0.137	0.033	0.084	<0.001	0.067

Note: Estimation method: OLS. "New machines" are high-end spinning frames and/or looms. All models include half-year and plant location fixed effects. Robust standard errors clustered at the plant level in parentheses. Data on the vocational school graduates are available only starting from 1908.

without new machines. It provides further support for "three-way complementarity."[21] We also implemented "reverse" regressions where the dependent variable is the dummy equal to one if the plant had new machines and zero otherwise, to examine the effect of different forms of capital and their interactions in the same model (see Table A6, Supporting information). The results remain qualitatively similar, although conditioning on plant size, we no longer find complementarity with internally trained workers. In sum, these results strongly support three-way complementarity between new technologies, capable managers, and skilled engineers under the product differentiation strategy.

It would be a mistake, however, to portray the transition to product differentiation strategy as all smooth sailing. To begin with, at the start of this phase, Kanebo went through a period of ownership and TMT turmoil. The timing of the events indicates that the decision to adopt the new strategy preceded ownership and TMT changes; nevertheless, possibly as a reaction to the adoption of the new strategy, the Mitsui group divested its largest block of shares, and the ensuing hostile takeover attempt forced Muto to resign. The episode was contained by the concerted action of the remaining shareholders and ended in less than a year with Muto returning to the helm, this time as the formally elected Executive Director. Importantly, the company also added two new top executives with experience in product upgrading (including, for the first time, an engineer by education) who replaced the previous Mitsui leadership.

More fundamentally, Kanebo faced various challenges to its resource allocation as it attempted to climb the quality ladder and add downstream textile production. First, the company had to set aside, at least temporarily, the goal of reducing operating expenses. The trend toward reducing the ratio of operating expenses to output, which was a top priority during the first strategy phase, was completely reversed until it was brought somewhat under control by 1910 (Figure A8, Supporting information). This seems to be closely related to the shift to the new strategy. For instance, new machines required more frequent and expensive maintenance (see Appendix C5, Supporting information for some suggestive evidence). High-count yarn production also required cotton inputs imported from the United States and Egypt rather than Chinese or Indian cotton, leading to increased delivery costs. Also, the higher the count of the thread, the thinner it is, and thus requires more packaging and shipping expenses per pound.

The strategic shift toward product differentiation also initially took a toll on the output scale. Figure 3 shows the dynamics of Kanebo's output by the type of yarn. By the end of the second phase (in 1910), the combined share of yarn of counts above 20s was still only about 30% of the total output. At the same time, with the best managerial and engineering talent occupied with implementing the new strategy, the output of what had been Kanebo's main product (low-end yarn) took a hit and barely recovered to the 1906 level 5 years later. Together with the increase in operating expenses, this affected the company's profitability—as can be seen from Figure 2 above, the firm's profits fell even below the industry average at some points during 1906–1910 and remained far below Amabo.

Thus, despite high initial expectations (see quotes from the company report and Muto's letter to plant managers at the beginning of this section), the new product-differentiation strategy proved to be a hard task to accomplish. The elevation of Muto's formal position helped stabilize the company's leadership, while the arrival of new TMT members, including a degreed

[21]In plants with new machines, observations are heavily concentrated in the cell that has both educated and experienced managers and an above-the-median number of engineers (63.2% of observations are in this cell), while in plants with no specialized machines, 59.7% of observations are in the cell with a manager who does not possess either higher education or previous experience managing a plant, and a below-the-median number of engineers.

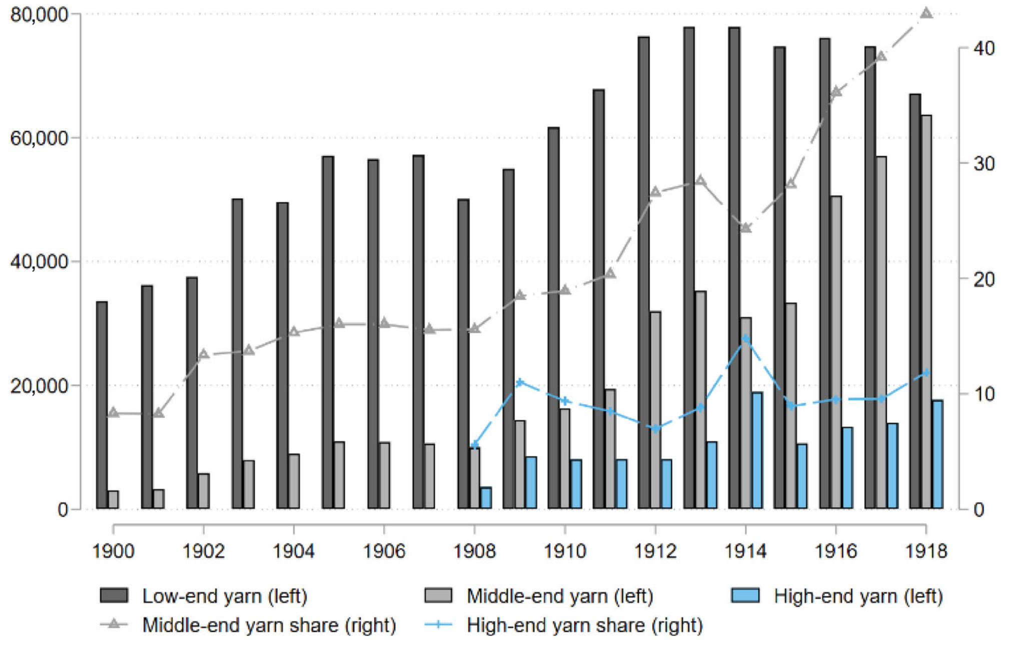

FIGURE 3 Kanebo total output by type of yarn. The left axis is the physical units of yarns. "High-end yarn" are counts ≥52s. "Middle-range (middle-end) yarn" are counts 21s–51s. "Low-end yarn" are counts ≤20s.

engineer, helped Kanebo both to recruit more much-needed engineering talent and to devise the right kind of strategy of allocating them to crucially important plants. As a result, by the beginning of the 1910s, Kanebo found itself in a position to move to the next phase of its strategic management.

3.4 | Industry leader: Balanced growth strategy and resource complementarity

The third and final strategy phase we analyze in this paper covers the period from 1911 to 1918. By this time, Kanebo had accumulated substantial stocks of both managerial and engineering human capital. They helped the firm recover from the troubles it faced during the second strategy phase and pursue growth along multiple dimensions, from continued product differentiation to new plant construction and more acquisitions, and to allocate and reallocate internal resources in doing so.

The key focus remained on product differentiation, but rather than breaking into some even newer product spaces, the firm focused on expanding the scope of product varieties while continuing to increase the share of high-count and processed yarn. As Figure 3 shows, the combined share of high- and middle-end yarn (both belonging to the high-count category over the 20s count) was still about 30% of the total output in 1910 but increased to almost 60% by 1918.

In line with the literature on the sequencing of product upgrading and diversification (Braguinsky et al., 2021a; Helfat & Raubitschek, 2000), after leaping into the high-end (and technologically most difficult) gassed yarn, the firm kept adding product varieties of in-between the lower-count simple yarns and high-end, processed yarns. In Table 7, we arranged the

TABLE 7 Yarn product varieties proliferation at Kanebo, 1900–1918.

	Single yarn counts						Doubled (twisted) yarn counts						Gassed yarn counts				
Period	≤18s	19s–20s	21s–35s	36s–51s	52s–61s	≥62s	≤18s	19s–20s	21s–35s	36s–51s	52s–61s	≥62s	≤18s	19s–20s	36s–51s	52s–61s	≥62s
1900-1	38,104	14,344	5443														
1900-2	20,663	10,770	2162														
1901-1	27,326	17,342	4138														
1901-2	25,866	19,792	3995														
1902-1	28,369	15,566	7047														
1902-2	29,158	20,626	7415														
1903-1	38,295	26,119	9357														
1903-2	40,504	20,656	10,622														
1904-1	36,421	24,095	10,635														
1904-2	44,637	18,785	11,777														
1905-1	54,616	19,818	14,373														
1905-2	48,779	19,473	12,870														
1906-1	51,537	19,571	13,156														
1906-2	50,543	19,439	13,779														
1907-1	56,548	15,314	14,208														
1907-2	55,849	15,229	12,128														
1908-1	49,821	18,269	11,846	536													
1908-2	44,971	11,878	9426	2645				311	114	216					20	3231	5641
1909-1	53,316	13,618	11,642	2806					76	190					163	3829	7046
1909-2	56,790	13,557	13,097	3670					106	4154					42	3672	6913
1910-1	63,765	14,123	12,702	3292				1048	468	4824				45	251	3198	6815
1910-2	61,241	13,300	11,598	1718				662	2101	3700						3241	6860
1911-1	61,691	17,514	14,982	2424				483	2440	3030			635	75	421	75	10,166

TABLE 7 (Continued)

	Single yarn counts						Doubled (twisted) yarn counts						Gassed yarn counts				
Period	≤18s	19s–20s	21s–35s	36s–51s	52s–61s	≥62s	≤18s	19s–20s	21s–35s	36s–51s	52s–61s	≥62s	≤18s	19s–20s	36s–51s	52s–61s	≥62s
1911-2	68,675	19,837	14,338	4730			48	537	2531	3621			23			3200	6783
1912-1	72,423	19,395	20,709	7376			61	839	1158	10,055			0	262	98	3226	6695
1912-2	75,457	19,853	20,213	6940			43	2137	2832	10,173			41	196	154	3601	6697
1913-1	75,342	19,376	19,411	9791	27		43	1703	7164	7478			48	302		3814	6731
1913-2	76,599	19,505	18,309	11,373	1084		169	1586	5918	8639	6691	8959					
1914-1	80,726	18,952	22,008	8580	21		300	762	3146	12,219			76	556	279	7693	9517
1914-2	76,396	15,106	15,640	9867	4936	2263	37	914	2330	3392	11,385		91	641		3758	7734
1915-1	74,634	16,802	15,448	12,788	2046	520	84	987	1649	11,816			118	748		5031	5624
1916-1	71,053	26,203	29,600	17,523	1377	658	69	845	2198	14,137	5	5	84	494	32	5615	9398
1916-2	65,041	25,164	26,676	19,748	901	651	70	696	2470	13,711	24	20	31	621	452	6003	8672
1917-1	64,251	27,306	27,483	19,747	746	265	7	556	2680	17,058	14	3	107	584	657	6099	9291
1917-2	65,508	27,248	36,881	16,100	1173	431	81	592	3347	18,001	57	12	39	562	580	6802	9875
1918-1	64,751	23,564	33,955	19,575	3680	256	20	785	6271	13,296	38	20	25	670	606	6430	10,378
1918-2	50,548	26,239	39,735	31,253	8747	111	22	544	911	13,249	53	6	23	706	505	5322	8959

Note: Volume of production (in physical units, adjusted to 20s count) by basic type of yarn in the corresponding counts bins. Gassed yarn of counts between 21s and 35s was never produced and the corresponding column is omitted. Data are missing for the second half of year 1915.

product varieties produced by Kanebo into three major "quality ladders" (single yarn, doubled [twisted] yarn, and gassed yarn), with varieties aggregated into 18 bins to reduce clutter and arranged within each ladder in the ascending order by counts. The table shows the jump up the quality ladder in 1908, followed by the gradual filling in the "gaps" (Callander, 2011) toward the end of the sample, with all the product space filled in eventually. Reflecting this, Figure 3 above shows that during 1911–1918, the most pronounced output growth happened in middle-end yarns (counts from 21s to 51s), which almost caught up with the output of low-end yarns by 1918. Figure A9, Supporting information, shows that while the whole product variety space in "basic" varieties (single, doubled, and gassed yarn) had already been filled by around 1914 so that the number of varieties in this space remained flat thereafter, there was the continued addition of even more granularly differentiated product varieties in different types of thread winding of single yarn (important for woven fabrics, thus a by-product of continued downstream diversification).

The increase in the output of high-count yarns was achieved both by adding new high-end machines to incumbent plants and by acquisitions. Kanebo installed new high-end machines and gassing facilities in its flagship Hyogo plant in 1913. The firm also kept purchasing more high-end machines for the Sumoto plant, whose production scale of middle-range yarns became 2.45 times larger than its low-end production by 1918. At the same time, however, other plants, including the newly built Takasago plant, remained in the low-count product space and did not engage in downstream diversification either (see Table 1).

The change in the nature of acquisitions is especially noteworthy—while increasing production efficiency through improved management remained a goal, Kanebo targeted plants that would increase its capacity to produce differentiated products. As seen in Table 1 above, most of the newly acquired plants (in 1911 and 1913) already had high-end machines and looms for producing textiles installed by the previous owners. Kanebo then expanded both the high-count and low-count production capacity of most newly acquired plants by purchasing and installing additional machines. Table A7, Supporting information, summarizes the product variety outputs for different plant groups: three "pioneering plants" that initiated large-scale product differentiation (Tokyo, Osaka, and Sumoto; Panel A), eight non-pioneering plants built or acquired before 1911 (Panel B), and five plants acquired after 1911 (Panel C). While most high-end yarns were initiated and produced by the pioneering plants, later-acquired plants contributed to adding product varieties by producing middle-end single and doubled yarns (i.e., filling in the "gaps").

The expansion of the product varieties entailed the reallocation of educated managers with prior experience in pioneering plants where they already oversaw product differentiation to new plants. For example, Toshijiro Sato, a graduate of Keio University who oversaw the upgrading and diversification of the Sumoto plant, was appointed to manage the two largest plants (Okayama and Bizen) among those acquired in 1911 and oversaw a big expansion of the high-end capacity in the Bizen plant. Another Keio-educated manager, Gota Miyake, previously in charge of the launch of the weaving division and middle-count yarn production in the Nakatsu plant, was reallocated to the Osaka plant acquired in 1913 and oversaw the start of its operations. Both later became company executives.

The reallocation of educated experienced managers was complemented by the corresponding reallocation of engineers. Suekichi Kido, hired right after graduating from the Imperial University in 1906, was assigned as the chief engineer in charge of the newly acquired Bizen plant in 1911 (complementing Toshijiro Sato during the plant expansion period).[22] Another university-educated engineer, Masaichi Iwata, who had worked at the Sumoto plant managed by Sato, was appointed

[22]Kido was also later promoted to the company board and eventually became company president.

TABLE 8 Experience at a pioneering product-differentiation plant and relocation of educated engineers.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	1 (Transferred to a plant producing high-count yarn)		1 (Transferred to a plant NOT producing high-count yarn)		1 (Transferred to a plant producing textiles)		1 (Transferred to a plant NOT producing textiles)	
1 (High-count yarn experience at a pioneering plant)	0.044 (0.020)	0.056 (0.021)	−0.058 (0.025)	−0.061 (0.025)				
1 (Textile production experience at a pioneering plant)					0.047 (0.025)	0.067 (0.025)	0.014 (0.011)	0.012 (0.012)
Logged plant capacity		−0.024 (0.006)		−0.017 (0.006)		−0.028 (0.006)		−0.009 (0.007)
Logged years since university/college graduation		0.015 (0.012)		0.034 (0.016)		0.017 (0.012)		0.012 (0.012)
Constant	0.023 (0.004)	0.245 (0.058)	0.064 (0.005)	0.176 (0.065)	0.008 (0.009)	0.266 (0.057)	0.025 (0.004)	0.094 (0.077)
Observations	1545	1544	1585	1584	1523	1522	1585	1584
R^2	0.119	0.142	0.108	0.119	0.114	0.153	0.111	0.115
Individual FE	Included	Included	Included	Included	Included	Included	Included	Included
Half-year and plant location FE	Included	Included	Included	Included	Included	Included	Included	Included
Mean DV	0.0324	0.0324	0.0511	0.0511	0.0263	0.0263	0.0303	0.0303
p-Values								
1 (High-count yarn experience at a pioneering plant)	0.032	0.010	0.02	0.014				
1 (Textile production experience at a pioneering plant)					0.058	0.009	0.207	0.347
Logged plant capacity		<0.001		0.005		<0.001		0.185
Logged years since university/college graduation		0.223		0.043		0.155		0.321

Note: Individual-level panel data on university- and technical college-educated engineers. Estimation method: OLS. All models include individual, half-year, and plant location fixed effects. Logged years since graduation capture nonlinear effects of this variable. Robust standard errors clustered at the individual level in parentheses. Pioneering product-differentiating plants are Tokyo, Hyogo, and Sumoto plants. The dependent variables in Columns 1–2 and 5–6 do not include pioneering plants. "High-count" yarn is yarn of counts 21s and higher.

as chief engineer of the Okayama plant to continue working with Sato in 1914. At the newly acquired Osaka plant, two technical college-educated engineers, Yoshitsugu Masubuchi and Zota Arai, who had previously worked with Gota Miyake at the Nakatsu plant, were redeployed to rejoin him in 1915 and 1917, respectively, alongside several more engineers previously involved in product upgrading and differentiation in other plants. Thus, "three-way complementarity" in product-differentiation plants remained at the core of human capital allocation. The regression results in Table 6 Panel B indicate that such three-way complementarity became stronger in Phase III even compared to Phase II.

Thus, in contrast to the previous strategy phase, where the three-way complementarity was only observed in the pioneering plants, in this new phase, it was also implemented in the newly added plants by reallocating managers and engineers. We employ regression analysis using individual-level panel data to examine if the engineers with experience in high-count (counts over the 20s) production at a pioneering plant were more likely to transfer to plants subsequently tasked with high-count production than other plants. Table 8 presents the estimation results. The dependent variable in Columns 1 and 2 is a dummy equal to one if an engineer was transferred to a non-pioneering plant producing high-count yarns. The explanatory variable of interest is the dummy equal to one if the engineer had previous experience in high-count yarn production at one of the three pioneering plants (Tokyo, Hyogo, or Sumoto). The estimation controls for plant capacity, logged number of years since graduation, individual fixed effects, half-year fixed effects, and plant location fixed effects.[23]

From Column 2 in Table 8, an engineer's prior experience at a pioneering high-count plant was associated with a 5.6 percentage-point increase (1.7 times the mean probability) in the likelihood he was later reallocated to a non-pioneering high-count plant ($p = 0.010$). As a placebo test, in Columns 3 and 4, we employ the same regressions for reallocation to a plant that did not produce high-count products. If anything, we find a negative relationship between the high-count production experience and reallocation in this case. The same exercise for downstream diversification (i.e., textile production) in Columns 5–8 produces similar results; engineers with experience in textile production at a pioneering plant were more likely to be transferred to another textile-producing plant than to other plants not producing textiles. Taken together, we clearly see the pattern where engineers with experience in production differentiations at a pioneering plant were reallocated to plants later implementing the same product-differentiation strategy.

Considering that pioneering plants initiated the high-end yarns while newly acquired plants targeted more of filling-the-"gaps"-type, middle-range products (see Table A7, Supporting information), these results suggest that the reallocation was presumably aimed at transferring the engineers' knowledge and experience gained through the highest-end production to plants producing middle-range products. Such "top-down" spillovers from the high-end to the middle-end products are consistent with the prior industry-level observation that experimentation of new products began with vertically moving up the quality ladders and then spread to horizontal expansions of product varieties (Braguinsky et al., 2021a).

While the balanced strategy in the third phase entailed the ramification and expansion of three-way complementarity already observed in the second phase, there were notable changes in the composition of educated engineers. During the early years of the product-differentiation

[23]See the blog post by Andrew Baker (https://andrewcbaker.netlify.app/2020/06/13/controlling-for-log-age/) for the rationale to include the logged years since graduation (age) term in two-way fixed effect models. The results do not change if we use the square term of years since graduation instead.

strategy, Kanebo relied heavily on university-educated engineers. But in the third phase, it began replacing them with technical college graduates, as seen in the decreasing university/technical-college engineer ratio in Figure A6 Panel A, Supporting information. The decline in the employment of university-educated engineers was not limited to Kanebo but also pronounced in Amabo and other firms in later years (see Figure A7, Supporting information).

How can we interpret these dynamics? Why did the employment of university-educated engineers decline in the 1910s while technical college-educated engineers and internally trained workers remained at high levels? One possible explanation could be as follows. New technologies, especially those that powered the initial leap to the high-end and highly processed (such as gassed) yarns, required the highest-level human capital (embodied in university-educated engineers), especially when they were just being introduced. However, as the emphasis shifted toward filling the "gaps" between the high-end and standard product varieties (see Table 7 and Figure A9, Supporting information), the required knowledge could now be transferred to cheaper lower-level engineers and even to skilled blue-collar workers within establishments who become technologically competent enough to run the production process on their own. Consistent with this notion, Figure A10, Supporting information, shows that within each pioneering plant—Tokyo, Hyogo, and Sumoto, the number of university-educated engineers did not increase and even declined a few periods after the initiation of product upgrading, while the number of technical college graduates and skilled workers kept increasing.

4 | DISCUSSION AND THEORETICAL INSIGHTS

Using detailed data from a major Japanese cotton spinning company over the first two decades of the 20th century, we illustrated how internal aspirations and changing external circumstances caused changes in the firm's strategic priorities and how those changes unleashed the process of resource (re-)allocation to implement the desired strategy. We now discuss some lessons and takeaways for strategic management and provide possible pathways for future researchers to explore.

Table 9, which expands on Table 2 above, summarizes the three different phases of strategic management and the types of resources acquired and (re-)allocated to meet those strategic goals. Kanebo's first strategic choice was to strive for cost leadership. The conventional logic (implicitly) assumes the "build" growth strategy takes time, while the alternative, "buy" strategy likely leads to a faster expansion (Capron & Mitchell, 2012). Kanebo pursued cost leadership through the "buy" strategy, exploiting the opportunity provided by the shake-out to scoop up production facilities of exiting firms and bring them up to their own management standards. However, it faced the integration challenges involved in the rapid scale expansion through acquisitions (Capron & Mitchell, 2012; Puranam & Srikanth, 2007; Zollo & Singh, 2004). Our evidence suggests that Kanebo could overcome those challenges by leveraging Mitsui and Muto's personal networks to hire managers with both higher education and managerial experience and allocating such managers to the most important plants, especially the newly acquired ones that badly needed managerial and organizational revamping.

The second phase of Kanebo's strategic management involved the start of product upgrading and diversification. Kanebo had to change its strategic priorities because the new, post-shakeout competitive landscape in the industry favored firms with differentiated products. At this stage, the company had to put aside, at least for a while, its previous priority of cost leadership. The switch to product differentiation involved large-scale investments in new types of machines and

TABLE 9 Kanebo's changing strategic management priorities and resource allocation.

	Phase I (1890s–1905) "Buy" growth strategy	Phase II (1906–1910) "Build" growth strategy	Phase III (1911–1918) Balanced strategy—"buy" and "build"
Number of plants	2 original plants + 8 acquired plants	10 existing plants + 1 newly built plant	11 existing plants + 5 acquired plants
Industry landscape	• Large-scale entry, then shakeout; some firms already starting product upgrading and diversification	• Emergence of industry-dominant "center of gravity" firms with diversified product portfolios	• Continued consolidation of the industry but also new entry by diversified firms trigged by WWI boom
Competitive strategy and product type	• Cost-leadership • Simple, homogeneous yarns	• Product upgrading and diversification in a few pioneering plants ○ Upgrading to high-count and processed yarns ○ Downstream diversification into textiles production	• Simultaneously pursuing cost-leadership and product differentiation strategies • Expanding output scale of high-count yarns and horizontal product differentiation
Resource acquisition to implement strategy	• Acquisitions of mismanaged firms • Hiring managers using Muto's and Mitsui network • Hiring university-educated managers but few educated engineers	• Capital investment for product upgrading and diversification • Purchasing high-end machines and looms • Internal vocational training school for blue-collar workers • Large-scale hiring of university- and technical-college educated engineers	• Acquisitions of diversified cotton spinning firms • Capital investment in more high-end machines and looms as well as in expanding low-end machine capacity • Internal vocational training school for blue-collar workers
Resource (re-) allocation to implement strategy	• Allocating better managers to priority plants (largest ones and newly acquired ones that needed efficiency improvement)	• Allocating educated managers and skilled engineers/workers to plants conducting product differentiation (three-way complementarity)	• Reallocating educated managers and engineers with experience of product differentiation in pioneering plants to newly acquired plants and more plants tasked with product differentiation

made it imperative for the firm to invest heavily in engineering and skilled worker human capital, which had not been the top priority in the previous growth phase. Kanebo could leverage the increasing supply of newly minted educated engineers from Imperial Universities and Technical Colleges by luring them to join the company. It also set up the company's own vocational school to train blue-collar workers. To overcome the initial shortage of high-level engineers, it designated just a few plants to pioneer the product differentiation strategy and prioritized them in terms of resource allocation. It appears that such selective allocation may have contributed to the successful implementation of new technologies, even though the company's bottom line was negatively affected for a while.

In the third strategy phase, Kanebo had accumulated a large enough internal human capital resource base to start pursuing "build" and "buy" growth strategies simultaneously. The priority remained continued product differentiation, and the "buy" strategy was also employed largely toward this priority, taking advantage of the fact that the firm could now assign not just managerial but also engineering resources to newly acquired plants. Leveraging the data on individual-level plant appointments as well as plant-level product varieties, we highlighted the potential mechanics of knowledge spillovers in strategic linkages of products over time (Braguinsky et al., 2021a; Helfat & Raubitschek, 2000), largely achieved through engineer reallocations. Specifically, engineering talent with product-differentiation experience at a pioneering plant producing high-end yarns was often reallocated to later acquired plants also implementing product differentiations based on middle-end yarns. The second-tier (technical college-educated) engineers and internally trained skilled workers also seemed to benefit from such knowledge transfer.

From these in-depth analyses of the Kanebo case, we can garner important theoretical insights regarding human capital (re-)allocation, capital-skill complementarity, and growth strategies. First, our study highlights the process through which the firm implemented different types of complementarities in different strategy phases. A large pool of prior literature on strategic human capital and economics has emphasized stronger complementarity between capital and skilled, as opposed to unskilled workers (e.g., Campbell et al., 2012; Caroli & Van Reenen, 2001; Choudhury et al., 2020; Griliches, 1969; Ployhart et al., 2014; Ray et al., 2023; Stadler et al., 2022). Historically, however, capital-skill complementarity has not been observed universally. In the early stages of the Industrial Revolution in England, capital (machines) tended to complement unskilled, often female and child labor, while displacing skilled (artisan) labor (Cain & Paterson, 1986; Mokyr, 2005). Capital-skill complementarity emerged in the United States only after adopting new technologies and production methods starting around 1909 (Goldin & Katz, 1998).[24] That is what we find in Kanebo's case—the complementarity between engineering skills and specialized machines emerged only after initiating product differentiation based on high-end machines. It was first implemented only in select plants tasked with product innovation and then spread to other plants through continued capital investment in conjunction with reallocating engineering resources. Describing Kanebo's evolutionary process of changing strategic priorities and human-capital allocation policies, we showcase the endogenous nature of capital-skill complementarity within a single firm. This process has not been documented in the prior literature that largely rests on the contexts of cross-sectional settings and exogenous technological change.

[24]While it may seem that capital-skill complementarity has completely taken over, relegating substitution between the two to the realm of economic history, recent studies suggest that computerization and especially AI once again threaten to replace highly skilled with unskilled labor (Frey & Osborne, 2017).

Second, and related to the above, we found that new technologies required the firm to allocate not just skilled engineers but also their better managers to the plants implementing new technologies. Prior studies have underscored the "two-way" complementarities between each resource. Higher (unit-level) managerial human capital likely increases the productivity of lower-level skilled workers (Crocker & Eckardt, 2014; Holcomb et al., 2009; Lazear et al., 2015). Higher managerial human capital can also enhance the productivity gains from physical capital (technologies) either by figuring out current technologies' effectiveness or adopting new technologies (Braguinsky & Hounshell, 2016; Holcomb et al., 2009; Queiró, 2016). Integrating those perspectives, our study further illustrates that Kanebo's human capital (re-)allocation enabled "three-way complementarity" between unit-level managers, engineers, and new technologies. Engineers trained in frontier technological knowledge were essential to comprehend and handle new machines specialized in high-end yarns, and better managers assigned were also critical for realizing value creation from those bundled resources.

Finally, this study details how human-capital resource (re-)allocation strategies need to match growth strategies. In the first strategy phase, Kanebo pursued the "buy" strategy by acquiring poorly operated plants from competitors and allocating talented managers to facilitate integration (Capron & Mitchell, 1998). In the second strategy phase, Kanebo shifted to the "build" strategy and implemented product differentiation by accumulating its own human-capital base and realizing the "three-way complementarity" in selected plants. Those strategies align with the notion that firms need to choose among alternatives to find the most suitable one for their strategic priority (Capron & Mitchell, 2012; Karim & Mitchell, 2000). However, in the third strategy phase, Kanebo blended the "buy" and "build" strategies (Stettner & Lavie, 2014). Several acquisitions of plants during this phase were different from the first phase in nature and aimed at expanding varieties of differentiated products. Our nanoeconomic analysis showed that the simultaneous pursuit of "buy" and "build" strategies, as opposed to choosing either of them, was enabled by reallocating "built" engineering human capital in selected pioneering plants to newly "bought" plants.

In addition to those theoretical intakes, our study also contributes to the resource allocation literature by providing empirical evidence on detailed human-capital (re-)allocation processes within a single-industry context as opposed to a diversification context (Ahuja & Novelli, 2016; Chauvin & Poliquin, 2020; Maritan & Lee, 2017). In particular, we use detailed machine order data to highlight plant-level complementarities that emerged at different timings and levels. This brings a call for widening the scope of resource allocation studies, as even within single-industry contexts, establishments may be quite heterogeneous in managerial practices and the types and levels of products and technologies used. We were also able to document a firm in the early 20th century already employing such resource allocation policies, which tend to be associated with well-managed modern firms rooted in a scientific approach to management that emerged in the mid-late 20th century.[25]

What are the key insights from the Kanebo case, particularly relevant for practitioners in emerging economies? In particular, how did Kanebo manage to transition from a low-cost to a differentiated manufacturer? In the first phase, when Kanebo conducted a series of acquisitions, its top management recognized a strong need for revamping production processes to maximize scale merits (see Appendix C1.1–1.4, Supporting information). Poor managerial practices are often a serious impediment to catching up in emerging economies (Bloom & Van Reenen, 2010). As we saw, assigning the best managerial talent hired through alumni and

[25]We thank an anonymous referee for bringing this aspect to our attention.

Mitsui networks appeared to be key to addressing this challenge. In particular, Muto's success at the managerial overhaul in Kanebo could be related to his prior experience of restructuring at the Mitsui bank during its managerial crisis in the 1890s, resolved by actively recruiting educated talent to both top management and branch managers (Kasuya, 1987).

In the second phase, Kanebo faced a situation similar to firms in emerging markets that often enter the global markets as cheap suppliers and later face the task of moving up the value chain (Wan & Wu, 2017; Wang et al., 2023). Lacking a sufficient pool of engineering talent, Kanebo employed “top-down” reallocations of engineers from pioneering plants producing high-end yarn to later-acquired plants producing middle-end yarn. Those reallocations appear critical for effectively diffusing their knowledge across plants and addressing the scarcity of engineering human capital.

However, we also noted that the external conditions significantly contributed to shaping Kanebo's strategic priorities and its growth path forward. This provides policy implications for emerging economies that seek to help their industries revitalize and catch up. In our context, the industry's competitive environment was based on merit but not on cronyism, causing selecting out poorly operated firms and creating an opportunity for Kanebo to scale up its production scale through acquisitions. Such acquisitions were enabled by the existence of the player providing financial capital, the Mitsui group. The Mitsui group was also an important intermediary for supplying top-notch human capital, as many newly minted university graduates were absorbed by Mitsui first and then transferred to Kanebo later. Finally, the explosive growth in higher technical education opened up opportunities for Kanebo to access high-level engineering human capital. If an emerging economy does not provide such institutional conditions, not even forward-looking firms like Kanebo can be expected to lead the industry catch-up.

We propose several potential pathways for future research. First, more studies may need to put resource allocation at the forefront of strategic management research by embracing the endogenous nature of resource allocation processes. It would involve thorough investigations on how the external environments (e.g., competitive landscapes, resource availability, and institutional settings) as well as the firm's internal conditions (e.g., resources, capability, and path dependency) shape their focus of resource allocations. Such resource allocations can in turn contribute to the accumulation of resources and capabilities and shape its subsequent strategic paths (Maritan & Lee, 2017).

Second and specifically to emerging economies, we suggest that more studies may incorporate the role of educated engineers, who stood out as a critical resource in product differentiation. While its enlightened management certainly played an important role, the proliferation of higher technical education was one of the necessary conditions that allowed Kanebo to escape from the trap of being just a cheap supplier. In other words, even though strategic management research naturally focuses on firm-level managerial decisions, future research could pay more attention to underlying ecosystems and institutions (Agarwal et al., 2021).

Third, more scholarly work might uncover the interplay between the firm's resource allocation policies and the industry landscapes. Our case analysis of Kanebo implies that resource allocation and resource procurement need to be discussed in tandem and that it is important to consider what kind of resources are available to the industry in the first place. What types and levels of human capital flow into focal industries in what ways depends on industry life stages (Gort & Klepper, 1982; Moeen & Agarwal, 2017). Scholars may synthesize the insights from the industry life cycle literature to explore the firm's resource allocation processes at different industry stages. Conversely, it would also be intriguing to see how the focal firm's resource allocations result in the accumulation of human capital stocks at the industry level. In the Kanebo case, we indeed observe several engineers who experienced product differentiations in Kanebo plants outflowed into competitors later. Future studies could extend the scope and elucidate the dynamic talent allocations inside and outside focal firms.

Our study tells the story of Kanebo's internal resource allocation, starting with a single plant producing simple basic products and with a narrow and limited stock of both machines and human capital. We follow it through what turned out to be a difficult, but in the end also a remarkable journey, involving growing scale and number of establishments, expanding the firm's technological frontier, and building up and (re-)allocating managerial and engineering human capital required to make this multifaceted expansion possible. The granular data employed in this study allows us to unpack the endogenous resource allocation process that led to Kanebo becoming one of the most important firms in this critically important industry.

ACKNOWLEDGMENTS

The work on this paper was partially funded by the National Science Foundation Award #2022440. We thank the editors, Cathy Maritan and Brian Wu, as well as two anonymous referees for comments and suggestions that helped greatly improve the paper from its initial draft. Rajshree Agarwal, Takuya Hiraiwa, and Atsushi Ohyama provided helpful discussions and advice. None of them bears responsibility for any remaining errors.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ORCID

Serguey Braguinsky https://orcid.org/0000-0003-3977-7848
Tetsuji Okazaki https://orcid.org/0000-0002-6017-6935

REFERENCES

Agarwal, R., Braguinsky, S., & Ohyama, A. (2020). Centers of gravity: The effect of stable shared leadership in top management teams on firm growth and industry evolution. *Strategic Management Journal*, *41*(3), 467–498.

Agarwal, R., Kim, S., & Moeen, M. (2021). Leveraging private enterprise: Incubation of new industries to address the public sector's mission-oriented grand challenges. *Strategy Science*, *6*(4), 385–411.

Ahuja, G., & Novelli, E. (2016). Incumbent responses to an entrant with a new business model: Resource co-deployment and resource re-deployment strategies. In *Resource redeployment and corporate strategy*. Emerald Group Publishing Limited.

Bloom, N., Brynjolfsson, E., Foster, L., Jarmin, R., Patnaik, M., Saporta-Eksten, I., & Van Reenen, J. (2019). What drives differences in management practices? *American Economic Review*, *109*(5), 1648–1683.

Bloom, N., Eifert, B., Mahajan, A., McKenzie, D., & Roberts, J. (2013). Does management matter? Evidence from India. *The Quarterly Journal of Economics*, *128*(1), 1–51.

Bloom, N., & Van Reenen, J. (2010). Why do management practices differ across firms and countries? *Journal of Economic Perspectives*, *24*(1), 203–224.

Braguinsky, S., & Hounshell, D. A. (2016). History and nanoeconomics in strategy and industry evolution research: Lessons from the Meiji-era Japanese cotton spinning industry. *Strategic Management Journal*, *37*(1), 45–65.

Braguinsky, S., Ohyama, A., Okazaki, T., & Syverson, C. (2015). Acquisitions, productivity, and profitability: Evidence from the Japanese cotton spinning industry. *American Economic Review*, *105*(7), 2086–2119.

Braguinsky, S., Ohyama, A., Okazaki, T., & Syverson, C. (2021a). Product innovation, product diversification, and firm growth: Evidence from Japan's early industrialization. *American Economic Review*, *111*(12), 3795–3826.

Braguinsky, S., Ohyama, A., Okazaki, T., & Syverson, C. (2021b). *Data and code for: Product innovation, product diversification, and firm growth: Evidence from Japan's early industrialization*. American Economic Association. https://doi.org/10.3886/E145421V1

Cain, L., & Paterson, D. (1986). Biased technical change, scale, and factor substitution in American industry, 1850-1919. *Journal of Economic History*, *46*(1), 153–164.

Callander, S. (2011). Searching and learning by trial and error. *American Economic Review*, *101*(6), 2277–2308.

Campbell, B. A., Coff, R., & Kryscynski, D. (2012). Rethinking sustained competitive advantage from human capital. *Academy of Management Review*, *37*(3), 376–395.

Capron, L., & Mitchell, W. (1998). Bilateral resource redeployment and capabilities improvement following horizontal acquisitions. *Industrial and Corporate Change*, *7*(3), 453–484.

Capron, L., & Mitchell, W. (2012). *Build, borrow, or buy: Solving the growth dilemma*. Harvard Business Press.

Caroli, E., & Van Reenen, J. (2001). Skill-biased organizational change? Evidence from a panel of British and French establishments. *The Quarterly Journal of Economics*, *116*(4), 1449–1492.

Chauvin, J., & Poliquin, C. (2020). *Worker redeployment in multi-business firms*. Georgetown McDonough School of Business Research Paper No. 3614269. https://ssrn.com/abstract=3614269

Chew, W. B., Clark, K. B., & Bresnahan, T. (1990). Measurement, coordination and learning in a multi-plant network. In R. S. Kaplan (Ed.), *Measures for manufacturing excellence*. Harvard Business School Press.

Choudhury, P., Starr, E., & Agarwal, R. (2020). Machine learning and human capital complementarities: Experimental evidence on bias mitigation. *Strategic Management Journal*, *41*(8), 1381–1411.

Coff, R. W. (1997). Human assets and management dilemmas: Coping with hazards on the road to resource-based theory. *Academy of Management Review*, *22*(2), 374–402.

Crocker, A., & Eckardt, R. (2014). A multilevel investigation of individual-and unit-level human capital complementarities. *Journal of Management*, *40*(2), 509–530.

Dickler, T. A., & Folta, T. B. (2020). Identifying internal markets for resource redeployment. *Strategic Management Journal*, *41*(13), 2341–2371.

Frey, C., & Osborne, M. (2017). The future of employment: How susceptible are jobs to computerization? *Technological Forecasting and Social Change*, *114*, 254–280.

Goldin, C., & Katz, L. F. (1998). The origins of technology-skill complementarity. *The Quarterly Journal of Economics*, *113*(3), 693–732.

Gort, M., & Klepper, S. (1982). Time paths in the diffusion of product innovations. *Economic Journal*, *92*(367), 630–653.

Govindarajan, V. (1989). Implementing competitive strategies at the business unit level: Implications of matching managers to strategies. *Strategic Management Journal*, *10*(3), 251–269.

Griliches, Z. (1969). Capital-skill complementarity. *The Review of Economics and Statistics*, *51*, 465–468.

Helfat, C. E., & Eisenhardt, K. M. (2004). Inter-temporal economies of scope, organizational modularity, and the dynamics of diversification. *Strategic Management Journal*, *25*(13), 1217–1232.

Helfat, C. E., & Raubitschek, R. S. (2000). Product sequencing: Co-evolution of knowledge, capabilities and products. *Strategic Management Journal*, *21*(10–11), 961–979.

Holcomb, T. R., Holmes, R. M., Jr., & Connelly, B. L. (2009). Making the most of what you have: Managerial ability as a source of resource value creation. *Strategic Management Journal*, *30*(5), 457–485.

Kanebo. (1988). *Kanebo Hyakunen-shi [The 100-year history of Kanebo, in Japanese]*. Kanebo.

Karim, S., & Mitchell, W. (2000). Path-dependent and path-breaking change: Reconfiguring business resources following acquisitions in the US medical sector, 1978–1995. *Strategic Management Journal*, *21*(10–11), 1061–1081.

Kasuya, M. (1987). Nakamigawa Nyuko Zengo no Mitsui Ginko [The consolidation of loans and reorganization of Mitsui Bank around 1890, in Japanese]. *Keiei Shigaku*, *22*(3), 29–55.

Kinugawa, T. (1939). *Hompo Menshi Bosekishi [History of cotton spinning industry in Japan, in Japanese]* (Vol. 4). Nihon Mengyo Kurabu.

Lazear, E., Shaw, K., & Stanton, C. (2015). The value of bosses. *Journal of Labor Economics*, *33*(4), 823–861.

Levinthal, D. A., & Wu, B. (2010). Opportunity costs and non-scale free capabilities: Profit maximization, corporate scope, and profit margins. *Strategic Management Journal*, *31*(7), 780–801.

Lieberman, M. B., Lee, G. K., & Folta, T. B. (2017). Entry, exit, and the potential for resource redeployment. *Strategic Management Journal*, *38*(3), 526–544.

Maritan, C. A., & Lee, G. K. (2017). Bringing a resource and capability lens to resource allocation. *Journal of Management*, *43*(8), 2609–2619.

Mita Shogyo Kenkyukai. (1909). *Keio Gijuku Shusshin Meiryuretsuden [Biographies of important graduates of Keio University, in Japanese]*. Jitsugyo-no Sekai Sha.
Moeen, M., & Agarwal, R. (2017). Incubation of an industry: Heterogeneous knowledge bases and modes of value capture. *Strategic Management Journal*, *38*(3), 566–587.
Mokyr, J. (2005). Long-term economic growth and the history of technology. In P. Aghion & S. Durlauf (Eds.), *Handbook of economic growth* (Vol. 1B, pp. 1113–1180). Elsevier.
Muto, S. (1901). *Boseki Daigodo-Ron [On the large mergers of cotton spinners, in Japanese]*. Dainihon Menshi Boseki Dogyo Rengo-kai.
Penrose, E. T. (1959). *The theory of the growth of the firm*. John Wiley.
Ployhart, R. E., Nyberg, A. J., Reilly, G., & Maltarich, M. A. (2014). Human capital is dead; long live human capital resources! *Journal of Management*, *40*(2), 371–398.
Puranam, P., & Srikanth, K. (2007). What they know vs. what they do: How acquirers leverage technology acquisitions. *Strategic Management Journal*, *28*(8), 805–825.
Queiró, F. (2016). *The effect of manager education on firm growth*. Mimeo, Harvard University.
Ray, C., Essman, S., Nyberg, A. J., Ployhart, R. E., & Hale, D. (2023). Human capital resources: Reviewing the first decade and establishing a foundation for future research. *Journal of Management*, *49*(1), 280–324.
Sakhartov, A. V., & Folta, T. B. (2014). Resource relatedness, redeployability, and firm value. *Strategic Management Journal*, *35*(12), 1781–1797.
Shihainin Kaisho. (1902–1918). *Notice letters from the general manager* [in Japanese]. Integrated Center for Corporate Archives, Research Center for Economics and Business Administration, Kobe University, Kobe, Japan.
Stadler, C., Helfat, C. E., & Verona, G. (2022). Transferring knowledge by transferring individuals: Innovative technology use and organizational performance in multiunit firms. *Organization Science*, *33*(1), 253–274.
Stettner, U., & Lavie, D. (2014). Ambidexterity under scrutiny: Exploration and exploitation via internal organization, alliances, and acquisitions. *Strategic Management Journal*, *35*(13), 1903–1929.
Wan, Z., & Wu, B. (2017). When suppliers climb the value chain: A theory of value distribution in vertical relationships. *Management Science*, *63*(2), 477–496.
Wang, L., Wu, B., Pechmann, C., & Wang, Y. (2023). The performance effects of creative imitation on original products: Evidence from lab and field experiments. *Strategic Management Journal*, *44*(1), 171–196.
Williams, C., & Mitchell, W. (2004). Focusing firm evolution: The impact of information infrastructure on market entry by US telecommunications companies, 1984–1998. *Management Science*, *50*(11), 1561–1575.
Wu, B. (2013). Opportunity costs, industry dynamics, and corporate diversification: Evidence from the cardiovascular medical device industry, 1976–2004. *Strategic Management Journal*, *34*(11), 1265–1287.
Yuki, T. (2014). Fukusu tan'i kigyo-no seisan soshiki—nijusseiki-niokeru kanegafuchi boseki gaisha-no gappei [Production organization in multi-establishment firms—acquisitions by Kanegafuchi Spinners in the 20th century, in Japanese]. In S. Ishiguro & M. Nakabayshi (Eds.), *Kigyo-no keizaigaku (Economics of a firm, in Japanese)* (pp. 149–188). Yuhikaku.
Zollo, M., & Singh, H. (2004). Deliberate learning in corporate acquisitions: Post-acquisition strategies and integration capability in US bank mergers. *Strategic Management Journal*, *25*(13), 1233–1256.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Yamaguchi, S., Braguinsky, S., Okazaki, T., & Yuki, T. (2023). Resource allocation and growth strategies in a multi-plant firm: Kanegafuchi Spinners in the early 20th century. *Strategic Management Journal*, 1–35. https://doi.org/10.1002/smj.3567