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Abstract

How companies can achieve the urgently required innovation is a contemporary issue. As a historical example of this issue, this paper notices the case of Tokyo Rope Corporation (*Tokyo Seiko*) in the Meiji era (1868-1911). The purpose of this paper is to examine the factors of Tokyo Rope's R&D based on the records of the company history and other documents. This paper points out three factors: (1) rebuilding a corporate governance structure for ambidexterity, which refers balancing the exploitation of existing products with the exploration of new developments; (2) intellectual communication between academic researchers and practitioners; and (3) smooth B2B transactions. The trinity of these factors could have brought about rapid innovation.

Keywords: innovation, R&D (research and development), ambidexterity, exploitation, exploration, intellectual communication, and B2B (business-to-business).

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Unexpected circumstances can force firms to achieve specified technological progress. As a recent example, automobile companies have prioritized the research and development (hereafter R&D) of electric vehicles in response to the move towards a decarbonized society. Throughout history, a number of companies have also been confronted with such a contemporary issue. Achieving industrialization was an urgent agenda for the government in Japan during the Meiji Era (1868-1911). The Meiji government prioritized transfer of technology from Europe and the United States. While industrialization could have benefited from borrowed technology to some extent, technological progress in Japan was not achieved simply by bringing in foreign equipments (Nakamura, 1983; Hayami, 2001). Some companies encountered a situation where engineers had to resort to trial and error and to proceed with R&D. As an example of such a company, this paper focuses on Tokyo Rope Corporation (*Tokyo Seiko,* hereafter Tokyo Rope).

Tokyo Rope, established in 1887, made the decision to manufacture wire rope in 1897 and commenced production the following year in 1898. The pace of this R&D can be deemed rapid compared to the several decades it took for the development of wire rope in Western countries. Wire rope, composed of solid metal wires twisted into a helix forming a composite rope, required the development of physics and chemistry related to metals for such precise metalworking to become possible (Mazurek, 2023). The invention of wire rope in Germany during the 1830s sparked a competition in the wire rope R&D, not only in Germany but also in the United Kingdom and the United States, lasting until the early 20th century. By 1927, Tokyo Rope had been granted a total of 40 patents for hemp rope and wire rope (Tokyo Rope, 1927). One of these patents related to preformed wire rope, variant with a stable cross-section even after cutting. While an early version of this type was invented in 1898, the prototype of the type still in use today was not invented in the U.S. or Europe before the 1920s (Verreet, 2018). This paper notices the factors that allowed Tokyo Rope to achieve rapid technological progress, surpassing developments in Western countries.

The purpose of this paper is to examine the facilitating factors of Tokyo Rope's rapid innovation, based on the records of the company history and other documents. The

records of the company history compiled by Tokyo Rope provide detailed records of the facts of the time based on oral records, while quantitative data to grasp the specific aspects of rope production are scarce (Tokyo Rope, 1957; 1989). The main work of this paper is to extract and organize what could be considered important from a perspective of economics.

This paper characterizes Tokyo Rope as a case of "ambidexterity" in that it achieved innovation. The concept of the 'ambidextrous organization,' emphasized by Duncan (1976) in analyzing the relationship between innovation and organizations, has been widely utilized in various studies for its diverse meanings (Benner and Tushman, 2003; Birkinshaw and Gupta, 2013; Junni, Sarala, Taras, and Tarba, 2013; O'Reilly, III and Tushman, 2008; 2016). Ambidexterity here refers to the combination of "exploitation" of existing products and "exploration" for new product development (March, 1991). Tokyo Rope had been producing Manila hemp for the fishing industry, and cannabis rope for the navy since the company's early days. As for the fishing industry, the spread of trawling in the early 20th century led to the hemp rope R&D. While continuing to produce and sell existing Manila hemp and cannabis products, Tokyo Rope decided to produce wire rope.

The contribution of this paper is to point out the three factors in achieving rapid innovation: rebuilding a corporate governance structure that encourages ambidexterity, facilitating intellectual communication between researchers and practitioners, and encouraging smooth business-to-business (hereafter B2B) transactions. The first is the issue of internal coordination. The resignation of director Takashi Masuda, who opposed the domestic production of wire rope, led the management team and shareholders to unite in favor of domestic production. Masuda had contributed to the production of existing products, such as Manila hemp rope, when the company was founded. After Masuda's departure, Managing Director Masakuni Yamada devoted himself to the exploration of a new axis—domestic wire rope production—while also engaging in the exploitation of existing products, such as Manila hemp rope.

The second element is the intellectual communication between academic researchers and corporate engineers. Tushman and O'Reilly (1996) have explained that ambidexterity would require the creation of a small, autonomous organizational unit independent of the organizational structure serving the existing market to accommodate innovation in the new market. This explanation can be confirmed in the case of Tokyo Rope. Masakuni Yamada, the executive managing director, organized an independent organization dedicated to the wire rope R&D. In the new independent team organized by Masakuni Yamada, Kuniichi Tawara, a young researcher in metallurgy at the time, lectured repeatedly to the workers. The significance of such intelligent communication in contributing to technological progress has been pointed out in studies of the British Industrial Revolution (Mokyr, 1992). This significance could remain unchanged with regard to industrialization in Japan.

The third element of supporting Tokyo Rope's innovation is a B2B (business-to-business) basis. The characteristics of wire rope can vary depending on the properties of the wire, the way it is wound, and the structure in which it is wound. Applications of wire rope could varied widely, such as ships, fisheries, railroads, automobiles, motorcycles, cranes, elevators, drilling, power transmission, and aircraft. Wire ropes could be considered both capital goods and intermediate goods, and traded mainly on a B2B basis. Some applications would require strength and sturdiness, while others would require flexibility (Taniguchi, 2012; Feyrer, 2014; Verreet, 2018). In researching and developing wire rope, companies would have to pay attention to the matching of properties and applications. Regarding Tokyo Rope's innovation, this paper notes the contribution of trading companies that played a B2B intermediary role, not only in terms of securing sales outlets, but also in terms of its ability to flexibly change raw material suppliers in response to R&D results. Meshitsuka (2009) has already explored this important point in detail with a focus on Moritani Shokai (present-day Moritani &Co.). This paper reframes this explanation in terms of innovation.

The remainder of the paper is structured as follows. Section 1 explains the founding of Tokyo Rope. Section 2 describes the domestic production of wire rope and the renewal of the management team. The factual details of the wire rope development process is

explained in Section 3. Section 4 presents an economic interpretation of Tokyo Rope's rapid innovation. Finally, Section 5 concludes.

1 Founding of Tokyo Rope

This section summarizes the history of Tokyo Rope at the time of its founding based on Tokyo Rope (1957; 1989).

Tokyo Rope's origins can be traced back to an idea for Manila hemp rope production business by Onn Watanabe, Noriyoshi Akamatsu, and Masakuni Yamada. All three taught at the Numazu Military Academy (*Numazu Heigakko*) in Shizuoka, under the jurisdiction of the former Tokugawa family, the former shoguns. Watanabe had a career as a finance bureaucrat and was in contact with Eiichi Shibusawa.

In March 1887, Watanabe and Shibusawa, as general representatives, obtained a license to establish Tokyo Rope. Immediately after the license was granted, a general meeting of the 15 shareholders was held. After the shareholders' meeting, Watanabe was appointed president, and Shibusawa and Takashi Masuda, a representative of Mitsui & Co. The 15 shareholders consisted of business people associated with Shibusawa, as well as several ship's equipment dealers who would soon become Tokyo Rope's business partners.

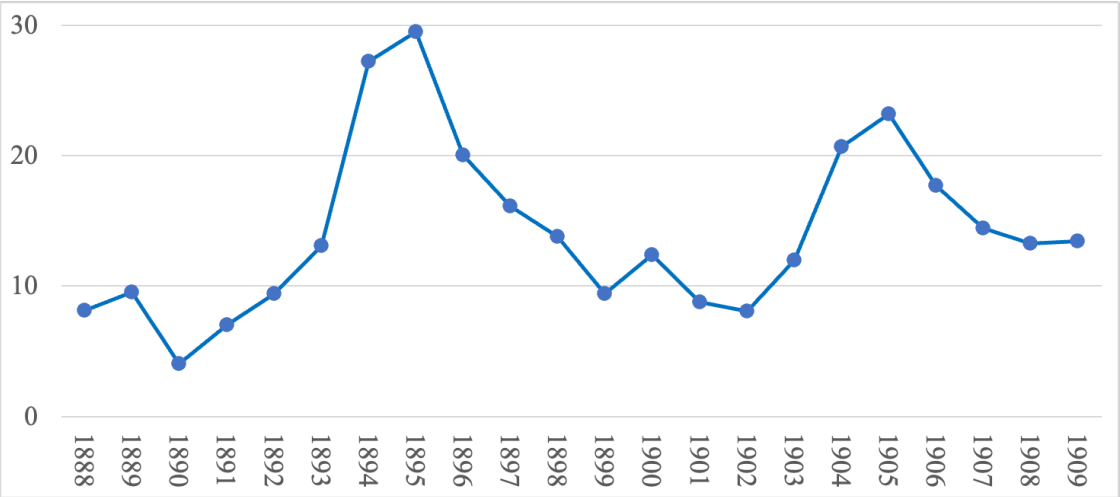
Masakuni Yamada was appointed manager of the rope manufacturing plant, and Yamada was considered the de facto head of rope production management. Shibusawa and Masuda were both directors and shareholders. They had the advantage of being advisors who could mediate between business partners. Masuda ordered rope-making machinery from New York when he founded the company. Shibusawa facilitated the placement of NYK, the largest shipping company in Japan, as a business partner for Tokyo Rope.

At the time of its founding, Tokyo Rope's main product was Manila hemp rope for the fishery industry. Prior to the company's founding, the fishermen used traditional

handmade ropes made from straw. Tokyo Rope's salesmen had to develop a sales network in fishing villages. The demand for Manila hemp rope increased when trawling became popular in the early 20th century. Rope needs were as diverse as they were multifaceted. In addition to Manila hemp rope, it was necessary to focus on the production of cannabis rope. The Navy was the main buyer of cannabis rope because of its softness.

Noriyoshi Akamatsu, one of the founding members of Tokyo Rope, provided a link between the company and the Navy. He had been an officer at the Yokosuka Shipyard (*Yokosuka Zosenjo*), which was under the jurisdiction of the Navy, and through his efforts he was able to recruit about 10 engineers from the Yokosuka Shipyard to work on Tokyo Rope. The Meiji government adopted a policy of promoting industrialization by allowing private companies to purchase factories and equipment built by the government (Nakamura, 1983). Tokyo Rope was also able to benefit from this policy. In 1889, Tokyo Rope purchased the Yokosuka Shipyard's rope making machinery as part of the Meiji government's program to promote industrialization. This purchase helped to secure the company's ties with the Navy.

Figure 1　Tokyo Rope's Return on Asset (%): 1888-1909



Source：Tokyo Rope (1957)

Figure 1 shows Tokyo Rope's return on asset (ROA) from 1888 to 1909. ROA here is the net profit (total for the first and second half of the year) divided by total assets (average of total assets at the end of the first half of the year and total assets at the end of the second half of the year). Two peaks can be identified: one from 1894 to 1895 and the other from 1904 to 1905. The former shows the influence of the Sino-Japanese War, while the latter can be seen to have been influenced by the Russo-Japanese War. The connection with the Navy was so important to Tokyo Rope that such a transition can be confirmed. The development of wire rope started in the interval between these two peaks.

2 Decision to Wire Rope R&D

This section outlines the circumstances behind Tokyo Rope's decision to pursue the wire rope R&D.

At the time of Tokyo Rope's founding, the market for imported wire ropes had already been established in Japan. Some Japanese engineers in the 1870s began to promote the advantages of wire ropes in Japan. Keisuke Ohtori had served in the Hokkaido Development Commission (*Hokkaido Kaitakushi*). In “The Coal Arc (*Sekitan Hen*),” a book published by the Commission in 1879, Ohtori reported the advantages of wire ropes. He was a person who wrote various articles as a magazine editor for the development of engineering. Through such discourse, the benefits of wire rope are thought to have become known. By the 1880s, trading companies such as Takada Shokai or Lucas Shokai began handling the importation of wire ropes from the United Kingdom, Germany, the United States, or Belgium (Meshitsuka, 2009). Customers were primarily in the mining sector or oil mining companies.

While Masakuni Yamada actively advocated for the domestic production of wire ropes, Takashi Masuda cautioned that it was premature. Masuda, the driving force, worked tirelessly to secure production facilities for Manila hemp ropes and potential buyers for the products. He voiced dissent against the domestic production of wire ropes, a fiercely competitive field in Europe and the United States.

Around 1896, a rift emerged between Yamada and Masuda. Except for Masuda, the rest of the management sided with Yamada through his persuasion. In response to this situation, Masuda resigned as a director in November of that year. In January of the following year, Onn Watanabe, due to health reasons, also resigned from the position of president. Seizing this opportunity, Eiichi Shibusawa became the chairman of Tokyo Rope, and Masakuni Yamada stepped in the role of managing director. In April of the same year, the proposal for the wire rope manufacturing business was approved at an extraordinary general meeting of shareholders (Tokyo Rope, 1957, pp.41-46).

Table 1 Market Size of Imported Wire Rope (in thousand yen, 1934-36 prices)

	Period I: 1888-1897 Annual average value (Standard deviation)	Period II: 1898-1909 Annual average value (Standard deviation)
A: Import value of wire ropes in Japan	182.9 (102.3)	444.8 (192.6)
B: Total Revenue of Tokyo Rope	468.2 (230.3)	1,626.9 (591.2)

Note) The average and standard deviation are indicated for the data series deflated by the manufacturing deflator and import deflator, respectively (1934-36 prices). Both of these deflators are estimated by Ohkawa, Takamatsu, and Yamamoto (1974).
Data: Meshitsuka (2009) and Tokyo Rope (1957).

Table 1 shows the annual average import value of import value of wire ropes within Japan (in thousand yen, A) and those of the total revenue of Tokyo Rope (in thousand yen, B) for Period I, spanning from 1888 to 1897, and Period II, from 1898 when Tokyo Rope began manufacturing wire ropes to 1909. While the product-specific sales revenue for Tokyo Rope is not available, the main product could have been hemp rope during both periods. In period I, the phase of deciding to localize wire rope production, the market for imported wire ropes accounted for 39.1% ([182.9÷468.2]×100) of Tokyo Rope's total sales. While Tokyo Rope's sales were higher, the scale of entry into Japan by foreign companies with new products could not be ignored for a leading domestic company.

From Period I to Period II, the annual average import value of wire ropes increased from 182.9 (±102.3) thousand yen to 444.8 (±192.6) thousand yen. The market size of imported wire ropes expanded by 2.4 times (=444.8÷182.9). On the other hand, Tokyo Rope's sales increased from 468.2 (±230.3) thousand yen to 1,626.9 (±5,912) thousand yen, in other words, it became 3.4 times (=1,626.9÷468.2). Tokyo Rope could have expanded its revenue, surpassing the entry of foreign capital into Japan, through the sale of both hemp ropes and wire ropes.

3 Beginning of the Wire Rope R&D

This section explains the circumstances when Tokyo Rope initiated the R&D of wire rope based on Tokyo Rope (1957; 1989).

In 1897, following the approval of the commencement of wire rope manufacturing at the shareholders' meeting of Tokyo Rope, a new factory was expanded in Fukagawa Ward, Tokyo. Approximately 300 workers were assigned to this new factory. The machinery for wire rope manufacturing was imported from the United Kingdom through Jardine Matheson (present-day Jardine Matheson Holdings Limited), the trading company. In this way, the labor force and capital needed for wire rope production were temporarily secured by importing them. The remaining task was to match the labor force with the capital. To accomplish this, Tokyo Rope recruited William Henry Wood as the engineer and Joseph Wilson as the foreman from the United Kingdom.

An unforeseen event occurred. It was discovered that Wood and Wilson had few knowledge in wire rope manufacturing, including the operation of the machinery (Tokyo Rope, 1957, p.558). The company was compelled to engage in research and development concerning how to operate the machinery and how to twist together which wire materials in what structure to form a rope.

In even this unforeseen situation, Yamada found two rescuers. One was the young employee Risun Tomura, and the other was the researcher Kuniichi Tawara.

Risun Tomura, despite not being well-versed in technology upon joining, made significant contributions to the R&D of wire rope manufacturing through self-study after entering the company. Tomura, initially assigned to the accounting department upon joining, progressed in his exploration through self-directed learning. He studied the company's history in the warehouse and obtained permission to visit the maritime school to learn the practical use of ropes. His diligence in learning became well-known within the company. Recognizing Tomura's dedication to learning, Yamada assigned him to the Fukagawa factory.

Upon being assigned to the factory in Fukagawa, Tomura engaged in conversations with engineer Wood and successfully obtained schematic drawings related to wire rope from his father. Tomura had a friend working at Furukawa Kogyo (the Furukawa Mining Company). This friend emphasized to Tomura the importance of a microscope in metal processing and also mentioned the name of researcher Kunikazu Tawara as a promising young scientist. As a result, Tomura, recognizing the significance, purchased a state-of-the-art microscope, a rarity in the country at the time, using company funds. Emphasizing the benefits of the microscope's capabilities, Tomura then recruited Kuniichi Tawara.

Kuniichi Tawara, a young researcher who graduated from the Mining and Metallurgy Department of the Engineering School at the University of Tokyo in 1897 and had just taken up the position of assistant professor, received an invitation from Tomura. Tawara, specializing in metallography, took on the role of lecturing Tokyo Rope's workers in his field of expertise. The workers, guided by Tawara, not only learned the fundamentals of metal processing but also the usage of the new microscope (Tokyo Rope, 1957, p.561).

After going through these experiences and trial-and-error processes, Tokyo Rope commenced the production of wire rope in 1898. In the strength test conducted at the Yokosuka Naval Shipyard in 1902, Tokyo Rope's wire rope surpassed the one manufactured by the British company Thomas Smith (Kinoshita and Kawano, 1903). In the same year, Kuniichi Tawara published a book titled ‘*Kinzoku Soshikigaku*

(Metallography).’ Coinciding with Tawara's efforts to expand the foundations of this field, the workers at Tokyo Rope flourished in the application of these technologies.

4 Discussion

This section addresses (1) reinterpreting Tokyo Rope's wire rope R&D under the concept of ambidexterity, (2) highlighting the perception that intellectual communication between academic researchers and the company's practitioners, and (3) B2B transactions.

4.1 Rebuilding a Corporate Governance Structure for Ambidexterity

The ambidextrous organization would be capable of simultaneously conducting both the exploitation of old certainties and the exploration of new possibilities (March, 1991).

Tokyo Rope merged with Tsukishima Rope (*Tsukishima Seiko*) in 1907, and with Nippon Rope (*Nippon Seiko*) in 1909. Both of these companies were manufacturers of hemp ropes. These activities resulted in the expansion of the production scale of Tokyo Rope's existing products. Hemp ropes were a product with room for R&D, during a time when the trawl fishing industry was gaining popularity. Tokyo Rope conducted the Manila hemp rope R&D and obtained patents. These activities would be regarded as the exploitation of old certainties.

Tokyo Rope aimed to eliminate the importation of wire rope and worked on their development, also obtaining patents for wire rope. It would be necessary to separate small, autonomous organizational units from the organizational structure that caters to existing markets, aiming to respond to innovation in emerging markets (Tushman and O’Reilly, 1996). In the case of Tokyo Rope, Yamada decided to establish the Fukagawa factory as a small organizational unit led by Tomura for this purpose. In 1907, the Kokura plant in Fukuoka Prefecture began operations as a new wire rope production site. These activities would constitute the exploration of new possibilities.

The decision of management on ambidexterity can be describes as the simple game in Table 2. In this game, strategies are either 'Yes' (choosing ambidextrous) or 'No' (not choosing ambidexterity). If the players (managers A and B) make different choices, the payoffs for both sides are zero due to organizational discord. If both choose 'Yes,' payoffs for both are 2. If both choose 'No,' payoffs for both are 1. This game has two Nash equilibria: 'Yes&Yes' and 'No&No.' The focal point of the game would be determined by the exogenous factors such as corporate culture (Kreps, 1990).

Table 2　Manager's Game: “Do We Choose Ambidexterity?”

		Manager B	
		Yes	No
Manager A	Yes	(2, 2)	(0, 0)
	No	(0, 0)	(1, 1)

Once the 'No&No' combination is chosen, the incentive for board members to choose 'Yes' would be lost. Even though the players (managers) know that the payoffs are good high in a 'Yes&Yes' combination, 'No&No' combination as Nash equilibrium has strategic stability. This situation is the essence of the so-called "innovator's dilemma” (Christensen, 1997; Igami, 2017). As a result, the company succeeded in avoiding this dilemma.

In the case of Tokyo Rope, Masakuni Yamada had might have persuaded stakeholders of payoffs of ‘Yes&Yes.' Within this persuasion, the resignation of Takashi Masuda became decisive in ambidexterity. The conflict between Yamada and Masuda was the turning point in whether Tokyo Rope would fall into the innovator's dilemma by insisting on producing hemp rope.

In April 1900, Tokyo Rope's extraordinary meeting of shareholders was held. At the meeting, several shareholders raised doubts about wire rope production. Among them were the following statements.

> "It makes no sense to manufacture unprofitable wire rope at the expense of profitable hemp rope. It is impossible to produce wire rope in Japan for the time being."
>
> (Tokyo Rope, 1957, p.46)

Masakuni Yamada responded in the following way to persuade the shareholders.

> "I will do my best to make this business a success, and I am confident of that. I am going to make this business a success, and I am convinced of it. If we do not succeed in the near future, I will certainly take responsibility."
>
> (Tokyo Rope, 1957, p.46)

The interaction between Yamada and these shareholders resembles the structure of the conflict between Yamada and Masuda. The key difference with shareholders is the less favorable initial returns of the wire rope production that was actually initiated. While Masuda was proud of his contribution to hemp rope production, the shareholders experienced disappointment with the practical outcomes of wire rope production. Yamada avoided the "innovator's dilemma" problem by desperate persuasion.

4.2 Intellectual Communication

Mokyr (1992) focuses on the spread of the concept known as 'industrial enlightenment' as one of the historical background of the Industrial Revolution in Britain. Industrial enlightenment is the belief that economic growth is realized through harnessing human knowledge about natural phenomena for manufacturing. Under this notion, advancements in postal services and transportation, for instance, facilitated exchanges of letters, expanding the scope of intellectual communication between university researchers and business practitioners. The importance of intelligent communication cannot be undermined while we cannot overestimate the success of the British experience (Yamamoto, 2018).

Intellectual communication at Tokyo Rope was fortunate in two ways: first, Risun Tomura had a wide range of intellectual interests. Since his activities of utilizing networks and information to locate appropriate experts, the company's practitioners became able to delve deeper into academic knowledge by learning from these experts.

Another fortune for Tokyo Rope was that Kuniichi Tawara was so committed to the close relationship between academia and practice that he was later called the "father of technical education" in the Japanese steel industry. Reminiscences on Tawara repeatedly emphasize that he had aimed to apply the results of his scientific research to actual factories, and that he had tried to train engineers and practitioners who had mastered this kind of research (Tawara-Sensei Kinen Shuppan Iinkai, 1959). At the time of Wire Rope's innovation, Tokyo Rope had a corporate culture that realized the ideals of intellectual communication.

Corporate culture that would promote intellectual communication was by no means widely observed in Japanese companies during the Meiji era. Jiro Yamaoka, a chemist who had served as an official examiner at the Ministry of Finance, was invited to give a lecture at a gathering of metalworking industry professionals in Tokyo in 1904. During this lecture, he pointed out the lack of communication between researchers in companies and universities as a challenge for Japan's manufacturing industry. Here is an English translation of excerpts from Yamaoka's speech transcript.

> "Anyone can produce a good product with a good item, and anyone can make a cheap product with a bad item.. The true difficulty lies in producing items of average-quality.…(omission) … Average-quality items must be made affordable and suitable for practical use. Even if we say that Japan lacks such average-quality goods.... (omission) … In such situations, engineers are needed. This requires academics, and that's why scholars are needed.… (omission) … When seeking assistance from scholars, one must entrust them with everything, vigorously pursue personal research, and adopt the idea of seeking additional wisdom. Unfortunately, this mindset is still scarce. Due to prevailing trends today, scholars and practitioners often find themselves

distanced. This is why Japan's manufacturing industry has not progressed to this day."

(Yamaoka, 1904, pp.22-24)

Yamaoka's reference to "average-quality goods" might pertain to the volume zone in marketing, indicating items positioned within the price range or popular price range where products or services sell the most. Yamaoka argued that internal standards must align with market trends, emphasizing the importance of fostering collaboration between corporate practitioners and university researchers dedicated to research for achieving this alignment. For Yamaoka, such intellectual communication seems to have been insufficient for Japanese companies in the Meiji era. Tokyo Rope's culture could be considered a rare case rather than a typical example in Japan at that time.

4.3 Smooth B2B Transactions

Firms producing intermediate goods face matching problems at two levels: the level of raw material procurement and the level of product sales. Matching would be socially more efficient if it were mediated by merchants rather than randomly determined (Watanabe, 2010). Trading companies play the role of such intermediaries.

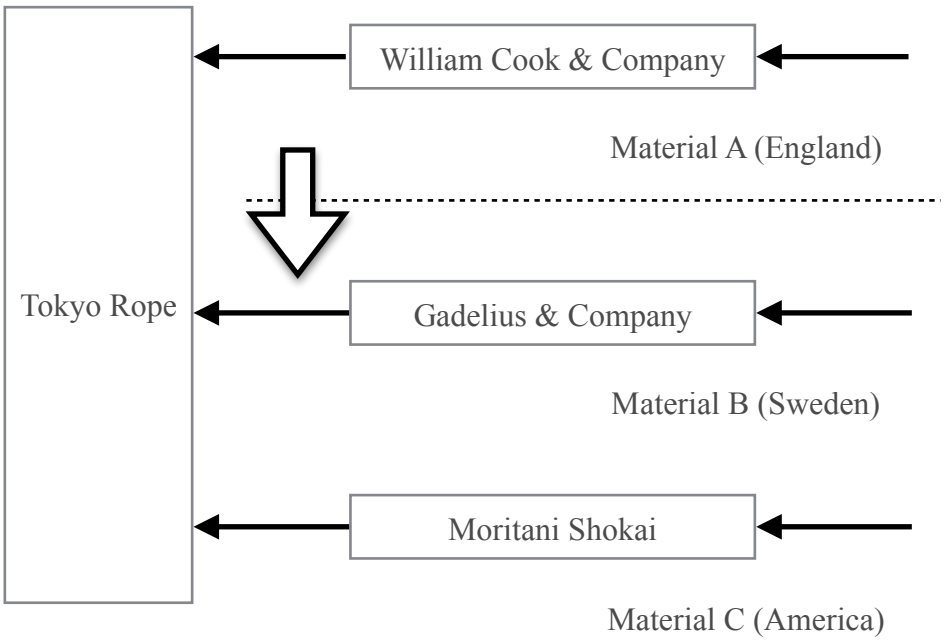
In the sale of wire ropes, the presence of trading companies would have been indispensable. Concerning Tokyo Rope's wire rope, Moritani Shokai played a role in contributing to the expansion of the rope sales network (Meshitsuka, 2009). Identifying the needs for ropes of different materials in various industries and appropriately distributing the corresponding products is crucial. Trading companies played a cooperative role in facilitating this coordination.

Tokyo Rope's management had to change suppliers flexibly according to the progress of intellectual communication or the results of R&D. Such management practices would have been supported by the activities of trading companies. During the 1910s, discoveries emerged, such as the suitability of wire materials from Sweden or the United States rather than those from England. The procurement of British wire

materials was facilitated by William Cook & Company, Swedish wire materials by Gadelius & Company, and American wire materials by Moritani Shokai, each serving as intermediaries (Tokyo Rope, 1957, p.340).

Figure 2 illustrates the shift of B2B transactions for raw material procurement. This transition was intended to be a decision at the company management level. The proposal for this shift originated at the R&D site and received approval at the management level. This reflects the management's flexible response based on R&D outcomes.

Figure 2 Shift of B2B Transactions



There are at least two reasons why Tokyo Rope was able to flexibly change suppliers. The first reason would be Masakuni Yamada's management skills. Another more important reason to be considered would be that Tokyo Rope was officially associated with Eiichi Shibusawa. Trading companies could have seen their associations with Tokyo Rope as a strategic entry point for business.

While Shibusawa was quiet about Tokyo Rope's ongoing management, he provided advice on B2B relationships, particularly M&A. For example, Shibusawa's diary entry of May 18, 1903 records a meeting of Tokyo Rope's board of directors to discuss a deal to acquire Tsukishima Rope (Shibusawa Seien Kinen Zaidan Ryumonsha, 1966, p.309). The merger was formed four years later. Shibusawa took the long view on this matter.

In the context of Fama and Jensen (1983), Shibusawa was an entrepreneur who took control, not management. By standing outside of management as a controller of various companies, he could have become able to mediate B2B. A number of entrepreneurs were eager to take advantage of his accomplishments and reputation, including Gohei Moriya, the founder of Moritani Shokai.

Meshitsuka (2009) explains the episodes on Moriya. After graduating from Keio Gijuku (present-day Keio University), he started his career at Mitsui Bank, where he worked for eight years before going to work for Oji Paper (*Oji Seishi*), also founded by Shibusawa. Moritani Shokai intermediated Tokyo Rope's wire rope sales partners, one of which was Iwaki Coal Mining Company (*Iwaki Tanko*), also a Shibusawa-related company.

Smooth B2B could have been realized by corporate management that demonstrated adaptability not only in internal coordination but also in engaging with external organizations. In the case of Tokyo Rope, the delegated manager was responsible for running an ambidextrous organization with the stakeholder influential enough to secure business partners in a time of need.

5 Concluding Remarks

This paper identifies three key factors: (1) rebuilding a corporate governance structure for ambidexterity, (2) intellectual communication between academic researchers and practitioners, and (3) smooth B2B transactions. Ambidexterity would involve coordinating corporate stakeholders. Intellectual communication would have been an

issue related not only to the motivation of the company's engineers, but also to the attitude of managers as to whether they would value contact with outside researchers. Smooth B2B transactions would be issues on external relationships.

To achieve innovation, Tokyo Rope had to adapt not only to internal coordination but also to interactions with academic researchers and external organizations. Through this application, innovation could have been realized.

Realization of an ambidextrous organization means that a company that has achieved one technological advance would embark on a new phase of technological advancement. Such management can not be realized in the early stage of industrialization. Even in the case of Tokyo Rope, the initial intention on wire rope production was to use the borrowed technology.

During the 1910s, both Eiichi Shibusawa and Jokichi Takamine, the scientist, dedicated themselves to the project of establishing Riken (present-day Riken, Institute of Physical and Chemical Research)

In 1917, Riken was established in March 1917. Eiichi Shibusawa was involved in this establishment. Shibusawa later recalled Takamine's vision at the time of this establishment as follows.

> “Dr. Takamine told me that the world until now has been an age of machine industry rather than science and chemistry, but that the future will surely be an age of science and chemistry rather than machine industry..…(omission) … The Japanese would be good at imitation, but they lack originality. To reverse this tendency of the Japanese people to be highly imitative and to become highly creative, there was no other way than to encourage research in pure physics and chemistry.”
>
> (Shibusawa, 1927, pp.522-523)

Takamine and Shibusawa were concerned about industrialization in the Meiji era, which relied heavily on imitation. On the other hand, Tokyo Rope might have been a

prime example of an exceptional company that became "highly creative." The type of companies that demonstrated such creativity would be an important issue in understanding the history of industrialization. Balancing the exploitation of this point with the exploration could be the subject of future studies.

References

Benner, Mary. J., and Michael L. Tushman. (2003). Exploitation, Exploration, and Process management : the Productivity Dilemma Revisited. Academy of Management Review, 28(2): 238-256.

Birkinshaw, Julian, and Kamini Gupta.(2013). Clarifying the Distinctive Contribution of Ambidexterity to the Field of Organization Studies. Academy of Management Perspectives, 27(4): 287-298.

Christensen, Clayton M. (1997), The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail. Harvard Business School Press.

Duncan, Robert B. (1976). The Ambidextrous Organization : Designing Dual Structures for Innovation. In Kilmann, Ralph H., Louis R. Pondy, and Dennis P. Slevin (Eds), The Management of Organization Design: Strategies and Implementation, pp.167-188. North Holland.

Fama, Eugene F. and Michael C. Jensen. (1983). Separation of Ownership and Control. Journal of Law and Economics, 26(2): 301-325.

Feyrer, Klaus. (2014). Wire Ropes: Tension, Endurance, Reliability, the Second Edition. Springer.

Hayami, Yujiro. (2001). Development Economics: From the Poverty to the Wealth of Nations. (Second Edition). Oxford university Press.

Igami, Mitsuru. (2017). Estimating the Innovator's Dilemma: Structural Analysis of Creative Destruction in the Hard Disk Drive Industry, 1981–1998. Journal of Political Economy, 125(3): 798-847.

Junni, Paulina, Riikka M. Sarala, Vas Taras and Shlomo Y. Tarba. (2013). Organizational Ambidexterity and Performance : A Meta-Analysis. Academy of Management Perspectives, 27(4): 299-312.

Kinoshita, Keisei and Sajuro Kono. (1903). Kangyo Koseki-Roku Dai 1 Hen (Industrial Achievement Records, Vol.1). Seinen Kyoiku Gikai.

Kreps, David. (1990). Corporate Culture and Economic Theory. In James. Alt and Kenneth A. Shepsle (eds). Perspectives on Positive Political Economy. Cambridge University Press.

March, James G. (1991). Exploration and Exploitation in Organizational Learning. Organizational Science 2(1): 71-87.

Mokyr, Joel. (1992). Lever of Riches: Technological Creativity and Economic Progress. Oxford University Press.

Mazurek, Pawel. (2023). A Comprehensive Review of Steel Wire Rope Degradation Mechanisms and Recent Damage Detection Methods. Sustainability, 15(6), 5441.

Meshitsuka, Yosuke. (2009). *Meiji Koki Shihonzai Sangyo no Seicho to Kikai-Sho* (Growth of the Capital Goods Industry and Machine Dealers in the Late Meiji Period). Working Paper Series, No. 094 （Management Innovation Research Center, Hitotsubashi University).

Nakamura, Takafusa. (1983). Economic Growth in Prewar Japan. Translation by Robert A. Feldman of the 1971 *Senzenki Nihon Keizai Seicho no Bunseki,* with revisions and updates. Yale University Press.

Ohkawa, Kazushi, Nobukiyo Takamatsu, and Yuzo Yamamoto. (1974). *Choki Keizai Tokei 1 — Suikei to Bunseki—* (Long-Term Economic Statistics 1—Estimation and Analysis—). Toyo Keizai Shinposha.

O'Reilly, III, Charles A. and Michael L. Tushman. (2008). Ambidexterity as a dynamic Capability: Resolving the Innovator's Dilemma. Research in Organizational Behavior, 28: 185-206.

Shibusawa, Eiichi. (1927). *Takamine Hakase to Rikagaku Kenkyusho* (Dr. Takamine and Riken). in Onuki, Shuichiro (ed). *Seien Kaikoroku Jo* (Memoirs of Seien, Vol. 1). Seien Kaikoroku Kankokai, pp.521-524.

Shibusawa Seien Kinen Zaidan Ryumonsha. (1966). *Shibusawa Eiichi Denki Shiryo Bekkan, Daiichi, Nikki, Ichi*. (Shibusawa Eiichi Biographical Materials, Extra Vol. 1, Diary 1).

Taniguchi, Hakobu. (2012). *Waiya Ropu Gijutsu Hatten no Keitoka Chosa* (Historical Development of Wire Rope Technologies). Research and Study on the Evaluation, Preservation, and Publication of Historical Materials on Industrial Technology, 5:1-94. Committee for Planning and Promotion of Research and Study on the Evaluation, Preservation, and Public Access to Material.

Tawara-Sensei Kinen Shuppan Iinkai (Tawara Memorial Publication Committee). (1959). *Tawara Kuniichi Sensei wo Shinobu* (In Memory of Professor Kuni-chi Tawara). The Iron and Steel Institute of Japan.

Tokyo Rope. (1927). Kosaku Waiya Ropu Zoho Teisei Dai Ni Han (Wire Rope, the Second Edition). Tokyo Rope, Corporation.

Tokyo Rope. (1957). *Tokyo Seiko Nanajunen-shi* (Seventy-Years History of Tokyo Rope, Corporation). Tokyo Rope, Corporation.

Tokyo Rope. (1989). *Tokyo Seiko Hyakunen-shi* (A Centennial History of Tokyo Rope, Corporation). Tokyo Rope, Corporation.

Tushman, Michael L., and Charles A. O'Reilly III. (1996). Ambidextrous Organizations: Managing Evolutionary and Revolutionary Change. California Management Review, 38(4): 8-29.

Verreet, Roland. (2018). A Short History of Wire Rope. Available on the internet (URL: https://www.ropetechnology.com/) Last access: 12/18/2023.

Yamamoto, Koji. (2018). Taming Capitalism Before Its Triumph: Public Service, Distrust, and 'Projecting' in Early Modern England. Oxford University Press.

Yamaoka, Jiro. (1904). *Kinzoku Dangi* (Discussion on Metalwork). Wada Tatsunosuke.

Watanabe, Makoto. (2010). A Model of Merchants. Journal of Economic Theory, 145(5): 1865-1889.