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**Introductory Research on the Genesis of Modern
Management of Technology:
The case of the Meiji Cotton Spinning Sector
Circa 1880s-90s**

Dr. Eugene K. Choi

Graduate School of Technology Management

Ritsumeikan University, Japan

Email: eugene@fc.ritsumei.ac.jp

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Technology in History

Technology has been the foundation of human command over nature. The availability of technology has also determined the quality of both human and physical capital. Thereon, technology has been an essential source for the growth of every business enterprise in global perspective. Technology has concerned systematic embodiment of evolving knowledge and culture in the history of civilisations. From the level of a regional community to that of the modern state, technology involved critical decisions that steered their following path of economic development.¹

A study of particular technologies in economic history may focus upon every detailed linear context of functional betterment within a specific phase. So the key research interest remains in the cohesion between technical change and socio-economic consequences. Strong and positive correlativity between new technology input and productivity enhancement would be a typical corollary. Alongside the investigation of the economic impact of technological progress, the effect of “lock-in” has been another significant historical theme. As the complexity of technology increases, so did switching costs for users. In considering technologies for more specific industrial purposes such as cotton spinning, the cost soars further. Once settled, a main technological path in a growing industry has hardly replaced. History of technology in most cases thence clarifies the nature of distinct path dependency.²

Inevitable Bifurcation

Business history in many Japanese studies has treated technology with a predetermined standpoint. Despite the significance in every context of managerial decision, technology

¹ David S. Landes, *The Unbound Prometheus: Technological Change and Industrial Development in Western Europe from 1750 to the Present*, (2nd Edition), Cambridge University Press, (Cambridge, U.K., 2003). Maxine Berg, *The Age of Manufactures 1700-1820: Industry, innovation and work in Britain*, (2nd Edition), Routledge (London, 1994), 235-54.

² Daniel R. Headrick, *Technology: A World History* (The New Oxford World History), Oxford University Press (Oxford, 2009).

was taken as a “given” factor rather than managers’ choice. It was a static constituent rather than a dynamic module that drives managerial discretion. In other words, technology was conceived as an exogenous variable apart from entrepreneurial management. The technological sphere was seen as an alienated field that either engineers or scientists should concern. Managers’ in-depth involvement with technology itself was interpreted as an “old-fashioned” institution; it was a hindrance to managerial professionalization. Definite separation of managerial knowledge from engineering techniques became an insignia of modern management, especially from the beginning of the 20th century; it concerned the beginning of a new epoch of Japanese large corporation.³

This point of view grew to be dominant in the field of Japanese-style managerial modernisation. Their approaches were upheld by a few indicative industrial transformations since the end of the 19th century: full-dress mechanisation, educational modernisation, and managerial specialisation. Mechanisation through imported Western technologies entailed an unprecedentedly high level of diversification in technical knowledge. Accordingly, the increased complexity necessitated higher calibres for both management and engineering. The up-growth of new institution for higher education such as Western-style universities was consequential. Soon, university graduates formed the top echelon of new knowledge management, and they began to set the courses of the key industries including textile manufacture. Universities both public and private thereupon became the hub of raising modern managers and engineers in a hotbed.⁴

Managerial specialisation in earnest was facilitated by a couple of industrial trends in Meiji Japan. Firstly, emergent large enterprises required quality recruits who could deal with the increasing managerial complexity. The necessity of more specialised skills in management became certain in accordance with the growth of organisational size.

³ Johannes Hirschmeier and Tsunehiko Yui, *The Development of Japanese Business 1600-1973*, George Allen & Unwin Ltd. (London, 1975), 111-120. Tetsuya Kuwahara, “The Development of Factory Management in Japan during the Early Stages of Industrialization: The Kanegafuchi Cotton-Spinning Company before the First World War,” in Douglas A. Farnie and David J. Jeremy (editors), *The Fibre that Changed the World: The Cotton Industry in International Perspective, 1600-1990s*, Oxford University Press (Oxford, 2004), 495-520.

⁴ Shin’ichi Yonekawa, “University graduates and large Japanese enterprises before the First World War,” *Business History*, 26 (2), (1984), 193-218. Johannes Hirschmeier and Tsunehiko Yui, *The Development of Japanese Business 1600-1973*, 145-227.

Secondly, the modernity in university education was proven by further specialism of respective subject, and this resulted in constant diversification as a common trend across different categories. As each subject furthered respective path of development, the distance to each other was extended as well.

To sum up, the rise of big firms alongside higher sophistication of mechanisation provided the primary ground for “divorce” between engineering and management. The level of technical sophistication within newly developed technologies became out of management’s reach. Likewise, the managerial complexity in crescendo of large and global business organisations began to dissuade engineers from concerning commercial matter. In addition, more education and training the industrial successors received, fewer point of knowledge exchange they shared. The divergence between the two kept progressing constantly throughout the 20th century.

Chasing a Rainbow, Bridging Two Separated Knowledge Domains

Research on management of technology (MOT) was initiated since the beginning of the 1980s at Massachusetts Institute of Technology in the United States. It is still a relatively new field of research in contemporary management studies. The principal standpoint in analysis is to look into the entire business context of value creation and acquisition. With regard to managerial practice, transforming technological potentials into business values through new product development constitutes the core activity. Together with theoretical development in managerial skills, MOT requires in-depth knowledge on science and engineering as well. So the research aim is to explore new technological platforms that support a competitive business model; and the realisation of sustainable competitiveness derives from creative combinations of technologies, either developing or mature. The conceptual backbone is therefore originated from Schumpeter’s idea of innovation, e.g. novel conjugation of resources, creation of inexperienced markets, and provision of new services and so on.⁵

Due to its noticeable impact upon managerial practice in most corporations of today, MOT as a juvenile subject has already achieved striking growth in both theory and practice. Nevertheless, MOT is there again, continuously extending its range of research.

⁵ Robert Burgelman, Clayton Christensen, and Steven Wheelwright, *Strategic Management of Technology and Innovation*, McGraw-Hill/Irwin, (New York, 2003).

My key attempt is hence to bring business history in to cultivate this fertile field of academic potential. Or vice versa, i.e. it would be fruitful to reconsider past and present themes in global business history via the evolving theoretical frames in MOT. As denoted in Teece's seminal article, the American manufacturing sector in the 1970s and the 80s witnessed the demise of superior technological foundation as the durable source for commercial success in global perspective.⁶ That is, technological superiority in merely technical terms declined to promise certain business gain, i.e. return on investment.

The linkage between competitive technology and popular product in market seemed fragile, and even untied in many cases; this implied that neither superior laboratory works nor engineering achievements would guarantee certain corporate profits. This turned out to be a serious reality, firstly concerning the crippled American manufacturers in the 1980s. However, the concern became global from the 1990s. As a technological leader in manufacturing through their outstanding process innovations, Japan began to keenly realise that the "usual" competitiveness could be undermined.⁷ The wing-footed catch-up in price competitiveness of the Asian neighbours was no primary concern; rather, Japanese manufacturers surely noticed the decomposition of their usual competitive advantage, based upon either straightforward cost leadership or technical differentiation. In other words, their new products became quickly commoditised, i.e. "nothing novel", "no excitement", "easily copied", "get common", in the eyes of customers both domestic and overseas. In a while after their first debuts, most products soon headed to "bloodbath of price competition", and this entailed exacerbation of poor corporate performance accordingly.⁸

⁶ David Teece, "Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy," *Research Policy*, 15, (1986), 285-305.

⁷ Christopher Wood, *End of Japan Inc. and How the New Japan will look*, Simon and Schuster (New York, 1994).

⁸ Scott Shane (editor), *The Handbook of Technology and Innovation Management* (Part II The Development and Introduction of New Products), John Wiley & Sons Ltd. (West Sussex, England, 2008). V. K. Narayanan and Gina Colarelli O'Connor (editors), *Encyclopedia of Technology and Innovation Management*, Wiley-Blackwell (1st Edition), (West Sussex, England, 2010), Part 4 Firm Level, 119-222.

Yaichi Aoshima, Akira Takeishi, Michael A. Cusumano, *Meido In Japan Ha Owarunoka?, Kiseki to Shuuen No Sakini Arumono, End of "Made in Japan?"*, Toyo Keizai Shimposha, (Tokyo, 2010), Chapter 1 on Reconsidering the Japanese Competitiveness, 24-65.

So its primary concern is how to avoid the vicious circle from commoditisation. For this conceptual essence, MOT advocates the significance of coupling management with engineering from initial business modelling to sales of final products. Regardless of Chandlerian terms of vertical integration by large modern corporations⁹, MOT involves a fundamental change in the process of value creation: the genuine source of entrepreneurial management would exist at the point of contact between engineering and management. New knowledge frontiers, explored from scientific research, provide new spurts of development in engineering. Superior engineering then materialises competitive manufacturing. A series of ongoing chain reactions between the two distant spheres is essential. Without efficient bridging the business seeds from science and engineering with the needs from market, commoditisation becomes inescapable, then in the end, the competitiveness in manufacturing crumbles. MOT aims to be a trailblazing field of research concerning the two-tier system of business innovation.

Back to the Future: Return to Meiji Business History

This article purports to outline a new historical study on the early evolution of the Japanese-style management of technology in the Meiji era (1868-1912). The reason for examining the cotton-spinning sector is straightforward. As a mainstay of the Japanese epoch of industrialisation, the cotton spinning was placed at the forefront of the economic modernisation during the 2nd half of the 19th century. The technical backwardness was overcome through the positive assimilation to the most advanced technology of the time, i.e. the British textile technology. The first full-scale mechanisation of cotton manufacture was also initiated from the spinning sector.¹⁰

Choice, procurement, delivery, installation, operation and following maintenance of every piece of machinery covered just a small part in the process of complete mechanisation. Taking real advantage of the progressive system of mass manufacture necessitated modelling of an unprecedented business system as well. The mechanisation was thus not a mere transplantation of British technology; a new business system

⁹ Alfred D. Chandler, Jr., *Scale and Scope: The Dynamics of Industrial Capitalism*, The Belknap Press of Harvard University Press, (Cambridge, Mass, 1990), 14-46.

¹⁰ Keijiro Otsuka, Gustav Ranis, and Gary Saxonhouse, *Comparative Technology Choice in Development: The Indian and Japanese Cotton Textile Industries*, Palgrave Macmillan (New York, 1988).

constitutes a wide array of non-technological factors that surrounds a chosen technology. In the case of a late industrialisation such as Meiji Japan, the productivity in the identical level of the British could never be achieved without resolving the formidable scarcity of human resources, especially skilled labourers, technicians, engineers, and managers as well. First of all, the commercial potential of a selected technology should be well understood; but more significantly, the fit between a chosen technology as a seed and a specific product as a need in market had to be assessed properly.¹¹ The required level of knowledge across management and engineering that would handle technical and organisational complexity was considerable.

So the most burdensome stumbling block before the Japanese catch-up industrialisation was the scant "knowledge reservoir" in modern engineering, and more severely, in global business. Despite the underdevelopment, once the technology transfer commenced from Britain, management of technology had to become an international concern notwithstanding their intention. The infant phase of the Meiji cotton spinning industry in the 1870s and the 1880s was therefore steered by a small group of talented elites. And the leading entrepreneurs were placed in the milieu of certain socio-economic backwardness. Amongst many and vary, the most severe backwardness remained in the underdeveloped commercial institution in global perspective that would save formidable cost of information as well as transaction in systematic way. This was sorted out by exploiting a small group of rare entrepreneurs capable of coping with both spheres of modern knowledge. The real level of their experts in management of engineering and administration was the second concern. Instead, the primary task concerns whether they could internalise the body of technical knowledge from learning by doing; then more importantly, bring forward a profitable business model. Advanced technologies were the essential external source of creating and acquiring commercial values.

For those "most wanted" engineer-manager (or manager-engineer), there was neither clear division nor distinct border between engineering and management. Their entrepreneurial concept was formed through dynamic daily concerns across the dual spheres of knowledge. Nonetheless, their business focus was so determined: create new

¹¹ Eugene K. Choi, *Technological Choices in the Rise of the Meiji Cotton Industry c.1860-1900*, Unpublished PhD Thesis, University of Cambridge (Cambridge, U.K., 2006).

markets and fill them up with their products. Nevertheless, the high time of these industrial elites did not last long; as the educational institutions were developed rapidly in the national slogan for modernisation, i.e. more precisely, Rich Nation and Strong Army, the demanded fields of the two subjects became specialised further; and their separation was consequential. From the turn of the century, the domestic supply of university graduates with specialities in engineering and management grew to be sufficient. Simultaneously, as the size of those spinning firms grew, the Japanese epoch of large corporation started; along with the growing divisional specialities, the distance between engineers and managers extended as well. The nature of entrepreneurial management was thenceforth changed as well.¹²

The principal research aim of MOT today involves how to arrange a successful "marriage" between the separated two. And the purpose is to develop new products that entail more values for both producers and consumers. This also purports to facilitate both product and process innovations through unprecedented combinations of knowledge. The increasing demand for MOT implies that, despite the common recognition in conceptual perspective, business practice has not reached to the identical level. It is remarkable to see that the dawn of the Meiji cotton spinning industry was broken by a small community of engineer-manager (or manager-engineer). For those first industrialists in the Japanese epoch of mechanisation, every business practice had to involve evenly and constantly with engineering. Concerning the calibre so desperately required in today's MOT in Japan, it would be interesting to bring those unique Meiji industrialists back to our research concerns henceforth. In other words, a more thorough historical investigation of their business practice in the time of hardship is certainly worth our attention. It is thus the main proposition of this study that the distinguished entrepreneurial history of the early Meiji cotton industrialists would provide a new platform for further theoretical development of MOT.

¹² Shin'ichi Yonekawa, *Tozai Sen'i Kei'ei Shi* [Business History of Textile Industries in the East and the West], Dobunkan, (Tokyo, 1998), Chapter 4 *Senkanki Sandai Boseki Kigyō No Gakusotsu Shoku'in Sou* [University-Graduate Employers of the Three Big Spinning Firms during the Interwar Period], 43-68, Chapter 5 *Senzenki Dai Nippon Boseki No Kei'ei* [The Management of Dai Nippon Spinning Company before WWI], 69-88. Matao Miyamoto, Takeshi Abe, Masaru Udagawa, Minoru Sawai, and Takeo Kikkawa, *Nihon Kei'ei Shi, Edo Jidai Kara Nijyū Issēiki He* [Business History of Japan: From the era of Edo to the 21st Century], Yuuhikaku, (Tokyo, 2009, 2nd Edition), 117-123, 169-189.

Gerschenkron and Nakagawa Revisited

Industrialisation in global perspective has varied in timing, speed, structural patterns, and source of finance and so on. A lot of variables, that were either correlated or not to each other, drive each context of industrialisation, thus in history, there has been no universal model. The speed of development, i.e. the rate of industrial growth in size and productivity, should be a primarily notable perspective; moreover, the productive and organisational structures of industry would present individual patterns. Even though, it is common in every case that technology brought the most immediate impact upon quick industrial progress.

Gerschenkron listed basic factors, which historically were peculiar to economic situations in backward countries and made for higher speed of growth as well as industrial formations. This led to his conceptual argument on pre-conditions for industrialisation. Then he pointed out that, regarding late industrialisation, institutional instruments such as banks and the states played the most prominent role of providing financial and ideological settings for successful progress. Possibility of borrowing advanced technologies from industrial forerunners was indicated as the late starters' distinguishing advantage.¹³ Nevertheless, no industrialisation has been completed solely by transplantation of technologies. So Gerschenkron's next theme of debate on catch-up industrialisation concerned the essentiality of high entrepreneurial calibre that could take full advantage of borrowed technologies and develop profitable business models.

Nakagawa led the Japanese research in the field of entrepreneurial history. Comparative business history was his principal research approach; and his comprehensive examination of the entrepreneurial management of British, American, and Indian corporations succeeded to clarify the key elements of individuality in the development of Japanese new business.¹⁴ Through Gerschenkronian framework of late

¹³ Alexander Gerschenkron, *Economic Backwardness in Historical Perspective; a Book of Essays*, Frederick A. Praeger Publishers, (New York, 1962), 5-30.

¹⁴ Keiichiro Nakagawa, "Keizai Hatten to Kigyousha Katudou, Kigyousha-Shi Kenkyuu no Tachiba Kara," (Jyo/Ge) [Economic Growth and Entrepreneurial Management: from the Perspectives of Entrepreneurial History (Part I and II)], *Shiso*, (September 1962).

industrialisation, Nakagawa pointed out that the substantiality of trading companies, i.e. Bussan. Bussan constituted unprecedented institutional (more precisely, corporate) foundation, and succeeded to cope with strategic information in surprisingly international perspective. More remarkably, his debate entailed the reconsideration of marketing as the most essential drive for corporate prosperity.¹⁵

Nakagawa's viewpoint is clear: the swift enhancement of marketing by Bussan should not be overlooked in regard to the historical context of the Meiji industrialisation. So Nakagawa's every debate on marketing identically concerned information cost; no corporate success could be achieved without constant acquisition of sufficient market information. He signified that Bussan played the vital role of creating demand, extending supply, and connecting them in either domestic or global scale. That is to say, although none of his research articles addressed technology management, his standpoint of business history involved a nature of MOT, which is the ongoing pursuit of strategic fit between market and technology. The significance of information cost in entrepreneurial MOT should be reconsidered henceforth.¹⁶

Outset of Anglo-Japanese Technological Connexion

Since the development of Richard Robert's Self-Acting Mule in 1830, the British textile machinery makers began to better the automation of spinning frames. The automation turned into a key method of increasing mechanical range within spinning process, and then reduced the significance of human skills in cotton manufacture. Besides, furtherance of technological sophistication in the main spinning frames was

Keiichiro Nakagawa, "Kei'ei Shi Gaku no Kadai – Mondai Teiki," [Assignments of Business History; Research Propositions], *Kei'ei Shi Gaku*, Vol.1 (1), (June 1966).

Keiichiro Nakagawa, "Indo No Keizai Hatten to Kigyousha Katsudou," [The Economic Growth of India and Entrepreneurial Management], *Kei'ei Shi Gaku Nenji Taikai Hokoku Ronbun Shu*, "Kigyousha Katsudou no Kokusai Hikaku", 1970.

Keiichiro Nakagawa, "Igrisu Sangyo Kakumei ni okeru Kigyoo Kei'ei Katsudou no Kenkyuu, Beikoku, Nippon tonon Hikaku ni oite," [The British Industrial Revolution and Entrepreneurial Management; in comparison with the American and Japanese cases], *Mitsui Bunko Ronso*, Vol.1, (1967).

¹⁵ Keiichiro Nakagawa, "Kigyoo Seichou to Ma-ke Tingu," [Corporate Growth and Marketing], in Jyojiro Nakamura (ed.) *Gendai Kei'ei Gaku no Kenkyuu* [Research on Modern Management Studies], Nippon Seisansei Honbu (Tokyo, 1968).

¹⁶ Mark Casson, *Information and Organization: A New Perspective on the Theory of the Firm*, Oxford University Press, (Oxford, 2001), The Process of Coordination, 35-75.

followed by the richer variety of ancillary machinery. This enabled the British textile engineering companies to broaden the scope of their offerings for the domestic spinners and the upcoming global demand from the 1850s onwards. The initial Japanese purchase of British textile machinery was made in 1866 by the Satsuma clan, and this was the beginning of their technological tie.

The Japanese orders for the British textile machinery became noticeable from the 2nd half of the 1880s, and soared distinctively throughout the 1890s. This was the period when the British textile engineering companies certainly championed the world market; and the level of their technical sophistication in customising textile machinery reached the technological zenith as well. That is, the leading British industry showed its competitive advantage in delivering a wide variety of customised sets of machinery for both domestic and overseas demands. This was applied to the Japanese procurement of spinning frames as well. Provision of sufficient information about the Japanese technical requirements could thus let the British side make quick suggestions of proper machinery assortment. So it might seem, superficially, just a matter of communication between the two. Nonetheless, it turned out to be a series of cumbersome business practice. The Meiji spinners' management of technology had to deal with more complicated concerns than simply making sensible decisions in new machine order.

Until they reached the "sensible choice" of technology, they had to clear a few stage gates through learning by doing. The alien technology from Britain, first of all, constituted an indivisible synthesis of unprecedented knowledge and techniques. A considerable level of tacit knowledge was enmeshed with the scientific foundation within the British mechanical engineering of textile machinery. Regardless of mastering the entire mechanism of advanced spinning, it was requisite for the Japanese engineers to understand both technical specifications and mechanical characteristics. The language barrier could be surely the first noticeable hurdle they faced. Besides, the Japanese market was yet minor for the British engineering companies' market portfolios. For the Meiji spinners, sufficient acquisition of up-to-date information about the British textile machinery was also bounded due to the still underdeveloped channel of global communication.

So the local spinners' access to foreign information was limited. Their independent investigation of the available foreign technologies was too costly. Despite the difficult

situation of risk assessment, it was urgent for them to spot the best combination of manageable textile machinery. Furthermore, their technological choice must guarantee business profits. Their concern was straightforward: quick clarification of a competitive model of technology mix. In the early phase of mechanisation, the essence of their management of technology resided in the “strategic” selection of “right” machinery. Technology choice remained the core of their early business modelling until the pan-industrial takeoff became obvious in the middle of the 1890s.¹⁷

A Japanese Model in the Epoch of High Mass Production

In the spring of 1926, Sir Kenneth Stewart, the British representative to the Chinese Customs Conference in Beijing 1925, called by Osaka the nucleus of the Japanese cotton industry. After his visits to several cotton mills, he made a lecture at *Tokyo Shoka Daigaku* (Tokyo University of Commerce, Present-day Hitotsubashi University in Tokyo) to discuss his comparative review of the business models in Manchester and Osaka. Concerning the Japanese mills, his viewpoint well depicted the virtually complete model of well-organised mass production of the time:

The great difference between Manchester and Osaka lies less in the cheap labour and lengthy working hours of Japanese labour than in the simple fact that Osaka has carried into practice the value and the economies of mass production... I inspected the factory in Osaka recently where I saw only 6 types of cotton fabrics being woven. The machinery was being operated at continuously unchanging tempo, weaving the same products throughout, and the mill workers were engaged in the same type of work, making for extreme savings in labour and economy of operations... Cotton fabrics being exported from Japan are shipped in quantities under the label of the manufacturing company; thus, products of the same trademark can be obtained in every corner of the world.¹⁸

¹⁷ Eugene K. Choi, *Technological Choices in the Rise of the Meiji Cotton Industry c.1860-1900*, Unpublished PhD Thesis, University of Cambridge (Cambridge, U.K., 2006).

¹⁸ Quoted in Keizo Seki, *The Cotton Industry of Japan* (Tokyo, 1956), 70-71. Another significant source concerning a British investigator's (from Foreign Office) investigation on the Japanese spinning mills (in Osaka in November 1898) can be found in: *Noshomusho* [The Meiji Ministry of Agriculture and Commerce], *Nippon Menshi Bosekigyo Enkaku Kiji* [Historical records of the Japanese cotton spinning sector] (Tokyo, 1901), 172-73.

The above denotes that, by the 2nd half of the 1920s, the Japanese cotton industry accomplished not only vertically integrated but also highly focused systems of manufacture. The Osaka model certainly committed to faster and more efficient production of a small variety of strategically selected products.¹⁹ Besides, the committed focus upon the strategic goods enabled them to realise the high level of standardisation across every process of manufacture. This so bolstered the flowing procedure of both production and distribution. Arno S. Pearse's detailed report in 1929 for the International Federation of Master Cotton Spinners' and Manufacturers' Association in Manchester also addressed this distinct achievement.²⁰ Soon in the following first half of the 1930s, the Japanese model surpassed the British in both production and exportation in global competition by dominating the source of the largest demand for their cotton goods, i.e. the markets of China and India.²¹

In search for the Japanese comparative advantage, Sandberg pinpointed the successful "supply of entrepreneurship and management skill together with the adaptability of the workforce to factory conditions".²² If the mass production system merely required cheap and unskilled labour en masse, the most abundant supply resided not in Japan but in either China or India (or even tropical Africa). Sandberg's comparative perspective brought up the issue of essential managerial impact upon industrial competitiveness. Wilkins' focus on understanding different industrial

¹⁹ Takeshi Abe, "Organizational changes in the Japanese cotton industry during the inter-war period: From inter-firm-based organization to cross-sector-based organization," in *The Fibre that Change the World: The cotton industry in international perspective, 1600-1990s*, eds. Douglas A. Farnie and David J. Jeremy (Oxford, 2004), 461-93; Etsuo Abe, "The development of modern business in Japan," *Business History Review* 71 (April 1997): 299-308; and for the Zaibatsu-level organisational innovation in the same period, see Seiichiro Yonekura and Hiroshi Shimizu, "Entrepreneurship in Pre-World War II Japan: The Role and Logic of the Zaibatsu," in *The Invention of Enterprise: Entrepreneurship from Ancient Mesopotamia to Modern Times* (Kauffman Foundation Series on Innovation and Entrepreneurship), eds. David S. Landes, Joel Mokyr, and William J. Baumol (Princeton, N.J. 2010), 501-526.

²⁰ Arno S. Pearse, *The Cotton Industry of Japan and China: Being the report to the journey of Japan and China* (Manchester, 1929), 25-29, 34, 38-42.

²¹ Foreign Office, Memorandum on Japanese competition, copy 1: Japanese competition, 'Notes on particular industries'; copy 2: Doc. 7883/583/23 No.521, Japanese trade competition, 17 January 1934 (British Embassy, Tokyo, 1934).

²² Lars, G. Sandberg, *Lancashire in decline: A study in entrepreneurship technology, and international trade* (Ohio: Columbus, 1974), 217.

performance was placed on managerial calibres as well. Her investigation on the Japanese multinational enterprise before WWI concerned the noticeable endeavour to establish international business infrastructure; her study clarified that the textile industry was at the entrepreneurial forefront of corporate internationalisation from the Meiji period.²³ The context of development was rather clear: the textile sector was most intensively engaged in global trade to secure overseas raw cotton and send value-added goods back to overseas markets.

The research of Mass and Lazonick also introduced a significant developmental perspective regarding the Japanese advantage. They highlighted the essential role of “planned co-ordination of economic activity, not only within dominant enterprises but also within the industry as a whole” in terms of leading the international competition. Their debate involved another important viewpoint that the “planned co-ordination” could be achieved through the “leadership of the dominant spinning and trading companies”.²⁴ A crucial implication from the above studies is that the competitive tendon of the Japanese mass production resided in efficient coordination across firms. Much broader organisational coordination was realised in tandem with the noticeable development of a leadership core within the industry, and this proved that the Japanese model of cotton business was neither the British-style nor the American in the epoch of mass production.

Collaborative MOT in Meiji Style

More than cost of business transaction, it was information cost that influenced decision-makings in MOT.²⁵ In tandem with the British-style mechanisation of cotton spinning, there was another attempt of managing native spinning technologies in particular rural regions.²⁶ The latter had a distinct advantage in its locality of information regarding

²³ Mira Wilkins, “Japanese Multinational Enterprise before 1914,” *Business History Review* 60 (July 1986): 227-29.

²⁴ William Mass and William Lazonick, “The British Cotton Industry and International Competitive Advantage,” *Business History* 32 (November 1990), 48.

²⁵ *Noshomu-sho* [The Meiji Ministry of Agriculture and Commerce], *Noshomusho Aichi Bosekisho Naikoku Bosekisho Renkogai Giji Hikki* [The proceedings of the conference of the Cotton Spinners’ Association at the Aichi Mill, owned by Noshomu-Sho, 17-20 October in the 15th Meiji Year] (Osaka 1882).

²⁶ Eugene K. Choi, “Another Spinning Innovation: The case of the rattling spindle, Garabo, in

MOT. The British-style mechanisation necessitated a wide array of inexperienced decisions concerning technology transfer. Despite the high literacy rate in the whole nation since the late Tokugawa era, acquiring sufficient sets of information, especially of those industrial, technical, and cultural (and including inevitable language barrier), was a massive roadblock before the domestic cotton masters. It is obvious that the complexity of scientific knowledge entailed high cost.²⁷ Nonetheless, the establishment of the British-style cotton industry was a national concern to stop the incoming tide of competitive British and Indian products. The problems had to be tackled by all means.²⁸

Regardless the long debate on the impact of the state enterprise, it is certain that a small group of industrial elites steered the industrial “vector” of development in its early stage. The essential example was the Osaka Cotton Spinning Company (1882-1914²⁹), which was directed by Takeo Yamanobe (1851-1920). As the initial private company with the groundbreaking success in both corporate performance and technology transfer, it provides the public with a new business model.³⁰ The OCSC sustained its trailblazer’s position within the industry until the first half of the 1890s, but more importantly, Yamanobe, the head of the firm, presented a new managerial blueprint through the first industrial journal for the cotton spinners’ association. His crisp voice with confidence induced a presentation not only of a profitable prototype of technology

the development of the Japanese spinning industry,” *Australian Economic History Review*, Vol.51, No.1 (March 2011), 22-45.

²⁷ Franco Amatori and Andrea Colli, “Models of entrepreneurship in a latecomer industry: Italy,” in Youseff Cassis and Ioanna P. Minoglou (editors), *Country studies in entrepreneurship: A historical perspective*, (London 2006), 129-48; David J. Jeremy (editor), *International Technology Transfer: Europe, Japan, and the USA, 1700-1914*, (Aldershot, Hants, U.K. 1991); Tetsuro Nakaoka, “The transfer of cotton manufacturing technology from Britain to Japan,” in David J. Jeremy, *International Technology Transfer: Europe, Japan, and the USA, 1700-1914*, (Aldershot, Hants, U.K. 1991), 181-98; Clive Trebilcock, *The Industrialization of Continental Powers 1780-1914*, (Harlow Essex. UK 1981).

²⁸ William D. Wray (editor), *Managing industrial enterprise: cases from Japan’s prewar experience*, (Cambridge, Mass. 1989).

²⁹ On the 26th of June 1914, Osaka Cotton Spinning Company was merged with Mie Cotton Spinning Company to form Toyo Spinning Company (Toyobo).

³⁰ Naosuke Takamura, “*Osaka Boseki Kaisha*,” [Osaka Cotton Spinning Company] in *Nippon Sangyo Kin’yushi Kenkyu: Boseki Kin’yu Hen* [Financial History of Japanese Industries: Finance of Cotton Industry], ed. Kazuo Yamaguchi (Tokyo 1970), 325-92; Matao Miyamoto, “The products and market strategies of the Osaka Cotton Spinning Company: 1883-1914,” in *Japanese Yearbook on Business History* 5, eds. Shigeaki Yasuoka and Hidemasa Morikawa (Tokyo 1988), 117-59.

mix but also of a strategic nature of mechanised cotton manufacture. By breaking away from the obsession of the previous state enterprise regarding the full utilisation of native sources such as domestic raw cotton and local power source from river stream, Yamanobe brought up a new combination of every accessible business resources. The source of Yamanobe's confidence remained in the body of his knowledge and practice; and his industrial knowledge was inherent in his rich field experiences in Britain and Japan.³¹

For the domestic cotton entrepreneurs yet shouldering the incredible burden of high information cost and uncertainty from the alien technologies and business systems, their choice of MOT involves seeking trustworthy guidance (or more realistically, directions) from the first path-breaker ahead and increase technical unification in speed; this then enabled them to accelerate industrial standardisation with determination. Regarding this pan-industrial coordination, the cotton spinners' association became an essential terminal to create and share "public goods" in MOT, i.e. reduction of information cost and uncertainty, and the association's publication for the members was the key media.³² So the noteworthy planned coordination throughout the fast growing phase of the 1890s and the 1900s was driven by their firm cognitive commonality within the industry as a whole. It was originally initiated from the cotton industrialists' endeavour to minimise the cost of coping with technical problems and accidents at shop floors by operating identical sets of British textile machinery.³³

A reported trouble and following effective countermeasures for the trouble at one spinning mill could be shared together by the whole industry since most of the spinning mills operated the same machinery. Through the pan-industrial practice in the early developmental phase to cut down information cost of technical and institutional

³¹ Eugene K. Choi, "Entrepreneurial leadership in the Meiji cotton spinners' early conceptualisation of global competition," *Business History* 51 (6), (November 2009), 936-40.

³² *Boseki Rengo Kai* [Association of Cotton Spinners], *Rengo Boseki Geppo* [Monthly Journal of Cotton Spinners' Association] (1889-1890); *Rengo Boseki Geppo Oyobi Boshoku Geppo* [Monthly Journal of Cotton Spinners & Weavers' Association] (1891); *Boshoku Geppo Oyobi Dai Nippon Menshi Boseki Rengo Kai Hokoku* [Monthly Journal of Cotton Weavers & Report of Cotton Spinners' Association] (1892); *Dai Nippon Menshi Boseki Dogyo Rengo Kai Hokoku* [Report of All Japan Cotton Spinners' Association] (1893-1902).

³³ *Noshomusho* [The Meiji Ministry of Agriculture and Commerce], *Nippon Menshi Bosekigyō Enkaku Kiji* [Historical records of the Japanese cotton spinning sector] (Tokyo 1901), chapter one on 'The locations of mills & the increase and decrease of spindles in operation', 24-25.

backwardness, the Japanese cotton spinners mastered taking advantage of both “voluntarily coordinating” themselves and “being positively coordinated” as one. In regard to the voluntary ethos, one should not bring forward an abstract concept of altruism as the principal foundation; they were convinced that collaboration would benefit them. Business was business. Entrepreneurial quest for managing information cost as well as better corporate performance therefore provided the essential drive of industry-wide cooperation.³⁴ The original source of planned coordination that formed a pillar of the Japanese competitive advantage remained there.

Entrepreneurial Leadership in MOT and Business Model Development

The unification of the textile machinery supply enabled the Meiji spinners to diminish, first of all, the information cost from finding out proper sets of British machinery.³⁵ The other distinct cost-saving effect surfaced in their planned coordination for technical knowledge diffusion and standardisation. The solely outstanding leader, the Osaka Cotton Spinning Company, provided the burgeoning community of cotton masters with an example to follow. Nonetheless, the industrial leader was never alone. Throughout Yamanobe’s full-dress quest for right textile machinery and closer communication with the British textile engineers of Platt Brothers & Co. Ltd. of Oldham³⁶, the London branch of Mitsui Bussan (Mitsui Trading Company) intermediated between the two thoroughly. The tight collaboration amongst the three paved the Meiji spinners’ road to the first winning formula during the crucial period of the 2nd half of the 1880s: a

³⁴ See Mark Casson, *Entrepreneur: An economic theory* (Cheltenham, UK 1982) for the information-cost-based theory of entrepreneurship. Also see Serguey Braguinsky and David C. Rose, “Competition, cooperation, and the neighboring farmer effect,” *Journal of Economic Behavior & Organization* 72 (May 2009): 361-76.

³⁵ The distinctive identicalness as well as cyclical repetitiveness in the pattern of the Meiji spinners’ orders and procurements of the Platt’s machinery can be seen in the Platt’s record of foreign sales. Platt-Saco-Lowell DDPSL 1/78/22-25 (Foreign no.7-10; November 1890 – May 1897).

³⁶ Platt Bros. Co. Ltd. of Oldham was the industrial leader not only in the scale of production but also in technological innovation as well as product development. See Reginald H. Eastham, *Platts Textile Machinery Makers: Civic leaders in Oldham*, country squires in North Wales (Oldham, UK 1994), 50 and Chapter IX on the Zenith of the Platt Brothers & Co. Ltd; Anna P. Benson, *Textile Machines*, Shire Album 103 (Princes Risborough: Shire 1983), 21. For the company’s changing global strategy in the 1st half of the 20th century, see Douglas A. Farnie, “The marketing strategies of Platt Bros & Co. Ltd. of Oldham, 1906-1940,” *Textile History* 24 (November 1993): 147-61.

strategic model of spinning frame for the Meiji spinners in the following phase of “industrial rocket-start”.³⁷

As the pre-eminent Meiji explorer of international business development, the Mitsui Bussan’s distinctive function was to reduce costs from search, negotiation, and transaction; and this sharpened its cutting edge in entrepreneurial combinations of business knowledge and opportunities in the global perspective. But more significantly, the trading agency’s strategic role was to supply the most up-to-date overseas information to facilitate its business partners’ understanding of the dynamic nature of global competition. Mitsui Bussan was not a mere agency for the cotton trade of the Meiji and the following era; the efficient importation of advanced, and more specifically, suitable machinery was as strategic as the increase in exporting competitive staple goods such as raw cotton. Thus, Mitsui influenced the early generation of entrepreneurial visions for approaching global market competition. As Witt argued, business conceptions would shape entrepreneurial venture, and a new breakthrough in forming a commonality within the shared conceptions would be accomplished by distinctive cognitive leadership.³⁸ Considering the immature stage of the Meiji spinning sector, especially in the last two decades of the 19th century, an industrial level of commonality could be generated by managerial coordination.

The best sidekick for Yamanobe of the OCSC was Senjiro Watanabe (1860-1916), the head of the London Branch of Mitsui Bussan (est. 1877). Together, they were at the forefront of the entrepreneurial pursuit of new visions of business opportunities through cotton trade. Jones’ study on British trading companies in Asia remarkably pointed out information asymmetry, the potential of opportunism, and quality control necessary for some commodities as the essential force of organisational integration.³⁹ However,

³⁷ Yamanobe’s “strategic model” was developed through the summer of 1887 (along with Senjiro Watanabe of Mitsui and Henry Ainley of Platt Bros. Co. Ltd.) and the specification of the particular technology mix can be seen in his order between September and November 1887. See Platt-Saco-Lowell DDPSL 1/78/19 Foreign No.4, 134-35 (Osaka Cotton Mill, and Osaka Weaving Mill, 3 September 1887), and DDPSL 1/78.20 Foreign No.5, 2-3 (Osaka Spinning Co. Ltd., November 1887).

³⁸ Ulrich Witt, “Imagination and leadership – The neglected dimension of an evolutionary theory of the firm,” *Journal of Economic Behavior and Organization* 35 (April 1998): 161-77; “Firms as realizations of entrepreneurial visions,” *Journal of Management Studies* 44 (November 2007): 1125-40.

³⁹ Geoffrey Jones, “Diversification strategies and corporate governance in trading companies:

concerning the Meiji cotton spinners in their early stage of takeoff, vertical integration was a yet incomplete method to hold down probable opportunism and confusion from underdeveloped knowledge (due to strikingly high information cost): a distinguishing leadership was necessitated to form a lucid entrepreneurial vision for the speed growth of the infant industry as a whole to ‘shepherd the uninformed and confused and even possibly opportunistic fellows into a successful model of planned coordination and collaboration’.⁴⁰

MOT Evolved: Conceptual Breakthrough and Grand Paradigm Shift

A couple of primary sources should be introduced. Through the key media, the monthly industrial journal such as *Boseki Geppo*, Yamanobe brought forward a wide array of critical issues in management that called for a certain change in the Meiji business paradigm. The new paradigm involved; more collaborative pursuit of profitable and marketable products, positive extension of both domestic and international marketing routes, adoption of modern accounting and recording system, standardisation of industrial measurements, technical outline of boilers for cotton spinning, cost saving in coal consumption and other operations on shop floor, global quest for new sources of raw cotton supply such as China and America, and applying more global perspective to daily management.⁴¹ The content of his every assertion for the industry had been hardly witnessed from the previous state enterprise. The crux of Yamanobe’s series of debates

Anglo-Japanese comparisons since the late nineteenth century,” *Business and Economic History* 25 (1996), 109; “Multinational trading companies in history and theory,” in *The Multinational Traders*, ed. Geoffrey Jones (London 1987), 1-21.

⁴⁰ Eugene K. Choi, “Entrepreneurial leadership in the Meiji cotton spinners’ early conceptualisation of global competition,” *Business History* 51 (6), (November 2009): 945.

⁴¹ Takeo Yamanobe, “Ronsetsu, bosekigyo no kakowo kaisoshi sono shoraini ronkyu su,” [Leading article: Considering the prospect of the cotton industry by reflecting on its past] *Rengo Boseki Geppo* 1 (May 1889): 1-12; Takeo Yamanobe, “Ronsetsu, bosekigyo kochaku shihon shokyaku oyobi son’eki keisan ni kansuru shisetsu,” [Leading article: My view of effacement of fixed capital and of cost and benefit analysis, Part I] *Rengo Boseki Geppo* 2 (June 1889): 1-6; Takeo Yamanobe, “Ronsetsu, bosekigyo kochaku shihon shokyaku oyobi son’eki keisan ni kansuru shisetsu,” [Leading article: My view of effacement of fixed capital and of cost and benefit analysis, Part II] *Rengo Boseki Geppo* 3 (July 1889): 1-7; Takeo Yamanobe, “Ronsetsu, boseki kojyo yo kiki kikan no gaisetsu,” [Leading article: A technical outline of steam engines and boilers for cotton spinning mills] *Rengo Boseki Geppo* 5 (September 1889): 1-8; Takeo Yamanobe, “Ronsetsu, bosekigyo no kon’nan no gaisetsu,” [Leading article: The difficulty of our cotton industry] *Rengo Boseki Geppo* 6 (October 1889): 1-7.

was crystal clear: successful transfer of the advanced British textile technologies certainly entails unprecedented technological innovation, but the technological innovation requires an equivalent level of managerial innovation. Yamanobe's determined emphasis upon the quick assimilation of the British and Western-style managerial institutions was made in accordance with his belief in the organic tie between management and technology. Behind all, Yamanobe perceived the urgent need for industry-wide paradigm change as the most fundamental drive that would induce not only the successful industrial take-off but also inimitable industrial competitiveness in global competition.

Since Yamanobe was also a 'fellow' himself in the cotton spinners' community, his stance was placed on the level of shop floor and that sensibly made his voice so vivid and compelling. It is noteworthy that, despite the Schumpeterian breakthrough in its pioneering spirit, Yamanobe's exhortations concerning the fellow spinners' strategic vision for growth and planned coordination was tinged more with the entrepreneurial concepts of Cole and Kirzner.⁴² Rather than putting forward any radical 'shock therapy', every perspective of his suggestion resided in a down-to-earth approach to accomplish constant technical betterment in daily production. His standpoint involved dynamic combinations of 'routine and new' types of entrepreneurial activities.⁴³ His conception had already clarified the long-range plan of pan-industrial coordination to enhance industrial competitiveness, which was eventually realised through the first couple of decades of the 20th century.

Watanabe was involved comprehensively with Mitsui's early entrepreneurial management in international perspective. Through investigating, assessing, and procuring a wide variety of the advanced Western technologies, his London office of Mitsui Bussan played an essential function of complying with the urgent and sometimes indeterminate demand in the hasty industrialisation including the infant cotton spinning sector. As an elite graduate of *Shoho Koshujyo*, the Commercial Training School (the

⁴² Arthur H. Cole, "Entrepreneurship and entrepreneurial history: The institutional setting," in *Change and the entrepreneur: postulates and patterns for entrepreneurial history*, ed. Arthur H. Cole (Cambridge, MA 1949), 85-107. Israel M. Kirzner, *Competition and entrepreneurship* (Chicago, IL 1973).

⁴³ Harvey Leibenstein, "Entrepreneurship and development," *American Economic Review* 58 (July 1968): 72-93.

initial origin of Hitotsubashi University⁴⁴, Tokyo), Watanabe was picked up by Mitsui and soon sent to the London office in 1882. Four years later, in 1886, Watanabe became an exclusive agent of the Platt Brothers & Co. Ltd. Of Oldham, and this made him one of the most strategic and entrepreneurial knowledge source for the Meiji cotton industrialists.⁴⁵ His close tie with Yamanobe in the years of significant technological choices of new spinning frames and ancillary machinery (in the 2nd half of the 1880s) implies that the OCSC's decision in both technologies and its growth strategy was made together with Mitsui. That is to say, Watanabe could conceptualise Mitsui's new global business opportunities as compatible with Yamanobe's entrepreneurial vision for growth. It was there for strategic matter for the two entrepreneurs to collaborate each other so closely, firstly for their companies, and later to the Meiji cotton industry.

Watanabe's conceptual breakthrough was well presented in his speech at the annual plenary meeting of the Cotton Spinners' Association after his investigations in India in February 1889.⁴⁶ This report was published on 31 July 1889 in *Kogaku Kaishi*, the Journal of the Engineering Society of Meiji Japan.⁴⁷ The essence of his opinion was twofold: the importance of developing pan-industrial awareness of global strategy and the urgency of studying as well as benchmarking the Indian cotton industry (rather than the British) as the consequential competitor in global competition. Watanabe's analysis of the Bombay spinning sector depicted the details of entrepreneurial management and this induced his call for a paradigm change in the Meiji spinning sector. As Wilkins' study denoted remarkably,⁴⁸ the cotton industrialists from this moment began to pursue

⁴⁴ Makoto Ikema, Yoshio Inoue, Tamotsu Nishizawa, and Susumu Yamauchi, eds, *Hitotsubashi University 1875-2000: A hundred and twenty-five years of higher education in Japan* (London 2000).

⁴⁵ Tsunehiko Yui, "Kenkyu Noh-Toh: Meiji-Ki Mitsui Bussan no Kei'Ei Sha (Jyo), 4 Watanabe Senjiro" [Research note: The managers of the Mitsui trading company in the Meiji period, part I, section 4, Senjiro Watanabe], *Mitsui Bunko Ronso* [The Journal of Mitsui Research Institute for Social and Economic History, Tokyo] 41(December 2007): 285-306.

⁴⁶ *Dai Nippon Boseki Dogyo Rengo Kai* [All Japan Cotton Spinners' Association], *Rengokai Gijiroku* [The minutes & proceedings of the special meeting of the All Japan Association of Cotton Spinner (15 March)] (Osaka, March 1889).

⁴⁷ Senjiro Watanabe, "Indo menshi bosekigyo no jikkyo, honpo dogyo ni kansuru iken," [A report on the Indian cotton-spinning industry of today, and my perspective of our (Japanese) cotton-spinning industry], *Kogakukaishi* [Journal of Engineering Studies] 91 (July 1889): 454-77.

⁴⁸ Mira Wilkins, "Japanese Multinational Enterprise before 1914," *Business History Review* 60

a reliable international infrastructure that would support their global competition. This necessity was satisfied by the “mighty” Meiji trading companies such as Mitsui Bussan. Even before achieving their dominance in the domestic market, the Meiji spinners became knowledgeable about the global nature of their business. This paradigm change had never been experienced in any of the previous state enterprise in cotton spinning. It was the Yamanobe-Watanabe combo that pioneered entrepreneurial management of technology in the early development of the Meiji cotton industry.

“The First Blood in MOT”: The Rise of Modern Managers in Meiji Japan

This study contends that the cotton-spinning sector was the initial Japanese industry that witnessed the rise of the modern management. The most distinctive “modernness” within this new emerging community involved application of scientific methods in both business administration and engineering. As Yamanobe through his leading articles in *Boseki Geppo* repetitively stressed the significance of scientific rationalisation and reasoning in terms of sorting technical problems at shop floors, the industrialists of this period certainly began to comprehend the impact of MOT and then practice MOT on daily basis.

In tandem with the early leadership of Takeo Yamanobe, the following new wave of engineer-managers (or manager-engineers) such as Tsunezo Saito and Kyozo Kikuchi⁴⁹ therefore formed the first frontier of the burgeoning Japanese MOT. Nonetheless, it might be illegitimate to conclude that these leading industrialists already practiced the “scientific management” of Taylorism that extended the managerial reach into factory relations. Rather, it would be appropriate to discuss that Sanji Muto of Kanegafuchi Spinning Company initiated the new era of scientific management in broader and more general perspectives.

From his reasoning of corporate administration as CEO to his welfare institutions for spinning workers, Muto provided a new model of managing big firms in Meiji Japan. In

(July 1986): 227-29.

⁴⁹ Janet E. Hunter, British training for Japanese engineers: The case of Kikuchi Kyozo (1895-1942), in H. Cortazzi and G. Daniels (editors), *Britain and Japan 1859-1991: Themes and personalities*, Routledge, (London 1991), 137-46.

the eyes of Frederick W. Taylor⁵⁰, Muto would stand out as a scientific manager amongst many in the cotton industry of the period. However, it is also worth denoting that Sanji Muto's style of scientific management facilitated the quick demise of the engineer-manager (or manager-engineer)'s era of early MOT: corporate managers became remote from technologies, gradually and constantly. The new epoch of "professional managers" gave a go thereupon.

Concluding Remarks

As an introductory research, this study aims to reconsider the significance of Meiji business history in terms of enriching the growing theories of today's management of technology. For the leading industrialists of the Meiji cotton industry, especially in the 1880s and 90s, the most vital corporate assignment was concerned with appropriation process to the borrowed technologies as well as to the rational reasoning within business administration. As both Gerschenkron and Nakagawa denoted, Meiji Japan as a late starter of industrialisation also took the full advantage of a particular non-market institution, namely, *Bussan* (i.e. Trading Companies). Besides, the core value that was created and then managed by the trading companies was nothing else but information. It is therefore quite worth addressing that strategic management of information cost was vital for catch-up industrialisation in the specific case of Meiji Japan.

Along with the propagation of "scientific management", the early engineer-managers (or manager-engineers) in the burgeoning cotton industry also played an invaluable role of saving information cost in regard to Anglo-Japanese technology transfer. More significantly, they were the pioneering industrial protagonists who provided not only early corporate prototypes but also a grand blueprint for the swift technological advance of the entire industry. It is remarkable that many calls from today's practice of MOT seem to concern, quite much, the outstanding entrepreneurial calibre of the Meiji engineer-managers (or manager-engineers).

⁵⁰ Frederick W. Taylor, *Scientific Management*, Harper & Row, (1947).