Management accounting implementation and engineers' networking: Mitsubishi Electric, 1921-1932

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ABSTRACT

Purpose – This paper seeks to demonstrate the role of engineers in the implementation process of management accounting within a group company of Japanese conglomerate during the interwar period.

Design/methodology/approach – Drawing on a historical case study of a Japanese manufacturing company, Mitsubishi Electric, we examine the relationship between implementation of management techniques and reinforcement of network of the engineers.

Findings – Engineers at Mitsubishi Electric played a key role in implementing production management techniques in 1922, discussing design details of the budgeting system in 1928, and facilitating the cost reduction project in 1930. They assimilated overseas management knowledge from books and magazines and, at the same time, put the knowledge into action, which had something in common with their experience in education. Through the implementation process, engineers of the process control section, sales engineers and design engineers had been connected to the network.

Originality/value – This paper illustrates the interaction between the management accounting implementation and engineers' networking. By describing the micro process of engineers' implementation efforts, this paper studies the possible conflict inherent in the educational approach and the decentralisation of the Mitsubishi conglomerate. The findings of this study can provide additional evidence for the diffusion and adaptation of management accounting into non-western countries.

Keywords Management accounting implementation, budgetary control, standard costing, engineers, accounting history, Japanese company

1. Introduction

This paper seeks to examine the role of engineers in the implementation process of management accounting at Mitsubishi Electric, a group company of the Mitsubishi conglomerate, between 1921 and 1932. During the interwar period, various management techniques originating from the U.S. had been implemented one after another into Japanese companies. For example, Niigata Iron Works carried out scientific management in 1915 (Sawai and Nakabayashi, 2010) and, around the same time, one machine manufacturer adopted standard costing (Hasegawa, 1936). A few years later than these, budgetary control were implemented at several companies in the mid-1920s (Hasegawa, 1936). Mitsubishi Electric, a case company of this paper, implemented budgetary control in 1928 (Mitsubishi Electric, 1951).

The growing interest in new management knowledge at that time could be shown by the fact that the Japanese version of the representative works on it was made soon after the original ones published. The Japanese edition of Frederick W. Taylor's *Principles of Scientific Management* was published in 1912 (the original version in 1911). James O. McKinsey's *Budgetary Control* published originally in 1922 was featured in the serial reports issued by the research department of the Mitsubishi conglomerate from April to August 1924.

In the same period, the higher education institutions of technology provided surging graduates for private companies. The number of graduates from the institutions increased from 5,078 in 1910 to 14,162 in 1920. The graduates who got a job at a private company increased from 2,843 in 1910 to 10,368 in 1920 (Uchida, 1988). At that time, it was the Mitsubishi conglomerate that hired the most engineers among private companies. In 1917, Mitsubishi employed more than one thousand engineers most of whom graduated from the hirer education institutions of technology (Suzuki, 2005).

The graduates from the higher education institutions of technology introduced advanced technological knowledge from the West and became the driving force of Japanese late industrialization during the interwar period. They similarly introduced management accounting as an element of the knowledge. However, little is known about the relationship between management accounting implementation and engineers at that time in Japan. This contrasts with the U.S., where it has been well known that such great engineers as Emerson, Church, Carpenter and Brown made a historic contribution to create various management accounting innovations (Chandler, 1977; Johnson and Kaplan, 1987).

After World War II, it has been demonstrated in some literatures that some

engineers in the Japanese automobile companies engaged in the development of target costing in 1960s (Okano and Suzuki, 2007; Maruta, 2006). Okano and Suzuki (2007) proposed that Japanese engineers who espoused 3-Gen principles had an attitude of skepticism toward accounting's monetary valuation and did not place emphasis on control at a distance but on communication with employees on actual site of planning, designing and production. In that sense, Japanese companies use management accounting as "an epistemic device, which strategically and rhetorically binds wider participants together" (Okano and Suzuki, 2007, p. 1133).

They concluded that the calculative techniques of Japanese management accounting originated from the West but, only if the techniques could be combined with the Japanese local conditions, the techniques became Japanese. On the other hand, they argued that standard costing and budgetary control "do not consist of defining characteristic of Japanese management accounting" (Okano and Suzuki, 2007, p. 1133). However, it is not clear that the other western techniques can be transformed in the Japanese context but standard costing and budgetary control cannot. The functioning may be specific to the context in question (Robson, 1991; Bhimani, 1993, Briers & Chua, 2001). It is likely that standard costing and budgetary control are also adaptable to the local conditions (Covalski and Dirsmith, 1986, 1988; Miller and O'Leary, 1987; Ezzamel, 1994; Edwards, Boyns and Mathews, 2002).

Okano and Suzuki (2007) suggested that more detailed examination is needed to illustrate "the process of 'naturalisation' in which the western calculative techniques were pragmatically transformed in the context of Japanese history, culture and society" (p. 1121). This paper seeks to be a contribution to meet the need by examining the relationship between Japanese engineers and the implementation process of standard costing and budgetary control.

We conducted a case study of Mitsubishi Electric, a Japanese electric equipment manufacturing company founded in 1921. Electric manufacturing was an emerging industry during the interwar period. From 1921 to 1929, the company doubled the number of engineers (38 in 1929) who graduated from the higher educational institutions (Uchida, 1987). The engineers were mainly assigned to the designing department and/or the production department and sometimes to the costing department and/or the sales department (Ichihara, 2005). Mitsubishi Electric implemented budgetary control in 1928 and standard costing in 1931 (or 1932) through the discussion at the committees consisting of the engineers (Mitsubishi Electric, 1951). These historical facts suggest that Mitsubishi Electric is a suitable case for exploring the relationship between engineers and management accounting implementation.

This case study draws on both primary sources and secondary sources. The primary sources include archival materials such as accounting and budgeting manuals, board minutes, internal investigation reports, and documented reflections by past company employees. Most of the archival materials are obtained from Mitsubishi's history museum, named Mitsubishi Archive. Mitsubishi Archive contains a variety of management documents and records from the foundation of Mitsubishi in 1871. The secondary sources include published company histories, biographies, and other academic theses. These sources enabled a detailed exploration of intentional organisational changes within the broader economical and social context.

The rest of the paper is organized as follows. In the next section, we explain the economical and organisational background during the interwar period in Japan. The third section demonstrates the approach to the introduction of overseas technology. In the fourth and fifth section, we describe the implementation process of standard costing and budgetary control at Mitsubishi Electric. The last section provides discussion and conclusion.

2. Wartime Society, Organisations and Engineers

In nineteenth-century Japan, there was neither a word for 'engineer' (gijutsusha)nor even a generally-accepted idea of what one would be. As noted above, Mitsubishi employed more engineers than any other private company, yet even inside Mitsubishi the word 'engineer' (gijutsusha) was not used in internal memos until the 1920s (Suzuki, 2004).

The type of person that later came to be referred to as an 'engineer' in post-1920s Japan had already existed in Japanese society - together with its various institutions - but it was not until the establishment of societal and organizational institutions, combined with the observance of 'engineer-like' behaviour within these institutions, the connection was made and the term 'engineer' (gijutsusha) was born. It is indeed thought that the behavioural patterns of such engineers were responsible in part for introducing systems of management accounting to Japan.

Following are two examples of systems that contributed to the rise of the "engineer" during this period. One relates to institutions of advanced technical education (and their courses of study), while the other concerns the nomenclature of particular vocations in the workplace (together with the working patterns associated with such titles). For the latter this paper will refer to the case of Mitsubishi.

Engineers and Advanced Technical Education

The Industrial Studies Faculty of the Sciences Division of Tokyo Imperial University, together with the Imperial College of Engineering (ICE) - both established in 1877[1] - were the first institutions to bring advanced technical education to Japan. Each was managed by a different governmental department; the ICE was funded by the Ministry of Engineering, while the Sciences Division of Tokyo Imperial University was funded by the Ministry of Education. In 1886, the abolishment of the Ministry of Engineering that had previously administered the ICE resulted in the merging of the two institutions to form the Tokyo Imperial University College of Technology.

Twenty-two teaching staff were assigned to the post-merger College of Technology, of which four were non-Japanese and three who had been teachers at the ICE. Of the eighteen Japanese members of staff, half (nine) were graduates of the ICE[2].

Pre-merger, the institutions had offered differing curricula as well. While the Science Division of Tokyo Imperial University only offered civil, mechanical, mining engineering and metallurgy, the ICE had also offered additional courses in telegraphy, architecture and shipbuilding.

A study of the courses offered reveals that one of the particular characteristics of the ICE was that it had built vocational training into the official curriculum. Indeed, out of a total period of study of six years, two were assigned to this form of training[3]. During their period of workplace training, students could gain experience alongside workers at factories affiliated with the Ministry of Engineering, occasionally assuming on-site supervising roles.

This focus on vocational experience within the ICE syllabus reflected the ideas of the founder and general manager of the school, H. Dyer.

Engineers within the Zaibatsu: A Study on Mitsubishi

The phrase ‘technology’ (gijutsu) was first integrated into official work titles at Mitsubishi in the 1880s. The title was, however, applied differently at the various bases

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[1] The predecessors to both institutions - the Kogakuryo to the ICE and the Tokyo Kaisei Academy Technology Department to the Tokyo Imperial University Sciences Division - had also been set up in the same year (1873).

[2] There were only three graduates of ICE that became professors initially. The reason for this was the comparatively young age of the rest of the teaching staff. Of the six remaining vice-professors four were promoted to professor (the remaining two left the university).

[3] As the final half of the second year was apportioned for writing up graduate papers, the actual length of these job placements spanned the course of one and a half years.

of operation and lacked any particular guiding rules; each used it however best it fit their situation. Yet there was a common factor between them in that the word was consistently used when describing technical skills and knowledge of the type introduced by foreigners (Suzuki, 2004).

Mitsubishi was unique among the zaibatsu in that it had developed from a solid core of heavy industry (Mishima, 1981). Its origins were in mining and shipbuilding and it was only later that it had branched off into electronics and aviation, both functions that essentially derived from shipbuilding. At the time, Japan's emergent machine industry lagged behind that of the developed countries of the West in technical skills and, as such, it was the Western companies that dominated the domestic market. In an attempt to accelerate the pace at which it caught up to such levels of technical skill, product quality and pricing, Mitsubishi began to hire large numbers of foreign workers to direct manufacturing on-site.

The dockyards at Nagasaki - one of Mitsubishi's primary shipbuilding sites - were a prime example of this, where the appointed heads of the design and production departments were non-Japanese until around 1890. Japanese engineers worked under them to learn from their technical abilities; others were dispatched to carry out technical study in the UK. Most of the postings abroad were for only a few months, but some lasted for a number of years. From the latter half of the 1890s, these engineers gradually came to replace the non-Japanese staff as heads of department. The transition began first in the design departments, with the production departments lagging a few years.

It was at this time that the term 'technician' (gishi) came to be used to describe staff employed in an engineering capacity. Some, but not all, of the technicians were graduates of higher-education institutes of technology. The former constituted around 80% of their ranks between the 1890s and 1900s. Such graduates of higher-education institutes of technology worked almost exclusively as technicians; non-graduates had a more difficult time assuming the post, generally having to begin their careers in less stable positions as part-time employees.

The ratio of engineers within regular-employees at Mitsubishi underwent a period of sharp growth from 1910 onwards, rising from 28% in 1909 to 36% in 1917. During the First World War in particular, the sudden growth of demand in the shipbuilding divisions pushed the ratio as high as 64%. The majority of engineers that were brought in to fill the gap were graduates from higher education institutes of technology. As the number of employees that were not graduates remained the same, there was a concurrent drop in their ratio to close to 15%.

Mitsubishi's engineers all began their careers at production centres similar to the

dockyards at Nagasaki. In contrast, the majority of non-engineer employees began their careers at the head office. Many of the engineers posted to production centres remained there for extended periods of time. Indeed, around 70% of retirees up to 1917 actually retired from the same production centres they had been assigned to when entering the company.

The engineers at these production centres were, over time, promoted into department heads, before eventually assuming positions as directors of the centres themselves. The table below reveals that as the numbers of production centres increased, the ratio of engineers fulfilling managerial or vice-managerial roles continued to rise. Some engineers went on to take leading positions in the controls departments of these production centres. Engineers also came to assume the roles of negotiators vis-a-vis the workers during the frequent labour disputes of the time.

	No. of Production Centres	No. of Directors / Vice-Directors	Of which are Engineers
1893	8	15	11（73%）
1907	15	28	22（79%）
1917	26		100%

The Decentralisation of the Zaibatsu

What kind of authority, then, was afforded to the engineers that had assumed management roles at the Mitsubishi zaibatsu production centres? Even among the zaibatsu, Mitsubishi in particular maintained a focus on the strong central authority of its founders, so much so that it was known as a autocracy of the president[4]. Indeed, Mitsubishi's relatively presidentially autocratic structures endured until the post-war decentralisation of the zaibatsu (Mishima, 1981)[5]. At the same time, however, there had

[4] Mitsubishi was founded in 1870, considerably later than Sumitomo (16th Century) and Mitsui (17th Century). The speed at which the company was able to grow over the following fifteen years was thanks, in large, to the leadership of its founder, Yataro Iwasaki; the strength of his central leadership became enshrined in the autocratic system that empowered his family as the company's future leaders.

[5] In contrast to companies like Sumitomo and Mitsui, the position of Company President in Mitsubishi was succeeded by generations of the founding family. Although this was the case, the second President, Yanosuke (1885-1893), had spent one and a half years studying in New York, the

also been a gradual shift towards decentralisation since the 1880s and the emergent push toward heavy industry.

The origins of this decentralisation lie in the basho ('place') system that propagated through the various production centres following 1886. The company's production centres - in mining, coal, and shipbuilding - were located over a variety of regions; the basho system was an attempt to gather the production centres together as regional blocks and manage them thus under the direct jurisdiction of the head office. The regional units under management were known as basho[6].

The company regulated the amount of capital assigned to each basho, and they were each required to report their financials to the head office, including balance sheets and profit-and-loss statements. In order to fulfil these requirements, each basho established an accounts department. Each basho would send profits back to head office after deducting any amounts for depreciation; they were allowed to retain the depreciated amount. It was the management of these funds that paved the way for the transfer of everyday business authority to the managers of the new basho. They were also able to seek head office approval for investment in new businesses. The managers of the above-mentioned production centres became managers for the new basho[7].

When the basho system first came into effect, each basho was under the direct jurisdiction of the head office. As the number of these regions grew, however, the head office became unable to manage them all and, in 1908, operations departments were set up to manage the banking, mining and shipbuilding businesses. It was decided that the managers of the operations department would consist of professionals in each field - this included a number of engineers[8].

The operations departments were allocated capital and had to report their financials, as with the basho, to head office. While the management units of the basho system remained in effect even after the establishment of the departments - capital was allocated and profit responsibilities declared as before - they were no longer allowed to retain depreciation for themselves. This was to be kept within the operations departments.

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third President, Hisaya (1893-1916), had graduated from Pennsylvania University and the fourth President, Koyata (1916-1945), was educated at Cambridge (Pembroke College) in the UK.

[6] The term 'basho' is still used at Mitsubishi today.

[7] The term 'basho' included non-manufacturing bodies such as offices and branches of banks.

[8] Before the establishment of operations departments there had been a function known only as the 'department' ('bu') in head office.

Further organisational reforms were made in the period following Koyata Iwasaki's appointment as the company's fourth president during the First World War in 1916 as the various operational departments began a period of separation and independence as subsidiary companies. Starting with Mitsubishi Shipbuilding in 1917, a series of subsidiary companies were formed over just a few years, including Mitsubishi Trading and Mitsubishi Mining. Following on from Mitsubishi Shipbuilding, Mitsubishi Electric - the focus of this article - gained its independence in 1921 as the ninth subsidiary to be established. While each company was a wholly-owned subsidiary of the parent company, some had issued shares to the public within the course of a few years. Mitsubishi Electric also forged a partnership venture with Westinghouse Electric, resulting in the latter coming to own 10% of its shares.

The heads of these companies were professional managers. Hideo Takeda, for example, a former naval officer and engineer graduated from the College of Naval Engineering (specialising in fuels), assumed the role of managing and supervising companies in the heavy-industry sector and, at one point, he simultaneously held the highest management positions at all four companies in the heavy-industry; yet his longest tenure by far was his leadership of Mitsubishi Electric.

Internal regulations defined the relationship between the Mitsubishi parent company and its subsidiaries. For the purposes of this paper the focus will be restricted to sections pertaining to financial management. The internal regulations document, "Agreement on the Relationship between the Limited Partnership Companies and Subsidiary Companies," declared the authorisation of the President of the parent company to be necessary for each company's budgeting and closing of accounts. Each subsidiary had to submit planned cash flows together with projected profit and loss statements to the parent company. The "Agreement on Subsidiary Company Financing and Usage Limits thereof," of the same year ruled that companies had to consult with the parent company for large-scale financing initiatives, and that any significant amount of surplus funds would either be deposited with the parent company or subject to consultation if used.

It can be seen, then, that the relationship between head office and the operational departments continued mostly as before, although the latter had been granted a somewhat higher degree of financial freedom. The section of the "Agreement on the Relationship between the Parent and Subsidiary Companies" concerning financial management was deleted in 1929, and following this the "Agreement on Subsidiary Company Financing and Usage Limits thereof," was abolished in 1932.

3. The Introduction of Technology for Business Management

From the latter part of the 1910s, Mitsubishi Electric came to employ an increasing number of engineers with a background in advanced technical education. Among the engineers to influence management accounting were Ryoichi Masaki and Tatsu Kojima (joining in 1909), Takichi Inagaki (1912), and Takeo Kato (1920). Engineers could be posted either to the design or production departments, but the majority of engineers that joined the company with backgrounds in higher education were posted to the design department. On the other hand, the majority of engineers in the production department had joined from vocational backgrounds[9]. Despite this, however, "there was a constant mixing of staff between design and production, and being a 'technician' was yet to be professionalised" (Mitsubishi Electric, 1951, p.37).

From 1914 onwards, the beginning of the First World War and the concurrent disruption of imports coming in from the West resulted in an explosion of demand for domestic makers of electronic goods[10]. During this period Mitsubishi continued to consolidate and grow its factories, entering a phase of alternating investment into the purchase and integration of new plant and equipment[11]. The company's organisational structure was also subjected to two major changes. The first of these was the specialization of the design and production departments respectively.

In 1916 the design department, with the aim of promoting specialisation, reassigned supervisors and their staff to functions delineated across the following product types: DC machines, AC machines, transformers, induction motors and distribution consoles. At the same time, there was a shifting of engineers between two departments of design and production. Masaki was one of the main proponents of these reforms, and was himself transferred from the production to the design department during the transfers that were occurring at the same time. The specialist areas fixed at this stage were maintained by the majority of engineers until at least the latter half of the

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[9] In 1906, the design, inspection and budgeting departments at the Shibaura production facility contained engineers that were university graduates, while the engineers at manufacturing sites had come from vocational backgrounds. (Sawai, 1995).

[10] Shin Hasegawa (1981). In 1914 over 40% of domestic consumption of heavy electric machinery was from imports; this fell sharply to close to 16% by the next financial year. While the amount spent on imports did recover in the postwar period, the internal market had grown considerably during wartime (from 8.133m yen in 1914 to 47.122m yen in 1920) and as such the value of domestic production continued to increase (from 4.832m yen in 1914 to 42.211m yen in 1920).

[11] Makoto Fujita (1981)

1930s, and during this period transfers between the design and production departments became a rare occurrence (Ichihara, 2007). It became the case that engineers would often remain attached to a certain specialist area once assigned; this was particularly so in the design department (Ichihara, 2005).

The establishment of the electronics manufacturing facilities in the production department in 1919 gave rise to the introduction of a new employment scheme. Factories became divided and specialised into the functions of coil winding, machine shops, iron-core, and control systems respectively, and a new staff department was formed for the purposes of inspection and testing (Mitsubishi Electric, 1951). Many of the engineers that worked in production, as noted above, had come from vocational backgrounds, yet these systemic changes resulted in engineers with backgrounds in advanced technical education being posted for the first time to positions of management within these departments.

Regardless of whether they were in production or design, engineers now had to decide on a specialisation; this signified the implementation of a systematic method to improve levels of technical ability. This could also be seen as a departure from the original approach where engineers had functioned more as a single body attempting to meet technical demands as they came along, regardless of whether they belonged to design or production, or came from a vocational or academic background.

Another significant structural change was the transfer of Genpachi Kawai from a separate Mitsubishi Group company for the role of Managing Director[12]. Kawai assumed the role of Managing Director for the Mitsubishi Electric Corporation when it was established in 1921. Kawai was a firm believer in the management principles of standardisation and mass production; he also made this known to the engineers. In 1929 he invited U.S. efficiency engineers Emerson and Hathaway to visit the Kobe manfacturing facility[13].

Soon after the Corporation was established, the company's engineers began a push to integrate new technology for management control. The following section studies the relationship that existed between the principles of those in management (and their ideas on management) and the introduction of technology orchestrated by the engineers.

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[12] Kawai had worked as the head of the Osaka branch of Mitsubishi Logistics, but resigned the position after taking responsibility for an accident.

[13] Emerson and his group were said to have performed on-site instruction and factory assessments, but had not been able to bring about any direct effect due to the short-span of their stay.

Process Control/Management

With the establishment of the Corporation a new director was brought into the Kobe Electronics Factory (Kobe Manufactring Facility from October 1921) and the system of employment was revisited. Under the guidance of the new director, a large scale production-enhancement plan was put into effect, aiming to increase monthly production levels by 400%. Orders were accepted as per the plan's outline but, among other factors, large-scale strikes in the summer of 1921 resulted in a spate of delayed deliveries. One delay in particular - a shipment for navy use - escalated beyond the remit of those directly involved and resulted in Chairman Takeda - himself having a background in the navy - having to issue a statement of formal apology. This prompted the new director, Kasahara, to establish a new management system within the factories by making changes in staff placement and organisational structure[14].

It can be argued, then, that the plan to expand production levels, the strikes, and finally the delay in delivery for navy products all came together to push the engineers into attempting to establish a new system of management and control. Yet, the management system introduced by Kasahara failed to function. Three engineers with a background in advanced education were initially put in charge of the management system. The three were assigned to manage 'staffing', 'planning' and 'direction' (Mitsubishi Electric, 1951, p.331) respectively, yet the structure failed to stabilise and was said to have caused further disarray within the factories.

At this point the production department created a new staff department – the Manufacturing Process Department – to be responsible for all process management and/or control-related functions. Masaki Ryoichi took the position of head of the department, who had been directly involved in the building of a management structure in his capacity as the facility director. Among the engineers assigned to work in Masaki to tackle the issue of process management were Takichi Inagaki and Otokichi Yasui.

According to Masaki, they researched methods of process management by studying management rules of other companies in the industry (such as Hitachi and Shibaura) together with methodologies outlined in various British magazines; "carefully deliberating what would be the most appropriate method to implement." They began,

[14] Kasahara was also a believer in scientific management. One of his members of staff from the time later remarked that his bookshelf was lined with books on the subject (Mitsubishi Electric, 1951). The relationship between scientific management and the management structure Kasahara introduced is, however, unclear.

then, by generating an understanding of the current state of management practice. Following discussions with Takichi Inagaki, they conducted surveys into the state of goods in process within the factories.

Next, they decided that production scheduling and parts procurement (which had been the remit of department heads until that point) would be carried out instead by the Process Department. Masaki's proposal was as follows:

> "In the current state we must all (i.e. foremen) make our way [to our respective work stations] to learn of the tasks assigned to their department, taking notes as we scour over allocation charts. Would it not be a good idea, then, if there was someone employed to scour the charts, take down the details, and communicate them to the respective department heads instead?"

> "In order to receive materials from the storehouse, it is the current situation that each head must examine a chart, complete an order chit, locate asenior staff member and get them to stamp the chit. I propose that [the process department] could instead perform the work of composing the order chits for the necessary materials and pass them directly onto you once you make your request of [the department]. Would this not be preferable?"

The department heads agreed to Masaki's proposal, welcoming it for having the process department relieve them of a cumbersome administrative task. In this way the responsibility for process management was moved to the process department, and the department became responsible for the creation of process (scheduling) charts. The first step towards their creation was to record the each step of the manufacturing process on paper. This job was taken on by Otokichi Yasui.

A chit would be issued for each step of the process. The progress of each step was to be recorded on the chit. The process chart would also generate warehouse requests/chits when necessary. Each process was monitored within the process chart, and it became the process department's job to make sure each step was completed on time; this particular role was managed by Inagaki and his staff.

Inagaki succeeded Masaki as head of the department, and he was succeeded by Yasui in turn; each further contributing to improving the robustness of process management. Meanwhile. improvements in process management were also being made outside of the process department - by a group carrying out a study into the time taken to manufacture electric fans.

The Introduction of the Scientific Management Method

It was Managing Executive Director Kawai who had in 1923 outlined a project for the mass production of a new electrical fan, expecting an increase in demand from the reconstruction efort following the Great Kanto Earthquake of the same year. Mitsubishi Electric had been involved in the production and sales of electric fans between 1918 to 1921. Quality issues had beleaguered the product, however, resulting in recalls and significant damages. For this reason, management felt uncertain regarding the direction of Kawai's proposal.

At the same time, a man by the name of Kamekichi Honma was already pitching his new design for a radically new type of electric fan. Honma, an engineer, had been dispatched to Westinghouse Electric to study methods employed in the production of electric fans; he had his knowledge put into action after returning to Japan. After a discussion with When Kawai sought Honma's opinion regarding his proposals for production of the fan, Honma had requested a new dedicated factory and staff together with close to 200,000 yen to build and install necessary facilities. Kawai agreed without hesitation.

The factory was completed at the Kobe Production Site by the winter of 1923 and production of the new electric fans began in January 1924. A target of 15,000 units had been set for the summer of that year, but delays ensued as staff took time getting used to the new facility and tools. Despite this, however, they were still able to grind out their production targets by working overtime on a daily basis.

In November 1924, Honma temporarily took leave from the factory and was dispatched to Westinghouse Electric. The new posting was in order to continue his research into electric fan manufacturing. During the same period, another Mitsubishi man - Takeo Kato - had also dispatched to a posting at Westinghouse. Kato was also an engineer but had studied scientific management at Westinghouse, gaining experience working in the cost accounting department. It is not known whether Honma and Kato met during their expatriation in the U.S., but after their return to Japan the two men worked together to initiate research into time study at the fan factory.

They carried out their research at the factory in Kobe from the summer of 1925. They had brought on board another important collaborator for the work – Nobuo Noda, a member of the Mitsubishi Research Department. Being an economist and not an engineer, Noda had spent time studying Taylor's work as part of his educational background.

In 1923 Noda had conducted a survey at the Kobe Manufacturing Facility as part

of a survey of subsidiary companies for Mitsubishi Group. He had summarised the results of his survey in a report entitled, “Research into Scientific Factory Management.” Inside the report, Noda linked the large-scale strikes of two years earlier with the problems of unit price devaluation; he explained this as follows (Noda, 1923, p.6):

> It is clear enough that unit prices become devalued after a marked increase in the volume of production, and that this often becomes the cause of worker discontent. We have experienced this a number of times here [Kobe Manufacturing Facility], yet we must count ourselves most fortuitous that we have not experienced more [worker] outcries as a result.

It is unknown how familiar Honma and Kato were regarding this report. Noda was Kato’s cousin and Kato had requested his assistance, quoted to have said that the project was too much for his to work on alone.

The time study project was carried out during the summer of 1925, one-and-a-half years on from the opening of the factory. The factory had already made great improvements in production efficiency, even before the time study.

Their methodology followed the handbook Kato brought back with him from Westinghouse; “[we] recognised the suitability of the Westinghouse method and therefore used it as the foundation of the work” (Noda, 1927). Yet, in light of the contents of the 1923 survey report (from before the Westinghouse partnership) they made two significant changes to the methodology of their research.

Firstly, the Westinghouse methodology dictated that motion studies should be performed in preparation for time study, but the team did not do this at the electric fan factory. Noda summarised the approach as, “Targeting the manufacturing process as it was, without thinking it necessary to further test certain parts of it specifically for [the] research” (Noda, 1927, p.2).

Second was that they conducted an additional survey into workers’ average monthly pay in order to fix the labor cost per hour amounts based on the time study. The Westinghouse method made no mention of such surveys. They claimed that the survey’s purpose was to calculate an amount for labour costs per hour and through this, “secure, at the very least, the current level of real income” (Noda, 1927, p.15).

The standard time (delineated by the results of the time study) was multiplied by the labour cost per hour to calculate standard direct labour costs. As standard time was measured on a component-by-component basis, the basis was also used to calculate standard direct labour costs. The team created a chart (“Operating Tasks by

Component") to help with their calculation of direct labour costs by process. This was a "chart of the processes involved in making each part, including a detailed summary of the direct labour costs thereof" (Noda, 1927, p.20)[15].

In order to prevent further strikes, they could focus primarily on the problems presented by falling unit prices, in which case it would be enough to carry out their time study methodology and define standard timings - in other words, it was not necessary to also calculate standardised direct labour costs; that they had, at this time, extended their time studies to include a calculation of the standardised direct labour cost was due, in large, to Kato's experience. Kato's experience was not limited to time study as he had also amassed on-the-job experience through his; there he had "partaken in accounting for standardised costs, and made detailed studies of methods of overhead allocation and systems for organising chits" (Kato, 1958, p.14). As detailed below, Kato was to play a role in the introduction of a standardised costing system (1932; he commented that his experience "[came to be] of great assistance when, later on, we adopted standardised costings" (Kato, 1958, p.15).

4. Engineers in Business Management

When the corporation was established in 1921, new sales and accounting departments were set up at the Kobe Manufacturing Facility in addition to the pre-existing design and production departments. Here as well, Mitsubishi Electric posted engineers to the new departments. Tanekichi Hibi was transferred from design to the new sales department, while Inagaki - who had succeeded Masaki as head of the process department - was transferred to the accounting department. For a number of years following, Hibi and Inagaki went on to work as the heads of each department.

In this way, engineers came to lead various functions during the latter-half of the 1920s. The latter-half of the 1920s thus saw many engineers take up managerial positions in a variety of functions, while at the same time the period marked a significant turn for the worse in business results. Around the period of April 1926, the company reported its first loss since forming the partnership with Westinghouse Electric. While total sales did rise during the next quarter, the company reported consistent losses

[15] They also designed a 'calculations table' in order to, "collate the processes for each part and assign to it a cost per hour, material costs and overheads, therefore creating a single chart to detail a standardised cost for each part" (Noda, 1927, p.25). It is not clear from the sources available, however, that standardised costs were also filed for material costs and overheads.

for the three periods leading up to April 1927. How, then, did management interpret these losses?

Minutes from the board of directors' meeting for the closing of accounts in June 1927 contain the following passage from Chairman Takeda:

> The alteration of our pre-existent systems of design and manufacturing since in the wake of our partnership with Westinghouse Electric has resulted in significant increases in expenditure, thus engendering losses of around to 460,000 yen in period eleven, 240,000 in period twelve, and 120,000 yen in period thirteen (abbr.).

The loss was thus attributed to the 'significant increases in expenditure' that resulted from adopting new design and production methods from Westinghouse. However, efforts were also made by the board of directors of that time to point out the positive aspects of the Westinghouse partnership:

> We are proud of the increasingly high quality of our products and of our continually improving reputation among the public that results from this. In large, this has been made possible because of the technical assistance and tireless efforts of Westinghouse employees bestowed on us since the formation of the partnership.

It can be seen then that management recognised the partnership with Westinghouse to have both positive and negative aspects; namely improved levels of technical ability gained at the cost of greater strain on financial resources. At the March 1927 board meeting, though a few months prior, a proposal for a new 'budgetary principle' was put forward. The bringing in of new techniques of management such as budgeting can be seen as a manifest attempt by the leadership to strengthen financial management within the company. Following is a study into the role played by engineers in positions of influence throughout the company in the context of the adoption of these new management techniques.

An Examination of the Budgetary System

In March 1927, a board meeting was held to discuss the, "creation of a standard proposal as per the accompanying document outlining production income, expenditure and investment that is in line with the factory's deployment of the budgetary principle

of management." During the meeting the document "A Standard on Production Income, Expenditure and Investments" (hereafter - 'standard') was ratified. The standard dealt only with maximum levels of expenditure, and contained no mention of procedures and/or formula for budget planning[16]. The maximum levels were defined by applying an across-the-board rate (87%) to expected income from orders (which were close to the previous year's amount); this was performed for each factory at the facilities in Kobe, Nagoya and Nagasaki. It can be seen, then, that while the management referred to the 'budgetary principle', the actual content discussed was limited merely to costs and did not extend to business planning.

The members of the board meeting were themselves aware that the standard was inadequate. According to the minutes of the meeting, the standard was noted as, "[being] inadequate in its inception in a number of ways, but shall be improved gradually until fully robust." Just a few months after the establishment of the standard, a committee was set up to further explore the budgetary system - 'The Research Committee for Systems of Accounting at [Mitsubishi] Electric' (hereafter, 'committee').

The committee held its first meeting in August 1927 and, following this, met a total of six times in the period leading up to November of the same year (Mitsubishi Electric, 1927b)[17] according to records. The members of the committee included the Managing Executive Director Kawai of Mitsubishi Electric, together with Masaki, then head of the technology department. Two members of external staff were also included from the research department of the Mitsubishi Group Office - one of whom was Noda, marking a continuation of his relationship with Mitsubishi Electric and following on from his contributions from the time study project of 1925. His participation in the latter had come about from his knowing Kato, and the project itself had been limited in scope to focus on a particular aspect of the factories. This time, however, his role was as part of one of Mitsubishi Electric's official committees.

Kawai gave the opening address at the first committee meeting. He outlined the purpose of the committee to be as follows (Mitsubishi Electric, 1927b):

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[16] Details of investment outlays were also included.

[17] During the first meeting, the primary address was given by the company's Executive Director, Genpachi Kawai. During his address, he argued for the importance of 'budgetary' management, and emphasised that Mitsubishi Electric should take the lead in its implementation across the entire Mitsubishi Group.

> It is not an option for us to approach this haphazardly. Management must be carried out, in all aspects, as following a budgetary approach. In short, we must become a business based on reason. To this end, we must rework our accounting systems to fit such a model.

Among other factors, the fact that Kawai - a member of the executive board - had led the opening statement made it apparent that the function of the committee was to redraft and fix the inadequacies of the standard drafted as part of the new budgetary principle. Noda's plan, however, extended beyond merely hoping to fix the inadequacies of the Standard, and instead he wanted to secure the establishment of an altogether new budgetary system. The details of the proposed budget were put together by Noda. It was within that context that Noda launched his criticism of the current standard for only addressing maximum amounts in a memo entitled 'Notes on the Purpose and Planning of a [New] Budgetary System', in which he denounced the current methodology as being ineffective (Noda, 1928).

One of the most notable differences between Noda's proposed budgetary system and the current standard was his integration of a system for 'prudent yet quick' amendments to any given budget (Noda, 1928); 'prudent', because it deemed it necessary to hold a budgetary meeting each time a factory wanted to amend its budget and 'swift', because of the addition of what he referred to as a 'working budget'. The working budget consisted of forecasted expenditure over the forthcoming two-month period, and was presented together with monthly profit reports. The working and initial budgets would sometimes diverge, but this did not necessarily result in an immediate amendment to the initial budget. The initial budget was referred to as the 'standard budget' and was only to be amended in cases where such a divergence was considered likely to continue (and not likely to be adjusted) for the foreseeable future.

During the course of the committee's six meetings, the proposal for a new budgetary system was presented to the Kobe Manufacturing Facility for the purposes of gaining feedback. The facility convened a meeting of the department representatives in order to discuss their response (Noda, 1928). Masaki also participated in the meeting as a head office representative. The heads of department were a roll-call of engineers, including Tatsu Kojima from the materials department, Yasuji Imanishi from manufacturing, Tanekichi Hibi from sales, and Takichi Inagaki from cost accounting.

The archival file "Mitsubishi Electric Plc., (Proposed) Budgetary System" (hereafter - 'Proposal') includes a document with the following name: "The Opinion of Kobe Manufacturing Facility with regards to Proposed Budgetary System" (hereafter

‘opinion’). These ‘opinions’ had been printed out, but not dated. A section had been handwritten over the first page, however, and this was dated March 23. The written section had been stamped with a seal bearing the name ‘Inagaki’. If the date can be assumed to be when these opinions were presented appended into the document, it would follow that the opinions were put together over a roughly one month period and submitted to the production facility on February 20.

The body of the opinion consists of machine-printed text, but in addition to the body also includes a copy of Noda’s proposal with amendments handwritten directly over it. The printed opinion and handwritten adjustments correspond to each other in terms of content, revealing the opinion to be an itemised rendering of the handwritten notes. It is not known who made the handwritten markups to the proposal, but as the contents correspond to each other it can be assumed that they were the same people that gave these opinions. No fundamental changes to the proposal were suggested in the engineers’ opinion; instead, it offered various amendments to the budget forms contained within it. The following are three examples of the types of proposed amendment as contained within the opinion.

The first are amendments made to the actual vocabulary of the document. ‘Contract Amount’ (keiyakudaka) had been amended to ‘Order Amount’ (juchuudaka), while ‘Supplies’ (chozouhin) became ‘Stock’ (shi’irehin - incorporating the idea that they were mass-produced items). The changes were most likely suggestions for making the documents more accessible to the reader.

The second type of amendment was the formation of a distinction between forms for mass produced items and order-made items. The “Budget System Proposal” had, for its part, made a similar distinction. Sales budgets, for example, had been necessary in monthly, quarterly and yearly increments for mass-produced items, while a two month budget had been seen as sufficient for order-made items. There was, however, no distinction made in the forms themselves. The opinion delineated a “Sales Budget” form for mass-produced items, together with a separate “Budget Chart for Production and Invoice Amounts”. Furthermore, the budget for order-mad items was extended from a 2-month to a quarterly increment.

The third type of amendment was to do with the clarification of each factory’s respective responsibilities. As outlined above, budgets contained a distinction between mass-produced products and ordered products, yet for the purposes of results report they stated, “as we are [reporting] results across the entire basho (factory), it is clear that stock should be included along with all other items.” The opinion also stipulated that “the order amounts per the relevant production facility should be reported regardless of

where the order is from," thereby calling for a calculation of a factory's profit and loss that was closer to the actual situation. Otherwise the possibility arose that the figures would become meaningless if orders were allocated to head office while factories were only allocated production costs, particularly as Mitsubishi Electric had sales departments in both its factories and head office.

5. Cost Reduction Projects

From around 1927 onwards, a 'budget limit' was to be enforced on ordered items that valued over ten thousand yen (Mitsubishi Electric, 1951; Imaike, 1943). There is not enough information stored in the document archives for us to know whether the budget limit was part of the aforementioned budgetary system, or whether it originated from another, separate venture. Even so, according to the "Accounts & Cost Department Journal" penned by Miyazaki from the accounts department of the Kobe Manufacturing Facility, the budget limit was established to be a system for defining target costs in relation to the value of any given order. This target cost was referred to as the 'budget limit' (gendo yosan). According to entries in the journal, the budget limit for factories was managed as follows (Miyazaki, 1929, p.305):

> In taking on orders where the price of goods suffered significant drops resulting from competition, the sales department must take positive steps with the aim of lowering costs, record [strict] savings targets in a chart denoting production costs and budget limit, then deliver this to each relevant department.

Within the journal, the target cost as shown within the production cost / budget limit chart was referred to as the 'standard cost' (Miyazaki, 1929, p.305). How, then, did the engineers tasked with achieving these cost savings meet (or fail to meet) these targets?

There are records of such cost saving activities relating to the design of a product for an electric railway project[18] in 1930. The records were collated by Otokichi Yasui, the above-mentioned engineer posted from the process department. According to Yasui, the product's order value was, "so low it would not even cover the purchase of raw materials". Yet there had, at the time, been indications internally that the factory would

[18] The order was from Sangu Express (Sangu Kyuko) and was the largest project related to electric trains of the time (Mitsubishi Electric, 1951).

be shut down if its debts reached one million yen - this information left those involved in a difficult position. The record is quite lengthy, but is an important document inasmuch as it enables us to infer the ways in which cost reductions were enforced; the relevant sections are as follows (Mitsubishi Electric, 1951, pp.96-97):

> *"With the objective of generating profits, we repeated discussion. As a result, we thoroughly analysed material costs and labor costs. Then we examined these costs for each component to formulate a budget plan. We agreed that we would ensure the execution of this plan and the implementation of an interim audit. In other words, every time the original drawing was completed,* in addition to engineers and planners, cost managers, process planning managers, and material purchase managers attended a drawing meeting for cost reduction, creating a tense atmosphere *and holding heated debates.*
> *Unexpectedly, we came to a conclusion that all related people in each department would be committed to coordinating in procuring materials and were willing to cooperate in material purchase. My respect goes to the related people including the material manager at that time, Mr. Kojima. This cooperation was cross-functional. Everybody showed beautiful collaboration without saying nonsense. No one insisted that the purchase department should be responsible for material purchase. The cost department or the process planning department did not refuse to engage in purchasing. I believe that this is a good example which we can follow even now.*
> *For example, unless the conductor of a motor is purchased at a cost of 1 yen or less per pound, the budget limit will be exceeded. The supplier came to a compromise of 1.05 to 1.15 yen. However, negotiation does not proceed any further. The purchase department cries out for help saying that it is too shameful to proceed with this negotiation to ask for 1 yen per pound. Then, the purchase department cooperates with the cost department and process planning department. The supplier who is negotiating with Electrical Cable Company S is willing to offer approximately 10 percent discount if an order is placed for a batch of 100 tons. Empowered by this opinion, the purchase department coordinated orders for other construction projects and successfully purchased more than 100 tons at 0.90 to 0.99 yen per pound. In this way, the budget limit was achieved."*

As can be seen above, the company sometimes helped in achieving its budget limit

thanks to the cooperation of the engineers that became involved from positions across the company but at the same time also highlights the conflicts that existed between them.

For any given railway system, there existed two separate models for using resistors in control units. One such model was newly introduced by Westinghouse and was expensive. The other model was pre-existent, and boasted cost reductions of 30% when compared to the former. The design and production departments were, despite knowing the extra costs involved, leaning towards the adoption of Westinghouse's newer design, arguing that it would be of benefit to them in the future. Yasui admitted that their will would be difficult to overrule as long as the cost difference was not astronomical, and as such began negotiations with the resistor producers. His aim was to negotiate a 50% reduction in cost, calculating that the reduction would ensure the profitability of the end product. The producer was, needless to say, unwilling to meet such a condition. Yasui then proposed a new production method that would allow for easier mass-production of the product without sacrificing quality. Through this, he succeeded in negotiating a deal to purchase the resistors at a 50% discount.

Yet the design and production departments continued, as before, to fight for the adoption of the Westinghouse model. The design department was, at the time, headed by a man by the name of Takeshi Tatsumi, an engineer that had been designing control units since the organisational changes of the department in 1916. Yasui marked him out for criticism during a meeting to decide which model to adopt, claiming that; "anyone attempting to design a product with high material costs despite the existence of a cheaper alternative increases the company debt and is therefore a enemy of the company." Yasui pushed again for the adoption of the original model. Tatsumi later recorded that: "[At] the time everyone was screaming this and that about cost reduction, we stayed late at meetings every day and there were frequent arguments between the production and costs departments."

The issues outlined above concerning budget limits and target costing can be therefore be seen to have allowed engineers to assume roles beyond those of their original positions. The modus operandi fixed at this time did not end as a single, isolated event, but instead continued over a number of times - across the factories - in the form of an official roster of projects for cost reduction.

The first such project was embodied in the "waste elimination movement" of October 1928. The administrative structure of the project is recorded within the company history (Mitsubishi Electric, 1951). According to the record, six themes were established (including materials, development and production), with a committee chief

and coordinator assigned to each. The committee chiefs and coordinators included Kato from the time study project, Masaki, Inagaki and Yasui from the processes department, and Hibi from the sales department. Indeed, the list contained the names of almost all the engineers that had become involved in management accounting within the company. The 'waste' project lasted for a ten-day period and was said to have achieved a 28% reduction in unit production costs (Mitsubishi Electric, 1951). Similar cost reduction projects were, as far as they are outlined in the records, held once again in 1929 and 1930.

6. Division of Profit and Loss between Factory and Sales

Mitsubishi Electric continued to turn a profit despite the depression of the late 1920s, up until October 1930. Minutes from a board meeting held in September 1930, however, reveal that orders had dropped significantly, claiming that it was difficult to predict how much work the factories would have from the following year onwards. At one point someone is quoted to have said, "we are struggling to find a viable strategy." In December 1930, as part of a series of concrete measures to lower costs, expense cuts were discussed and authorised for business trips and entertainment expenses alike.

In April 1931, the company recorded its first loss in eight quarters. During the executive board meeting of September in the same year, a summary of the financial results was reported as follows, outlining the distinction between fixed and variable costs:

> Compared to a production level of 4.26 million yen in the preceding period, a 40% decline is expected in the current period - a drop, in other words, to 2.5 million yen. If we are to apply the same ratio to the 2.1 million yen of expenses of the previous period, this results in expenses of 1.26 million yen for the current period. The expenses contain both fixed and variable costs. Although the fact that some costs are indeed variable, it remains difficult to reduce these at the rate in which production levels are falling. Accepting that the drop in expenses will not match production drops, then, we can assume an average expenses reduction for the current period of 20%, resulting in a final amount of 1.68 million yen. The resulting difference of 420 thousand is not a production loss but rather an expenses loss engendered by the drop in manufacturing.

Towards the end of the passage, the distinction is made between a 'production loss' (i.e., a loss for the factory) and the drop in manufacturing (i.e., a drop in sales).

This distinction between the profit and loss of the factory and that of sales was also touched upon in the earlier '(proposed) budgetary system' and the 'opinion' that issued in its response. In the following year, a 'standard cost system' was established; the head of cost accounting, Inagaki, explains the process that led to the following statement (Imaike, 1943, p.21):

> One of the motives behind establishing the system was, of course, the importance we placed on efficiency improvements, but at the same time, vast price reductions would be rebuked as asinine by the factory whose staff were worked to the bone. So a distinction was made by which the factory became responsible for the cost price [only] and anything else became the responsibility of the sales side [of the business]; the division meant that even if orders were taken for lower prices, it was no longer the concern of the factory. We had used the budget limits system during Showa 2 and 3 [1927-8], and then the working budget system during Showa 5 and 6 [1930, 1931], but from 1932 we began using standard controls.

As can be seen, a standard cost system (referred to above as 'standard control method') was introduced in 1932. A team of engineers was assembled from across the company's various functional areas to implement the system. Masaki was appointed committee chief while Inagaki, Kato and Kojima were also added as committee members.

Unfortunately, there are no known primary sources detailing the steps and processes involved for this system of standard costing. The notes of Jinkichi Yamanaka (included as part of the company history), however, outline three new structures brought in as part of the system. Jinkichi Yamanaka had himself participated as a coordinator for the implementation.

These included two new forms - the 'Records per Business Type' and the 'Record of Operations Type', along with the establishment of a 'Cost Reduction Committee' (Mitsubishi Electric, 1951, p.321).

The 'Record of Business Type' was for the heads of business sections that bore responsibility for profit and loss and was divided over five groups of products, outlining the entire process - from design to production - for each. The five groups were; rotary machines, transformers, switchboards, submarines, and feeder sections. The heads of each business section became the 'outer wings of responsibility in the job system' (Mitsubishi Electric,1951, p.321), responsible for linking together the various job

functions that orbited the ‘central axis’ of product groups.

The ‘Record of Operations’ was designed to clarify the areas of responsibility for each department relating to indirect cost variances and divisional variable budgeting. Indirect cost variances were divided into a ‘responsibility variance’ (the difference between budgeted and actual amounts) that was the responsibility of the heads of each production facility, a ‘peaks and troughs variance’ that was the responsibility of the manager’s office and sales department, together with a ‘calculation variance’ that was the responsibility of the accounting department.

The committee itself was set up to reduce the base standard costs themselves. Its main functions were to conduct research into the reduction of production time, examine materials used, fundamentally improve the tools used, and design reappraisal.

In this way, it can be seen that time studies were not necessarily the basis on which the standard cost system was established. Inagaki himself also made the following comments on the relationship between standard costing and time studies (Imiaike, 1943, p.21):

> Some people believe a standard costing system cannot be set up until this research (time and motion study) has been completed, yet this has not always been our method. In some cases where a standard time was yet to be fixed for a particular process, we were been able to study it on the spot as the process was carried out and then assign a standard and materials time in tandem once it was completed.

7. Discussion and conclusion

Engineers at Mitsubishi Electric played a key role in implementing production management techniques in 1922, discussing design details of the budgeting system in 1928, and facilitating the cost reduction project in 1930. They assimilated overseas management knowledge from books and magazines and, at the same time, put the knowledge into action, which had something in common with their experience in education. Through the implementation process, engineers of the process control section, sales engineers and design engineers had been connected to the network.

Using the case study of Mitsubishi Electric during wartime, this paper has examined how such engineers - each with their own unique modes of thought - created and brought into practice of a system of management accounting within the organizational opportunities and limitations of the zaibatsu. The implementation of management accounting was seen to have promoted partnerships beyond engineers’

individual job functions, and it was those partnerships that went on to become a stage for further study into management accounting.

Through designing a management accounting system, these engineers shared their experiences; their training at Westinghouse, the costs of implementing new technologies, the benefits of standardising products, methods of achieving target costings, and a combined sense of fate when faced with the potential closing of the factory. The forming of a system of management accounting was a process that came together through the creation of a number of sub-systems, including the measurement and calculation of time studies and standard costings, a budget system, and a systems of variance budgeting and standard cost calculation. The design of a management accounting system was, in many ways, a process of experimentation, but it is clear that it strengthened the managerial of the engineers involved in the project.

This paper illustrates the interaction between the management accounting implementation and engineers' networking. By describing the micro process of engineers' implementation efforts, this paper studies the possible conflict inherent in the educational approach and the decentralisation of the Mitsubishi conglomerate. The findings of this study can provide additional evidence for the diffusion and adaptation of management accounting into non-western countries.

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