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Toward Sustainable Production: The Role of Emotion in Material Flow Cost Accounting (MFCA) Practices[1]

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1 Introduction

The Sustainable Development Goals (SDGs) which published by United Nations in 2015 have been embraced by a range of actors, including public sector and private sector organizations, NGOs, and accounting professionals worldwide. The SDG framework includes 17 goals that relate to the social, ecological, and economic outcomes required for achieving environmental and human development, and are expected to be delivered by 2030. While being referred to by policy making communities rapidly, these "global goals" are expected to provide a guide for development across nations.

However, the methods to achieve the SDGs are inevitably affected by the national "local" context, and their corresponding processes impact each society differently (Komori, 2015; Belal *et al*., 2017). In translating universal, "global" SDGs into local organizational and social contexts, accounting plays a pivotal role, and has been argued to affect strategizing, thus guiding organizations to achieve the SDGs (Bebbington and Unerman, 2018). However, SDGs are criticized as being ideologically

Eurocentric and neo-liberal in nature (see Weber, 2017). Therefore, it becomes important to examine the ways in which sustainability and environmental agendas are coped with and resolved within a different (i.e. Asian) socio-cultural context. Such an exploration will shed light on the role of accounting in translating SDGs, which has not yet been established in Western-led discussions.

With this in mind, this paper discusses a case study of Material Flow Cost Accounting (MFCA), a significant accounting practice of Japanese manufacturing companies, which has sustained the process of Monozukuri ("manufacturing craftmanship", the Japanese term for "sustainable manufacturing"**)** (Fujimoto, 1999). Hitherto, it has been used to evaluate opportunities, effectiveness, and the potential of technology improvement for cost reduction regarding the environment. Japan is now leading its international standardization.

MFCA could be a significant technical tool to realise Goal 12, "Ensure sustainable consumption and production patterns (Responsible consumption and production)". The International Federation of Accounting (IFAC) has identified eight SDGs (out of 17) which accounting and the accounting profession could contribute to (see IFAC, 2016) and Goal 12 is one of them. To date, several scholars have argued the significance of creating a balance between the economy and the environment (see Burritt and Schaltegger, 2010).

Initially developed in Germany (see Wagner, 2015), MFCA has been widely implemented in Japanese manufacturing firms as an environmental management accounting practice that responds to the need of creating the above-mentioned balance in the production processes. It does so by helping harmonize the different and often conflicting values and priorities of the economy and the environment. MFCA enables reducing the waste of material resources and energy by identifying material loss costs separately from product costs. Working with the International Organization for Standardization (ISO) to develop and publish its international standards ISO 14051 and 14052, Japan is now taking the initiative to establish these standards[2].

Although the significance of the role of accounting and accounting professionals for achieving the SDGs is well recognised, how to achieve and continue them remains largely unexplored. The examination of the

continuous practices of MFCA would thus provide insight into the ways in which accounting serves to shape the process for delivering sustainable production.

This study thus explores the reasons why MFCA has been introduced and maintained as an accounting practice by Japanese manufacturing companies by using the concept of "practice theory". Practice theory is relevant in the accounting context to "elaborate the ways in which specific organisational members sought to use accounting to achieve, if not grand strategic missions, at least specific subsets of organisational objectives" (Ahrens and Chapman, 2007, p.4). While MFCA as a practice has significant global impact, the differences in linguistic and socio-cultural contexts make it difficult for the academic knowledge on MFCA to be translated and "travel" beyond national boundaries. With emphasis on field observations and paying attention to the relevant translation processes practice theory could potentially highlight the ways in which MFCA has been used in the manufacturing processes in Japan. Accounting research incorporating sustainability agendas has mainly developed in terms of reporting standards and practices (e.g. GRI). However, less attention has been paid to its relationship with everyday management accounting practices. By applying practice theory, this study helps translate how the processes of MFCA practice are constructed within the organizational and socio-cultural context of Japan. It specifically sheds light on the significant role of emotion to create balance between the economy and the environment.

This paper first reviews the literature on MFCA and highlights the gaps in the existing studies in the next section. Section 3 discusses the relevance of practice theory to address these gaps. This is followed by the case study of Naniwa company (a fictitious name) in Section 4. Drawing on Shatzki's practice theory (1996), this paper shows how MFCA has been introduced and practiced in the socio-cultural context of Japan. The paper concludes by discussing the significance of emotion, which is found to play a significant role in achieving and continueing sustainability goals through accounting practice.

2. From local to global: Developing the knowledge and practice of MFCA

MFCA has been researched and developed through case studies by both the government and industry. Specifically, since its development by the Institut für Management und Umwelt (IMU) at the end of the 1990s, MFCA has proven its efficacy in projects conducted by the German Government or the Bayern state (Kokubu, 2007; Wagner, 2015). It was subsequently introduced in Japan in 2000. Several case studies commissioned by the Ministry of Economy, Trade and Industry (METI) were conducted on this topic. Then, the ISO standardization of MFCA was discussed at Japan's initiative, which materialized with the publication of ISO 14051 in 2011. As of 2009, more than 150 firms as were the object of case studies in the form of projects conducted in Japan (Nakajima, 2009), the number of cases is increasing now. Many of cases are conducted by METI in Japan as projects (see Okada and Kokubu, 2018).

One major objective of MFCA is reducing the environmental burden, while at the same time, improving profitability (ISO 14051; Kokubu and Kitada, 2015). It can be defined as a method of calculating costs according to the actual flow (flow and stock) of materials. As per ISO 14051, under MFCA, "the flows and stocks of materials within an organization are traced and quantified in physical units (e.g. mass, volume) and the costs associated with those material flows are also evaluated" (ISO 14051, p.1). Calculating the quantity for each input material and multiplying it by the unit price enhances the transparency of the use of materials and energy. In the manufacturing industry, raw materials constitute a large part of the product, and more precise quantitative techniques are necessary to calculate and classify cost and waste. As such, by applying MFCA, cost is calculated not only for final products, but also for waste. This largely departs from traditional cost accounting. In a traditional cost calculation, waste is not calculated separately from the product. By evaluating the cost of waste in the same way as for a product, MFCA enables us "to grasp how much money has been thrown away" (Kokubu, 2010).

In parallel to the government and industry case studies, MFCA has also been pursued academically. Such studies could be categorised into three key areas.

In the early period of its introduction, MFCA's distinctive nature from traditional management accounting and the problems caused by such differences have been discussed (see e.g. Nakajima and Kokubu, 2003). This is followed by a second stream of research that is related to an expansion in the use of MFCA and the associated challenges. Numerous studies discuss the potential and effectiveness of MFCA expansion into supply chains (Higashida, 2008; Nakajima, 2009; Okada and Kokubu, 2018). The expansion of MFCA beyond single companies enables determining losses for supplier or downstream companies as well, thus helping increase resource efficiency throughout the supply chain. Previous studies mostly discuss the role of MFCA in an inter-firm context and how to make its expansion successful. Higashida (2008) and Nakajima (2009) point out that MFCA plays the role of an information system that connects the buyer to the supplier. It is thus important for managers to be responsible for the entire process, from product design to operations, since they play the key role of mediators in linking the focal company with other companies (Higashida, 2010). Historically, companies that strongly promoted the diffusion of MFCA throughout the entire supply chain were also successful in decreasing material loss (Nakajima and Kimura, 2012, 2014; Kimura and Nakajima, 2013).

This leads to the third body of studies, which discusses the limitations or challenges of MFCA (Kokubu, 2007; Higashida, 2008; Higashida and Kokubu, 2014). Theoretically, corporate business activities are likely to be governed by the economic behaviour principle: there is a trade-off between decreasing input costs and increasing future revenue profitability, and the latter is generally prioritized over the reduction of environmental impacts (Kokubu, 2007). Such conflicts with the economic behaviour principle cannot be easily resolved. Although any area for improvement is detected via the use of MFCA, economic interest typically takes over. Higashida and Kokubu (2014) highlight that this tendency becomes more prominent for long-term implementation and continuous application. This highlights that, for the effective operation of MFCA, the "institutional support from outside the company" (Higashida

and Kokubu, 2014, p.98) becomes indispensable to help the "society and markets positively evaluate companies introducing MFCA" (Kokubu, 2007, pp.55-56). The conflict between economic principles and environmental protection is strongly linked to the main limitation of MFCA, which also represents the issues related to its expansion (Kokubu, 2007; Higashida and Kokubu, 2014). As such, the need to encourage environmental impact reduction from outside the firm becomes essential. In SDGs context, it is important to support from outside the firm in the same way.

Although studied extensively, the existing research on MFCA was predominantly conducted by Japanese scholars, meaning its findings are less likely to be shared beyond the Japanese context. Such research gap resulted from the differences in research epistemology and methodology compared to international accounting research, and potentially limits the internationalisation of accounting knowledge (see Humphrey and Gendron, 2015). However, if carefully applied, Western-led theory could help offer innovative ways of translating indigenous phenomena and knowledge (Kamla and Komori, 2018). Practice theory, for example, could help highlight how MFCA has been used and developed in practice, reconfiguring organizational relationships by making losses more visible and transparent (see Kitada, 2011). The continuous application of MFCA thus became possible because the organizational mechanism among practicing members and the interactions among them supported MFCA processes. The application of practice theory by Schatzki (1996) is relevant to understanding such intricate mechanisms and help develop knowledge to be shared beyond national boundaries.

3 Practice theory

The practice theory developed by Schatzki (1996) provides an effective angle to understanding the dimension of accounting practices that cannot be explained by rational reasoning. Practice is defined as "organized human activities" (Schatzki, 2005) and "any practice is an organized, open-ended spatial-temporal manifold of actions" (ibid., p.471). Further, practice can be developed as social order (and consequential rule), while

the way it is applied takes diverse forms. Schatzki (2011) contends that, at the basis of social order, lie the social practices that govern both the importance of involved arranged entities and the actions that shape their arrangements. Arranged entities are called "material arrangements" (Schatzki, 1996), for example, configurations of machines and computers. On the other hand, practices are constructed by arrays of actions (Schatzki, 2005), being organized by three phenomena: practical understandings of how to do things, rules, and teleo-affective structure. (p.471). Rules are "explicit formulations that prescribe, require, or instruct that such and such be done, said, or the case" (ibid., p.241). The teleo-affective structure is constructed by teleological dimensions, representing an array of ends (objectives), projects, uses (of things), and emotional (affective) elements that are acceptable or prescribed for participants in practice.

The unique perspective of Schatzki's practice theory (1996) is that practices show intentionality within the teleo-affective structure. Extending the discussion of Davidson (1963), who highlights the role of desire and belief in shaping one's action, Schatzki (2011) argues that beliefs (understanding and expectation) and emotions are responsible for moulding one's actions and behaviour. Therefore, one's actions are constructed by his/her emotion (affective structure). However, this emotion is stimulated by practical intelligibility (Schatzki, 2011).

The affective structure (emotion) acts in two ways in shaping practice. First, it helps identify the direction of the meaning involved in practice. Emotions act as "determinants to shaping people's orientation toward ends" (Schatzki, 1996, p.123), helping people determine their objectives. Second, emotions act directly on one's behaviour, instead of following one's rational objectives. According to Schatzki (1996), "mattering can structure activity independently of an actor's ends and thereby overturn the teleological character of action" (p.123). Therefore, emotion is observed as part of practice when "[people are] in particular moods and emotions or having particular feelings, affects, and passions" (ibid.).

Therefore, the practice theory developed by Schatzki (1996) provides a theoretical account that cannot be fully explained by the teleological argument, through clarifying the aspect of emotion. By highlighting the concept of teleo-affectivity, Schatzki (1996) demonstrates that "the thing

to do either derives from the actor's ends and projects, given particular states of affairs and how things matter, or reflects simply how things matter in a given situation" (pp.123-124). In short, the application of practice theory on accounting practice clarifies its dimensions beyond the account of rationality and objectivity. Particularly, it helps us understand the mechanisms of practice by identifying the relationship between the chain of action and the goals or feelings caused and shared in practice. The subsequent section seeks to demonstrate how this relationship plays a key role in MFCA practices, having been sustained by observing the case study of a Japanese company, Naniwa.

4 Introducing and sustaining MFCA applications: Case study of Naniwa Company

4.1 Research method

This paper explores the case of Naniwa, a middle-sized manufacturing electronic equipment company with over 100 employees. Established in the 1970s in Osaka prefecture, the company sells products not only on the domestic market, but also exports them to Europe, North America, and other Asian countries. Naniwa is part of a supply chain for corporations within the factory automation market, in which Mitsubishi Electric and Panasonic act as key players.

Since its introduction in 2000, a collection of MFCA case studies has been published by METI (2009, 2011a, 2011b). We have reviewed these 144 case studies and contacted those companies that demonstrated the intention of adopting MFCA calculation practices and applying it for improving their activities. Naniwa is one of four companies that accepted to participate in our interview. At Naniwa, accounting and finance department played a leading role in the continuous practice of MFCA within the company.

Since the first visit to the company, in June 2016, we have conducted a series of interviews with their financial manager and maintained close contact with him. The financial manager has been with Naniwa since 2004 and has taken a decisive role in introducing MFCA. Drawing on the

interviews, as well as official documents or reports used in company meetings, the case study below discusses the process by which MFCA was introduced and continuously practiced at Naniwa.

4.2 Introduction of MFCA

Naniwa introduced MFCA in the early 2000s, when an independent administrative agency, "Small and Medium Enterprise (SME) Infrastructure Development Organization", started an MFCA joint research model for SMEs (METI, 2009). Naniwa applied for this outsourcing project due to their pressing need to grasp disposal costs. Their financial performance was declining and they attempted to determine the various costs and grasp what caused these problems. They found specific problems in waste management, in which they had applied a "non-adjusted rate" for the measurement and management of the production process. In this method, the production ratio was managed as the ratio of goods obtained from an input, excluding the number of recycling or return items. Basically, the application of the non-adjusted rate helps understand the percentage of items that went smoothly from the initial to the final processes. This means waste management was done based on the number of items. However, their cost varies depending on the location within the production process, and the prices also differ. Therefore, even if they achieve the same non-adjusted rate, the cost impact is different for the company. As such, for efficiency improvement, it would be more effective to prioritize the process with the highest losses. This was particularly important for Naniwa, which saw the urgency in improving costs by loss reduction. The company had chosen to apply MFCA, as it provides transparency to the loss rate by measuring the inputs and outputs of the process on a quantitative basis and multiplying them by cost.

MFCA was applied for a total of four production stages, including the processing stages of three parts of the electronic product and their assembly process. As a first step, a material flow model was created, illustrating the flow from receipt of materials to shipment. This flow chart shows not only the entire cost of defective items but also the amount of input materials that was not used for a product. This loss rate is important

for creating an improvement plan at a later stage. As a result of the MFCA application, a total of 15 causes were identified (METI, 2011b). To improve these causes, each site (genba), including the design, purchasing, production technology, and manufacturing sites, needed to cooperate to reduce waste. At the same time, 20 improvement targets were presented, and the departments related to the respective improvement targets specified (METI, 2011b). This was followed by specific improvement activities. For example, to eliminate material loss generated at the manufacturing stage, the optimum specification width was set by the cooperation between the design and manufacturing departments. Delivery of materials with optimum specification width was realized as a result of discussions with the supplier. Furthermore, by improving the design aspect, it was possible to reduce the number of steps, ultimately reducing edge material.

All these improvements became feasible because of the MFCA calculations, which allowed visualizing the rate of waste in monetary terms, thus enabling the company to evaluate the effects of equipment changes as numerical values (METI, 2009). This increase in visibility also lead to an improvement in their overall activity. Over the subsequent 10-year period, the company would gradually engage in 20 improvement objectives, which included changes in design and production technology (as explained during the interview). The measurement and visualization of the loss rate also continued in parallel. Specifically, the yield rate of each process was multiplied by the material cost and could be measured and tracked. As a result, it became possible to determine the cost of waste, which was not known at the non-adjusted rate. The products targeted in the introduction stage were transferred to overseas plants, where the waste assessment for each product was visualized and managed by MFCA. Therefore, at Naniwa, MFCA had been continuously practiced and successfully maintained throughout its supply chain. This raises the question of what has enabled the company to do so. The mechanism of this case could be explained not only by examining it teleologically, but also by exploring the teleo-affective structure sustaining the practice.

4.3 *Recognising "how much we end up wasting":* Teleo-affective structure of Naniwa.

Practice theory provides an effective angle to identifying the reasons why MFCA has continued being used as a method to evaluate rejected goods and waste at the production site of Naniwa. This process could be achieved by understanding the teleo-affective structure for the continuity of MFCA. We first discuss their ultimate goal by considering the semantic chain of introducing MFCA. This is further analysed by determining the emotional structure behind it.

The financial manager explains the reasons why Naniwa introduced MFCA as follows:

"We were in the process of rebuilding many things from scratch to recover our poor performance. For this, it was important to think about the ways to understand the cost of discarded materials. To date, by using the non-adjusted rate, we managed the quantity of products compared to the number of inputs. In this calculation based on quantity control, the impact of one unit is deemed the same, no matter if the product is hundreds of yen or higher – it is calculated as the same one unit (product). But if expressed in monetary terms, the impact it gives to the company is totally different. The application of non-adjusted rate did not help us feel and think in this way. That is why I started to advocate introducing the different calculation method of grasping the amount of loss and manage the loss rate."

Applying the "signifying chain" (Schatzki, 1996, p.122), the purpose for Naniwa's MFCA practice discussed above could be explained as follows:

① Corporate activities should raise profit.
②To gain profit, cost minimization is needed.
③For cost reduction, the measurement and management of invisible cost is necessary.
④Evaluation based on the number of items fails to recognize all costs; therefore, it needs to be changed.
⑤Losses need to be managed by physical quantity and monetary terms, not number of items.

⑥MFCA is an accounting technique that enables evaluation both quantitatively and in financial terms. Therefore, MFCA is effective for Naniwa.

The ultimate objective of the MFCA practice was "to manage profits". Naniwa introduced MFCA to improve its financial position and manage profits, which required a drastic effort for the improvement of business performance.

The way to maximize profits is either by raising the profit though increasing sales or by reducing cost, or both. For Naniwa, the latter took priority. While the effect of cost reduction could be demonstrated rapidly, MFCA was practiced within the manufacturing department, which shows greater concern over cost management. This leads to their next objective: minimizing expenses. For this, it was important to visualize and evaluate uncalculated cost. Until then, the non-adjustment rate had been their management philosophy, where the calculation was based on number of items instead of monetary terms. However, this calculation method does not demonstrate the cost and financial amount of loss, meaning it does not help with loss management.

Understanding that the non-adjusted rate method cannot fully recognize the cost of the production process, Naniwa was looking for a method that can visualize this cost:

"Basically, our urgent concern is to understand the method of collecting information. Once it is done, we can collect and organize information in the way we aim at."

Therefore, the above analysis on "signifying chains" demonstrates that the introduction of MFCA was the outcome of the need to visualize cost and manage it, which leads to the ultimate objective of increasing earnings. However, the continuous application of MFCA at Naniwa cannot be explained only by cost management, as several cost management methods exist besides MFCA. The question remains as to why MFCA has been continuously applied within the company.

To answer this, one could focus on the examination of changes in MFCA practice. Since its introduction, there have been changes in the

way and format MFCA was applied at Naniwa. There are two main objectives of MFCA implementation: evaluate in monetary terms the amount of waste generated by the design and processing processes and determine cost management in the production process. Although the company stopped updating the former processes since the final implementation in the first half of the 2000s, they continued to manage material loss by using the data gained from these outcomes:

> "Above all, we wanted to see the whole picture. Some parts turn out to be products, and some unused materials as waste. Even for the materials that are 100% used, there are end materials. So, I made a flow chart to show the points in which end materials are produced. We followed what is flowing to the disposal waste and tracked data for a long time. By so doing, we can understand the amount of waste in the entire production process including disposal."

The major reasons they continued the MFCA practice lies in the management of material loss they conduct monthly. The data regarding the flows of input materials obtained by MFCA enables Naniwa to make long-term incremental improvements (kaizen) in reducing and managing production cost. Thus, once the data on material flow and its monetary evaluation are obtained, the company stops tracking the data:

> "We could understand the amount of cost by grasping all the expenses involved and used there, not by simply stacking ordinary material parts. Once we get the outcome after a number of simulations, we terminate this process."

Therefore, the major reason for the sustained MFCA application at Naniwa lies in the waste value evaluation of cost management. The importance of cost minimization has led to their choice of MFCA instead of other methods, such as yield management. However, why they see it as important to evaluate the value of defective products and waste materials remains unanswered. One of the important reasons is related to the importance to visualize the loss and the shared notion of what is "wasted" at the production site:

> "The most important thing for us is to help workers in manufacturing site critically recognize 'how large amount we end up throwing away'. By changing the unit from a number of items to the monetary evaluation, it is expected that our employees have a more critical awareness of the loss we are incurring."

Applying practice theory, Naniwa's sustained MFCA practice could be teleologically explained by its effectiveness in cost evaluation. However, this function could be realized only when the company was enthusiastically committed to expressing the cost in the monetary terms of input materials, both for the end products and those "wasted". This objective is achieved when the "feeling" associated with loss is understood and shared at the manufacturing site. This is not a teleological structure but an emotional one. By enhancing the shared feeling associated with the monetary amount of how much "we are throwing away", MFCA helps the company achieve its purpose of enhancing profits, but also "determine doing by shaping people's orientation toward ends" (Schatzki, 1996, p.123). In other words, Naniwa's sustained MFCA practice is explained not only by the teleological dimension in terms of rationality, but also underpinned by the affective (emotional) dimension, which creates a shared awareness within the organization with the scope to reduce waste.

5 Emotion matters for strategizing sustainability: Discussion and conclusions

People, things, and technologies are connected through the repetitive activities of accounting practices. Therefore, context matters in the way accounting practices are embedded and operate (Burchell et al., 1985). While helping create a globally impactful local practice, the distinctive Japanese context creates limitations for the existing MFCA academic knowledge to "travel" beyond local contexts and be shared in the international accounting academic arena (Komori, 2015). However, it must be emphasised that the exploration of MFCA provides important

insights into understanding how accounting played a role in the ways in which the sustainability and environmental agendas are dealt with. By applying practice theory, this paper illustrates the ways in which MFCA has been continuously practiced in the organizational context of a Japanese manufacturing company. This would help broaden our understanding of the ways of achieving the SDGs, which tend to currently be argued from a Eurocentric perspective.

This study highlights that Naniwa's continuous MFCA practices cannot be explained only from the teleological perspective of achieving the economic driven objective of enhancing profit. MFCA has played an important role in managing their material loss within the production process. It does so by awakening workers' feeling of "throwing away a lot of things" through the quantitative visualization of waste. The capacity of accounting to visualize (wasted) values numerically has helped shape emotions to "determine doing by shaping people's orientation toward ends" (Schatzki, 1996, p.123). By working on the emotional dimension, accounting helps create balance between the economy and the environment within the production processes itself, thereby helping shape sustainable production.

The significance of emotion in everyday accounting practice provides important implications for "strategizing" (Jørgensen and Messner, 2010; Sawabe et al., 2010) the SDG agenda. In response to the ecological responsibility and shaping accountability processes of endangered species, for example, attention could be paid on how numerical visibility can trigger human beings' empathy and compassion to non-human species at the risk of extinction (Atkins et al., 2014). Such emotional emphasis could even help create a more salient non-Western epistemology that underpins the human–nature relationship that has yet to be fully discussed in Western accounting literature (Birkin and Polesie, 2011), which would bring balanced socio-cultural epistemic values (Hines, 1992). These values are the products of non-Western socio-cultural contexts. Asian accounting scholars have both the opportunities and important roles of introducing such dimensions, which are still waiting to be discovered and re-discovered.

Notes

1. This paper forms the basis of the SUMS-Kobe Research Partnership and was discussed at the SUMS-Kobe International Partnership Seminar, "Integrating Sustainability with Management Practice: A Role of Material Flow Cost Accounting", delivered by Professor Katsuhiko Kokubu at Sheffield University Management School (June 2018).
2. Professor Kokubu served as a convenor for ISO/TC207/WG8.

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