



## Review

## Material flow cost accounting: a review and agenda for future research

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## ABSTRACT

Recent times have seen the business world challenged to improve efficiency by reducing its material and energy usage. Material flow cost accounting has been suggested as a management tool that can assist and a new international environmental management accounting standard, ISO 14051, has emerged for consideration by business. This paper presents a review of extant MFCA literature, the purpose being to develop a research agenda which will provide a foundation for future development of the material flow cost accounting tool. Concerns are raised about the absence of theorising behind material flow cost accounting; the lack of knowledge and application of the tool in practice; the need for survey, interview and statistical research methods to supplement case studies; lack of systematic evidence of the tool's applicability beyond manufacturing and in different firm sizes; and complementarity with other accounting tools used to improve performance. An agenda identifying promising avenues for research, the scope of application within companies and broadening of methods for investigation is then outlined.

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## 1. Introduction

With increasing “pressure to achieve higher productivity with reduced environmental impacts”, business organisations require access to tools that enable them to account for all inputs and outputs to their operations with a view to supporting eco-efficient decisions that simultaneously improve economic and environmental performance (Kokubu and Tachikawa, 2013, p. 351). Material flow cost accounting (MFCA) has been suggested as one such tool that can support eco-efficient decisions. The potential importance of MFCA has been further recognised with the release in September 2011 by the International Organization for Standardization (ISO) of the ISO 14051 standard for material flow cost accounting.

MFCA has been described as among the most basic Environmental Management Accounting (EMA) tools<sup>1</sup> (Jasch, 2006; Schaltegger and Wagner, 2005). The data afforded by MFCA also

provides a foundation for the development of further environmental management accounting activities which may include investment appraisal, environmental impact assessment and short and long term environmental budgeting (Burritt and Schaltegger, 2001; Jasch, 2006; ISO, 2011). Based on these arguments it would be reasonable to assume knowledge concerning MFCA would (or should) be among the most developed topics within the EMA literature. However, a review of available publications suggests that despite 15 years research in this field, there remain more questions than answers.

To date, extant research on MFCA has been predominantly conceptual. Although limited case studies do exist, these are largely action-based projects in which experienced researchers played a central role in facilitating the adoption and implementation process (Heupel and Wendisch, 2003; Jasch, 2006; Nakano and Hirao, 2011; Schaltegger et al., 2012). Furthermore, even in the presence of experienced researchers it may be difficult to convince managers of the merits associated with MFCA activity. For example, at the Mackenzie Paper Division paper mill in Canada, Gale (2006) found that while an MFCA approach revealed environmental expenses to be more than double what would usually be reported in the financial statements, management remained unconvinced of the merits associated with EMA in general and argued that the organisation was already efficient.

While the normative origins associated with MFCA are not problematic in and of themselves it can be argued that, if the take up of MFCA by business is to improve, it is now necessary to

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E-mail addresses: [chrkl002@mymail.unisa.edu.au](mailto:chrkl002@mymail.unisa.edu.au) (K.L. Christ), [roger.burritt@mq.edu.au](mailto:roger.burritt@mq.edu.au) (R.L. Burritt).<sup>1</sup> Environmental Management Accounting being the term used to describe the integration of physical environmental information into the management accounting system. EMA incorporates a variety of tools that can be physical or monetary; past or future-oriented; routinely generated or produced on an ad-hoc basis; and, finally, they can have either a short or long-term focus. For a comprehensive coverage of available options readers are advised to consult Burritt et al. (2002).

establish what is currently known about the direction of research on the topic. This knowledge can then be used to inform the development of a pragmatic research agenda. With the release of ISO 14051 the future is likely to see increased interest in researching MFCA techniques. In order to be effective it is important this research be placed in the context of what is already known and what needs to be known. Accepting that contemporary organisations require access to management tools that support improved resource efficiency and reduced environmental impact, this paper utilises a literature review to develop a greater understanding of MFCA, the purpose being to develop a research agenda by which knowledge can be improved and the implementation of MFCA activities by organisations further promoted and improved.

The remainder of the paper is arranged as follows. The next section provides a basic overview of what MFCA is and places it in the context of more generic EMA knowledge and development. Section 3 discusses the method used to undertake the literature review. Section 4 covers the development of MFCA as a management tool. This is followed by section 5 in which the MFCA process is discussed. Empirical evidence concerning MFCA in practice is synthesised in Section 6, with Section 7 summarising what is currently known on the topic with a view to identifying what needs to be known via the presentation of a research agenda. Section 8 then concludes the paper.

## 2. What is material flow cost accounting?

The purpose of this section is to provide a basic overview of material flow cost accounting. The discussion will commence with brief mention of EMA as the larger discipline from which MFCA emerged and is closely aligned. This is followed by a basic overview of MFCA and what the practice entails with the research question presented towards the end of the section.

### 2.1. Generic environmental management accounting background

With population growth and increased demand for finite resources in the face of an often limited supply, recent years have seen mounting interest in developing business tools that support high levels of productivity while simultaneously minimising resource use and adverse environmental impacts. The need for a more integrated approach to corporate economic and environmental management led to the development in the 1990s of Environmental Management Accounting (EMA) (Christ and Burritt, 2013). EMA provides a starting point to redress the oft cited shortcomings associated with traditional management accounting which has been criticised for its failure to explicitly consider environmental information; a situation which may lead to flawed conclusions (de Beer and Friend, 2006; Godschalk, 2008; Schaltegger and Burritt, 2000; Tsai et al., 2012). Thus EMA offers organisations an information system in which physical and monetary data concerning how business activities impact on, and are impacted by, environmental issues is explicitly considered (Burritt et al., 2002). The further relevance of EMA to business becomes clear upon reviewing extant case studies presented in the academic and professional literature in which the potential for cost savings, more efficient material use, and increased revenue streams have been consistently supported (Altham, 2007; Burritt et al., 2009; de Beer and Friend, 2006; Deegan, 2003; Ditz et al., 1995; Schaltegger et al., 2012; Ván and Gärtner, 2011).

The last two decades have seen the EMA literature develop to incorporate a number of different tools. Lang et al. (2005) suggest Material Flow Cost Accounting (MFCA) is among the most fundamental and well-developed of these. The recently released ISO 14051 standard defines MFCA as a “tool for quantifying the flows

and stocks of materials in processes or production lines in both physical and monetary units” (ISO, 2011, p. 3).<sup>2</sup> MFCA is underpinned by the premise that all materials purchased by an organisation must eventually leave as either product or waste, also referred to as non-product output or negative product (Fakoya and van der Poll, 2013; Jasch, 2009), and Jasch et al. (2010) describe MFCA as the starting point for the implementation of EMA activities.

### 2.2. A basic overview of MFCA

MFCA incorporates two distinct elements: physical and monetary. Within the EMA literature, MFCA falls within the group of tools that come under the umbrella term ‘environmental cost accounting’ (Papaspyropoulos et al., 2012). As with environmental cost accounting, although generally classified as a monetary EMA tool, MFCA relies on access to “corresponding physical information” but specifically “about materials and energy flows” and is usually classified as past-oriented with a focus on short-term management (although the information provided by MFCA can be used to support the implementation of other future-oriented EMA tools such as various forms of environmental budgeting) (Bennett et al., 2013, p. 8; Burritt and Schaltegger, 2001; Wendisch and Heupel, 2005). In addition, the information made available via implementation of an MFCA system is expected to be generated on a routine basis (for further information, please refer to the comprehensive framework for EMA presented in Burritt et al., 2002).

Jasch (2011, p. 256) submits the reason EMA places especial emphasis “on the use, flows and final destiny of energy, water, materials and wastes” is because “(1) use of energy, water and materials, as well as the generation of waste and emissions, are directly related to many of the environmental impacts of organisational operations; and (2) materials purchase costs are a major driver in many organisations”. Thus by focussing on material and energy flows, as well as their related costs, MFCA provides a foundation by which opportunities for improved eco-efficiency are able to be more clearly articulated and understood (Scavone, 2006). In addition, prior research has shown the costs associated with wasted materials can amount to as much as 40–70% total environmental expenses for individual organisations; environmental expenses being defined as those business expenses that are associated with impacts on the environment which includes the cost of environmental protection (Bautista-Lazo and Short, 2013; Jasch, 2009). In consequence, it can be argued the effective management of material and energy flows constitutes an important undertaking for contemporary organisations, both economically and environmentally.

### 2.3. Context of the research and research question

Yet despite the arguments presented in the preceding paragraphs, knowledge concerning MFCA in practice remains underdeveloped. Furthermore, a comprehensive agenda to guide current and future research in this area has yet to be developed. Thus the purpose of this paper is to provide a synthesis of current knowledge concerning MFCA and to present a number of directions for future research by which knowledge can be advanced and the further take up of MFCA by business promoted and improved. In doing so the following research question will be addressed: (RQ1) *How can academic research be used to further understanding of current MFCA development?* The next section will discuss the method used to investigate this research question.

<sup>2</sup> ‘Materials’ in this context is generally held to include energy and water (ISO, 2011, p. 3).

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