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Editorial

Material Flow Cost Accounting – looking back and ahead

A B S T R A C T

Material Flow Cost Accounting (MFCA) combines physical flows and monetary units and is located between energy and material efficiency analyses, environmental management and managerial accounting procedures. Since the development of ISO 14051:2011 research and application in industry increased, but still some theoretical, methodological and practical gaps exist. This Special Volume addresses some of the existing deficits and shows the fertile contribution of MFCA on resource efficiency. As can been seen by the articles and case studies in this Special Volume, MFCA still is continuously spreading into further countries and the methodology is extended, refined and elaborated and increasingly applied in combination with various other tools and concepts. The main challenges are still the continuous implementation of the method in industry and the public dissemination of the results.

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Environmental management accounting
Eco-efficiency
Resource efficiency

1. Material flow thinking can shape managerial thinking

To cope with complexity the perception of corporate reality is reduced by narrowing the focus of perception, resulting in limited attention (Simons, 1995). Engineers see the functioning of technical processes and products. Managers see the cost and profit side. Environmental officers see emissions, effluents and waste. All three tend to improve the corporate reality they see. This does not necessarily lead to an overall optimization of corporate goals as conflicts occur. Technical improvements focus in the first instance on the technical functioning, and might neglect costs and environmental aspects. Cost saving procedures might lead to staff reduction, not considering that this might produce new environmental burdens. Environmental considerations might request a new product design (e.g. of decomposability), leading to conflicts with production engineers etc.

By showing the common denominator of the various perceptions and foci, material flow thinking supports the integration of the various views: Engineers might become more aware of environmental consequences. Environmental officers get better information on cost effects. In addition, management might get a better overview of all, technical, monetary and environmental aspects. Material Flow Cost Accounting (MFCA) as a tool for implementing material flow thinking can considerably enhance an integrated optimization.

This Special Volume offers a first comprehensive overview over roots, conceptual characteristics, recent and future developments of MFCA and governmental initiatives. MFCA has not yet been explored in depth in research literature. MFCA so far has been subject more to practical application and less to empirical coverage. The method is being used in many companies, especially in Japan and Germany, but also in low-income countries. Some of these more recent applications are documented in this Special Volume. However, for reasons of competition and confidentiality many companies hesitate to publish detailed information on material flows, on efficiency achievements and saving results. Nevertheless specific and new internally reported data and information on material flows are an important lever for more efficiently structuring material flows in a company and also making a contribution to “cleaner production”. Thus, MFCA is not only a corporate accounting exercise but also belongs to the method toolbox of industrial ecology, as it chiefly addresses the efficient and effective use of natural resources. Its scope recently is being extended to the supply chain as well as to an even further reaching Life Cycle perspective.[5]

MFCA essentially addresses the monetary relevance of physical material flows and losses for companies. It demonstrates physical and monetary quantities of material flows as two sides of the same coin. By quantifying physical material flows it not only provides a basis for technical analysis, but also for an environmental assessment. It quantifies the material going into the product, into air, into water or into soil, but it also traces indicators like material efficiency, toxicity, criticality etc.. And finally it also contributes to economic optimization as all flows are monetarily assessed.

[5] See e.g. the recent development of a new ISO-Standard 14052 on MFCA in the supply chain still in progress or the proceedings linking MFCA to the concept of Life Cycle Assessment in the Abstract Book of the 11th International Conference on Eco-Balance by The Institute of Life Cycle Assessment, Japan: http://ilcaj.sntt.or.jp/EcoBalance2014/program/scientific_program.html.

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Thus the method is used to analyse the physical energy and material flows[6] in production systems and then to assess them in monetary terms. Thinking in material flow systems enables the tracing of inefficient material and energy use, both from an economic and ecological perspective. Waste reduction becomes a major opportunity and objective. The assessment of an input-/output-mass balance of physical material flows is the starting point for several tools related to environmental management and cleaner production (emissions control, resource efficiency). In essence, all material input flows including energy and water are distinguished into product output and non-product output. Non-product output is evaluated not only with its disposal, treatment, and recycling costs, but the wasted material's purchase value, as well as handling and storage costs are included in the production costs of non-product value and disclosed in the management control system. At the same time, this full costs overview also can establish the baseline for an idealized zero waste scenario. Ideally, in a resource efficient production system, all inputs would be converted into products. MFCA is located at the interface between energy and material efficiency analyses, environmental management and managerial accounting procedures. Above all, the method points out opportunities for action that are economically advantageous from the point of view of companies, and at the same time, by saving resources, emissions, waste etc. are also environmentally expedient.

By this MFCA adopts a different perspective to many other environmental management and accounting tools. Savings in energy and material do not only lead to cost reductions, but are generally also environmentally advantageous. MFCA reveals material efficiency and cost saving opportunities regarding the wide range of raw and auxiliary materials and energies. And it also comprises all flows and storages along the value chain between input (purchase), throughput (production) and output (delivery or disposal). Thus MFCA can help to identify economically attractive materials that have so far slipped through the net of conventional economic assessment or cost accounting. It can help to prioritize the economically and environmentally most attractive starting points. And it supports a holistic view comprising the entire flow of materials throughout the company from R&D and product design to recycling and reuse, not only optimizing from a narrow functional or departmental point of view. In this way MFCA expands the options for action in companies that have so far been defined by narrow accounting and management control procedures. It should thus be seen as an instrument for management control purposes and be applied on a regular level, integrated with existing accounting, management control, planning, reporting, and production information systems.

Meanwhile the procedure is well documented in an international standard that enhances the understandability and the reception of the method: The ISO 14051 standard describes the “general framework” of the MFCA approach. A second standard, ISO 14052, that addresses “guidance for practical implementation in a supply chain” is currently being developed.

Nevertheless, even if MFCA is accompanied by scientific support or extended to scopes across the company boundaries it expresses the results in simple physical and monetary quantities that can be easily understood.

In this editorial we identify research gaps for MFCA-related topics and give an overview on the papers of this special volume.

[6] Energy flows as long as they are of material substance (oil, gas, wood, coal etc.) can be treated as other material flows and quantified in mass values (kg, m^3). Electricity or heat flows with negligible or no masses in MFCA are considered separately or parallel in kWh or kcal.

2. Research gaps

As early as 1959, the German economist Paul Riebel already pointed out that conventional cost-accounting in companies aims to fulfil a number of different purposes, for instance cost-efficiency comparisons, price policy, or current profit and loss statement (Riebel, 1990, 1994). He inferred from this that first of all a purpose-neutral accounting database is necessary, on which various evaluation calculations with different objectives or purposes could then build. Based on physical quantities it should be possible to produce information for decision-relevant events between the company and the market as well as for those within the company. Viewed in this way, MFCA also serves a specific purpose, namely in the first instance to provide a purpose-free information basis describing present material flows (stocks and movements) in physical and monetary terms as the core of business. If this material based accounting system is available, a wide range of reports, evaluations, and calculations can be derived for various purposes, for purchasing, for production planning, for product design, for quality management, for investment decisions, up to environmental management evaluations. This would then even result in a natural bridge between an economic and environmental assessment of the same system. This common information basis could show material inefficiencies in physical quantities and value these inefficiencies in monetary terms. The results can be transferred into the profit and loss statement on the one hand, as well as into a company's environmental report on the other. The two sides of one coin could target for special analyses of efficiency potentials. What costs could be saved by avoiding inefficiencies? Or alternatively, what environmental pollution could be saved by this?

It is important to campaign for such a basic accounting system in companies. This alone allows the holistic assessments of production that are becoming increasingly significant in times of climate change and scarcity of resources. Companies must recognise that this leads to additional benefits which conventional accounting systems do not offer. MFCA is a strong argument here, as it calculates in monetary units. However, it should not be forgotten that MFCA at the same time is also a toolbox for sustainability and resource efficiency and that there is also a need for other, non-monetary evaluation views.

Separation into material basic accounting and specific assessments, such as Carbon Footprint, can above all supply key performance indicators that are necessary for efficient and environmental steering of a company. The challenge in closing the efficiency gap is not to reveal potentials in a one-off exercise, but instead to continuously improve and above all implement findings in management action and operational routine. Experience from the lean production movement shows that the challenge lies not only in “hard” technical issues but quite often in “soft policies” (Rother, 2010; Schmidt, 2013). How can constant awareness for improving effectiveness and efficiency be created among management and in each individual member of the workforce? This is a question of leadership, but it has to be supported and accompanied by the constant supply of data and performance indicators. Peter Drucker expressed this succinctly: “If you can't measure it, you can't manage it.” The inefficiencies must therefore be continuously tracked down and quantified. The MFCA approach is one technique for this aim.

The reference to lean production should be taken seriously as well. Lean production originated in the Toyota Production System (Ōno, 1988) and addresses efficiency and waste in production. Today there is hardly any automobile manufacturing company that does not work in accordance with these principles. But they do not consider energy and material wasting as wastage of value creation, faulty products, working time and scarce and costly