Material flow cost accounting with ISO 14051

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Material flow cost accounting (MFCA), an environmental management accounting developed in Germany in the late 1990s and since adopted widely in Japan, focuses on tracing waste, emissions and nonproducts, and can help boost an organization's economic and environmental performance.

To standardize MFCA practices, working group (WG) 8 of ISO technical committee ISO/TC 207, *Environmental manage*- *ment*, is currently working on the development of ISO 14051, *Environmental management – Material flow cost accounting – General framework*, targeted for publication early in 2011.

ISO 14051 will be complementary to the ISO 14000 family of environmental management system standards (EMS), including life cycle assessment (ISO 14040, ISO 14044), environmental performance evaluation (ISO 14031), and the

greenhouse gas management standards (ISO 14064-1-3, ISO 14065).

In this article, the basic concept and application of MFCA, and development of the new International Standard are explained.

A vital social issue

Climate change, environmental legislation, and the global economy are in the headlines more than ever, highlighting the fact that effective management of environmental and economic affairs has become a vital social

issue. In response, manufacturers and other businesses are under pressure to increase productivity while reducing environmental impact.

MFCA can help organizations to achieve such objectives by identifying emissions and waste within a process in cost and physical terms. Such precise data can motivate managers to enhance material productivity and significantly reduce waste far more effectively than relying only on conventional production and cost accounting information.

The original concept of MFCA was developed in Germany by Professor Bernd Wagner and colleagues at IMU (Institute für Management und Umwelt) in Augsburg, Germany, and introduced in Japan around 2000.

Many Japanese companies have since adopted MFCA, supported by the Japanese Ministry of Economy, Trade and Industry. In 2008, the Japanese Industrial Standards Committee (JISC) submitted an MFCA proposal to ISO/TC 207, resulting in the creation of a new working group, WG 8, in March 2008, to develop ISO 14051.

MFCA explained

MFCA is a management information system that traces all input materials flowing through production processes, and measures output in finished products and waste.

For example, where 100 kg of materials is input into a production process and 70 kg of finished products is obtained, 30 kg of waste has also been produced. An equivalent cost evaluation of the finished product and waste can then be made.

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Figure 1 – The concept of material flow cost accounting.

MFCA can boost economic and environmental performance

In MFCA, finished products and waste are respectively termed positive and negative products. The essential point of MFCA is to recognize waste as non-marketable (second) products in the sense that materials are consumed and manufacturing facilities are used (see Figure 1).



Figure 2 – An example of conventional cost accounting.



Figure 3 – An example of material flow cost accounting.

MFCA calculations differ from conventional cost accounting, as illustrated in **Figures 2** and **3**. In the examples, each production process yields a single product from 1000 g of material at a cost of USD 1000, plus the processing cost at USD 800. The costs are calculated using conventional cost accounting in **Figure 2** and MFCA in **Figure 3**.

Even if waste is visible in the factory, the cost of that waste is usually ignored in conventional cost accounting, as shown. This amount is automatically included in the cost of output (finished products).

However, in MFCA, waste is considered to be another product (negative product), and hence has cost allocated to it based on certain criteria, which in example **Figure 3** is weight. Therefore, the cost of the waste, as a negative product of 300 g, is calculated as USD 540. This is a new information generated by MFCA that provides an incentive to management to reduce that cost, achievable by reducing waste.

MFCA in action

MFCA can provide internal and external benefits, enabling an organization to make a greater profit with less environmental impact. A typical internal benefit is the strengthening of an organization's competitiveness, since MFCA delivers both increased profits and material productivity.

A good example of how MFCA enabled a company to improve productivity is shown in a case study of Nitto Denko, a major Japanese manufacturer of chemical, electronic and healthcare products (see **Figure 4**). The company significantly increased the ratio of positive versus negative products during the period 2001 to 2004, using MFCA.

MFCA can also bring external environmental benefits by enabling organizations to manufacture the same amount of finished product with less input. As a result, they can reduce environmental impacts such as CO_2 emissions and consumption of natural resources, as exemplified in the case of the Sanden Corporation, a Japanese manufacturer and supplier of automotive, commercial cooling and heating products (see Figure 5).

	2001	2004	2009 (Target)
Positive products (ratio)	68%	78%	90 %
Negative products (ratio)	32%	22%	10%
Total (ratio)	100 %	100%	100%

Figure 4 – Improvement in material productivity at Nitto Denko through MFCA.

	Current amount	Target amount	Amount of reduction	Rate of reduction
Input Materials	119t	109t	10t	-8%
Emissions (waste) Negative products	41t	31t	10t	-24%
CO ₂ emissions	1,234t- CO ₂	1,151t- CO ₂	83t- CO ₂	-7 %

Figure 5 – Reducti	on in CO ₂ emission	s at Sanden	Corporation	through MFCA.
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By applying MFCA to its manufacturing processes, Sanden found it could reduce the amount of input materials and CO_2 emissions, and thus contribute to sustainable development.

Balancing environmental and economic factors are vital issues confronting many organizations wishing to achieve sustainable development. MFCA can be of great assistance in this endeavour. It has become recognized as a valuable management tool because it links the environment to economics, as shown in **Figure 6** (preceding page).

MFCA offers the potential for:

- increased production efficiency through capital investment, based on appropriate and accurate evaluation of investment projects;
- cost reduction through changes in product design and raw materials based on precise evaluation of manufacturing cost;
- revitalizing on-site improvement activities (e.g. environmental and quality management systems) by providing specific targets;
- possible extension to the supply chain and social cost management;
- applicability to any organization, regardless of type, size, activity and location, and in developing as well as developed countries.

MFCA implementation need not involve advanced computer-based information databases since simple spreadsheet calculations and the use of a

calculator are often sufficient – an advantage for small and medium-sized enterprises.

Standardizing MFCA

ISO/TC 207/WG 8 is currently progressing from working draft to committee draft stage in the development of ISO 14051, *Environmental management* – *Material flow cost accounting* – *General framework*. The International Standard will comprise :

- 1. Scope
- 2. Normative reference
- 3. Terms and Definitions
- 4. Objectives of MFCA
- 5. Framework and Elements of MFCA
- 6. Approach for MFCA
- Annex: Calculation Methods and Case Studies

While the objective of ISO 14051 is to standardize the general principles and framework of MFCA, it does not cover detailed procedures for accounting calculation but rather the steps required to introduce MFCA, and as such is expected to benefit a wide range of industries.

ISO 14051 can be considered as a standard for sustainable development. However, implementation of the cost accounting method is not within its scope at this stage, nor is it intended for the purpose of third-party certification.

Integration with ISO 14000

MFCA can be integrated into the ISO 14000 family of EMS standards and is complementary to life cycle assessment (LCA), environmental performance evaluation (EPE) and greenhouse gas management standards.

With regard to EMS integration, MFCA can provide significant information to an organization in the Plan-Do-Check-Act (PDCA) cycle. LCA generally regards the lifecycle of a product and service as a system, and analyses the environmental influence in the lifecycle but does not currently include economic aspects of an organization. MFCA supports this point.

- MFCA focuses on emissions (waste)
- Profit is hidden in emissions (waste)
- MFCA finds out the hidden profit



Figure 7 – *Spotlighting the benefits of MFCA.*

Concerning EPE – the PDCA continual improvement process – ISO 14031 in principle sets the outline necessary to monitor material flows within organizations, but does not relate this information to financial information systems and business decisions regarding costs and the setting of product prices. However, MFCA provides this link.

MFCA can provide significant information to an organization

In addition, the assessment of CO_2 emissions in many sectors is based on the evaluation of the material input of energy carriers, which need to be thoroughly registered in technical as well as monetary information systems. MFCA, again, provides this link.

ISO/TC 207/WG 8 proceedings

ISO/TC 207/WG 8 has already held workshops and meetings twice, first in Bogota, Colombia, in June 2008 and second in Tokyo, Japan, in November 2008. A Committee Draft is planned to be circulated in March 2009. Currently some 42 experts from 24 countries are participating in the development of the standard, with publication expected in 2011.