1

Overview of Presentations and Panel Discussion

Overview of Presentations and Panel Discussion

CONTENT

1. Environmental Accounting for Corporate Management and Environmental Protection

Katsuhiko Kokubu

Environmental accounting has two functions: external disclosure (external environmental accounting) and internal management (environmental management accounting). Both types of environmental accounting are indispensable not only for environmental management but also for corporate management itself.

Environmental accounting in Japan has developed rapidly during recent years. This development was triggered by the initiatives by the government. Of these initiatives, those of Ministry of the Environment (MOE) and Ministry of Economy, Trade and Industry (METI) are considered to play a more important role in Japanese companies. The MOE environmental accounting guidelines stress the external disclosure of environmental accounting information by environmental reports. On the other hand, the METI initiative has developed various environmental management accounting tools including material flow cost accounting.

Based on some surveys of IGES Kansai Research Center, Japanese companies put much more stress on external disclosure purpose of environmental accounting. Their disclosure practices have been strongly influenced by the MOE guidelines. However, corporate practices of environmental management accounting in Japanese companies have not been well developed yet. Therefore, two important issues for Japanese companies can be pointed out. First, they should sophisticate their external environmental accounting system and lead international practices. Second, environmental management accounting should be well introduced into Japanese corporate practices. For this purpose we believe material flow cost accounting has huge potentialities.

(For full text, please refer to page 30.)

2. Efforts of Japanese Government - Focus on the Role of Ministry of the Environment -

Kenji Sawami

1. Roles of environmental accounting in policy making

i. Transition of environmental issues in Japan

Environmental issues in Japan can be roughly divided into three groups: (a) those in the high growth period when industries served as a source of pollution; (b) those in the stable growth period when pollution surfaced as a result of urban-centered life; and (c) those in the present period since global environmental issues have been recognized.

ii. Roles of environmental accounting in policy making

One of the most effective measures to cope with these environmental issues is the optimal policy mix. Since disclosure of environmental information is the key to promote environmental-friendly activities, companies should closely connect the following three elements, so as to use them as an integrated tool for environmental information disclosure: (1) environmental accounting; (2) environmental report; and (3) environmental performance indicators.

2. Measures taken by the government and other organizations

i. Current prevalence of environmental accounting in Japan

The number of companies introducing corporate environmental accounting is constantly increasing in Japan. According to the survey by the Ministry of the Environment, 491 companies introduced an environmental accounting system (367 of them have announced their introduction.) and 580 companies were considering the introduction of such a system in the last fiscal year.

ii. Governmental policy to promote environmental accounting

The increased introduction of environmental accounting by companies attributes to the active promotion by the government as shown in the Basic Environmental Plan and Three-Year Program for Promoting Regulatory Reform (Revised). In addition to the Ministry of the Environment, various ministries and agencies are engaging in projects to promote the introduction of environmental accounting.

iii. Environmental accounting guidelines

The Ministry of the Environment has published the environmental accounting guidelines based on the opinions of many business people and experts. The Ministry regularly holds workshops for companies and enjoys a cooperative relationship with the Japanese Institute of Certified Public Accountants. Furthermore, the Ministry has published guidebooks containing the results of some relevant researches with the aim of promoting an understanding of environmental accounting and making the system more user-friendly.

3. Issues to be considered in the future

i. Transition in corporate sustainable development management

Circumstances surrounding corporate sustainable development management is going through a major transition. It is expected that companies will be urged to further disclose environmental information and will be evaluated based on the disclosed information. Considering this, the demand for environmental accounting that relates financial information to environmental information is likely to increase significantly.

ii. An issue to be considered in the governmental policy

Environmental accounting, one of the most important measures to pursuit of environmental conservation and economic growth in tandem, is needed to be spread more widely. Particularly, when environmental accounting information is disclosed in environmental reports, their comparability and credibility must be improved.

iii. Harmonization with international trend

In order to harmonize with international trends, it is necessary to review methods mainly designed for internal functions, which have been considered at expert meetings of UN Sustainable Development Department, while contributing to the regional promotion of environmental accounting using the Environmental Accounting Network - Asia Pacific.

(For full text, please refer to page 38.)

3. Efforts of the Japanese Institute of Certified Public Accountants (JICPA) -Toward the Establishment of an Environmental Accounting System (Interim Report)-

Eriko Nashioka

1. Activities about environmental issues on JICPA

JICPA originally formed in 1949 as an association, and reorganized under the Certified Public Accountants Law in 1966 and is the sole organization for the CPA profession in Japan. Qualified persons who wish to practice with the title of CPA must register with JICPA and join its membership. JICPA members consist of CPAs, Foreign CPAs qualified by passing special examination, audit firms, and Junior CPAs as associated members, about 18,000 people.

With the objectives of the CPA profession as a whole to maintain a high level of ethical integrity and to improve and enhance high quality professional services, JICPA continues to be involved in various activities including: Enhancement of members' service opportunity, including harmonization of services and cooperation with other qualified professions.

For its part, JICPA set about investigating environmental auditing and accounting by establishing in 1993 an Environmental Auditing Subcommittee under the Management Research Committee (established in 1987), followed by an Environmental Auditing Research Group in 1995. In 1998, the research structure was bolstered by dividing this group to form an Environmental Accounting Working Group and an Environmental Auditing Working Group. GHG Emission Trading Working Group was formed in 2002. Since then, several research reports have been published (see the reference). JICPA has also been involved in a number of collaborative projects, such as a joint research group formed in cooperation with the Ministry of the Environment.

2. Environmental accounting statements initiative

Environmental accounting is still at the developmental stage, the approach adopted to date has been to look to innovation by individual corporations. Such activity should be encouraged all the more in the future, and there is a particularly important role for diverse action by corporations in fields as yet untouched by environmental accounting.

Given that almost 500 corporations have already adopted environmental accounting, we have reached the point where standards should be progressively adopted starting with those areas where standardization is feasible. In particular, if environmental accounting is to provide core data for the evaluation of environmental management, the methods used to calculate the figures should be, to some extent, standardized in order to increase the utility of this information.

Environmental accounting data are presently generally disclosed in the form of a couple of pages of information in environmental reports. For such data to be capable of being used to evaluate environmental management of corporations, however, it is necessary to establish a more comprehensive system of environmental accounting that and goes beyond the environmental accounting data presently required under existing environmental accounting guidelines. Environmental accounting in the future should thus consist not simply of a collection of data expressed as a page of tables, but include an integrated system of accounts comprising a variety of tables of monetary and physical data. The data for disclosure should, as far as possible, be interlinked and each table systematically interconnected. The system of accounts we propose should also include supplementary schedules setting out the bases of calculations and giving a detailed breakdown of the principal figures contained.

Building a society where the level of environmental management of corporations can be accurately evaluated by the markets requires that environmental accounting takes large responsibility of providing core data necessary for such evaluations.

Environmental accounting needs to function as a tool to enable corporations to fulfill their duty of accountability regarding their environmental protection activities. Environmental accounting data should therefore incorporate sufficient information to enable the assessment of the level of environmental management of corporations. Environmental accounting should cover not only those aspects environmental management that a corporation has adopted, but include the basic data

required to evaluate environmental management. By analyzing environmental accounting data, it is necessary to determine the level of environmental management of a corporation.

By processing the various kinds of environmental accounting data described above, the user would be able to calculate a corporation's environmental efficiency index along with numerous other indices and use this information for evaluation purposes.

3. Forward the evaluation of corporate sustainable management

An accurate assessment of level of environmental management requires certain basic information. Environmental problems faced today are diverse and their relationships to corporate activities are complex. A proper social consensus concerning how much emphasis should be given to what kinds of problems when evaluating corporations has thus yet to be reached. It is consequently conceivable for different evaluation agencies to hold different positions concerning the appropriate method of evaluation. It is necessary, however, to define and standardize the method of calculation of the data that form the basis for evaluation. This is because it is impossible for evaluations to be accurate, even where the same method of evaluation is used, unless the underlying data meet common standards. Common standards on the preparation of basic data must therefore be adopted, though diverse methods may be used for its evaluation. Furthermore, information provided by corporations is of little use unless it actually conforms to these standards. Given these considerations, the following two conditions must be met in order to enable the accurate evaluation of environmental management.

Firstly, standards that is considered to be fair and proper concerning the basic data for evaluating environmental management must be established. And secondly, the reliability of the information to be evaluated must be guaranteed.

If access to highly reliable information can thus be ensured, the level of environmental management may be evaluated more easily. This will as a result, for example, put higher rated corporations in a better position to raise funds on the markets. The accurate evaluation in this way of a corporation's contribution to the protection of the environment should thus act as an incentive to pursue environmental management. If the outcomes of the actions by corporations to protect the environment can thus be accurately ascertained, preferential treatment can be offered-both on a program and policy basis-to corporations corresponding to these outcomes. And if access to data enabling the accurate assessment of the level environmental management of corporations can be ensured, it should result in both incentives in the markets and policy-based incentives.

Note: This report include my private opinion based on deliverance of JICPA.

"Environmental Reports Assurance Guidelines (draft)" (interim report), *JICPA Journal* November 2001

"Current Situation and Issues of Environmental Reports Assurance" (interim report), Summary published in *JICPA Journal* December 2002

(For full text, please refer to page 42.)

4. Development of Environmental Management Information in the Material Flow Cost Accounting Practices

Michiyasu Nakajima

In a company, Environmental Management Accounting (EMA) attracts attention with a promotion of environmental management today. Management accounting is the tool which offers useful accounting information when managers do decision making in company, and this information is management accounting information. Therefore, EMA is a tool offering useful accounting information to do appropriate decision making when managers do environmental management, and such information is EMA information.

Then what kind of management will be recognized as environmental management?

For example, it may be defined as the management that seems to improve company profit while reducing environmental impact with environmental management or the management to aim at maximization of company profit with minimum environment impact. It may be said that EMA to provide accounting information to be useful for this environmental management is a tool

offering useful information to lead company to achieve improvement of profit and reduction of environment impact at the same time.

Then what will a concrete EMA tool be?

If one of concrete and useful EMA tool is given, it can be a Material Flow Cost Accounting (MFCA). MFCA is one of useful EMA tools developed in the flow management to understand flow and stock of material in a meaning of physical substance in a company.

A mass balance and eco-balance are made to understand an environmental impact of a company as the whole. However, it is necessary to analyze a process in a company produced emissions from namely material, because the emissions which give environment impact is produced by a process in a company. Instead of conventional measures for a result as an end-of-the-pipe, it is more important that a cause is got rid of.

In this viewpoint, a flow (stock is included) of materials in a company, or between companies is understood, and the management to be going to make use it can be defined as the flow management. But there are variations regarding the definition of the flow management. For example it depends that the range is company unit or the whole society, and the elements are just only materials or including energy. Therefore the thought of flow management has expansibility and possibility.

Emissions (mainly, wastes) of a company (mainly, waste) are focused from the flow management thought, and the concrete EMA tool, by which a waste is reduced, in other words environment impact is decreased and manufacturing cost is reduced, is devised. One of the useful EMA tool is MFCA developed Prof. B. Wagner (IMU, Germany). This is carried as the EMA tool which is useful in some environmental handbooks issued by the German Ministry of the Environment. Moreover, Systems Approach developed by Prof. R. Pojasek is influential, and it is introduced as a waste reduction tool of US-EPA (Environmental Protection Agency).

Two these tools have common points. In both of tools, a flow of materials in a company is understood, a flow of emissions (wastes) is made transparent for the amount of materials, and a cost is evaluated, then these information are made use for resources productivity improvement. Also they are introduced into a company concretely, and lead to good results.

Through presentations about two these tools, we will understand how MFCA or Systems Approach is really applied in German and North American companies, and how they function as an EMA tool in practice.

Furthermore, in a panel discussion, MFCA trial project by IGES will be explained. In trial project, two Japanese companies (Nippon Paint and Shionogi & Co., Ltd.) participate, and Japanese MFCA is developed. About this result, we will be able to see an evaluation of MFCA as environmental management tool from a viewpoint of company.

At this symposium, it is one purpose to understand MFCA in Germany and Japan, Systems Approach in North America. Moreover we do not only understand that they have relevance and possibility as EMA, but also we need to have more purposes to find what is international environmental management supported by EMA and, to discuss the perspectives in order to realize it.

(For full text, please refer to page 48.)

5. Trends of Material Flow Cost Accounting in Germany

Bernd Wagner

Environmental Management in Germany presently shows various lines of development. Starting point and still continuing is the classical environmental protection approach, technology oriented, end of pipe. This still covers probably the most dominant range of activities of the environmental officers, especially in bigger companies, securing the functioning of the end of pipe technologies for waste, waste water and emissions treatment, securing compliance.

In the 90ies the introduction of Environmental Management Systems became a widely spread standard. Even though after a first wave of enthusiasm bureaucratic experiences led to some disappointments. Today the European Environmental Management and Audit Scheme (EMAS) is staggering , the number of participating companies even dropping, while its sister, the ISO 14001 Environmental Management Norm, is taking over

and continuously develops to be the international accepted standard, comparable to the acceptance of the analogues Quality Standards ISO 9000 ff.

With the introduction of Environmental Management Systems various environmental reporting procedures developed, including methodological questions of environmental performance measurement (EPA), mostly focusing on measuring with the help of environmental performance indicators (EPI). Meanwhile various guidelines (e.g. by the German Ministry for Environment or the ISO Norm 14031) are in use. Until today these indicators generally are input-output-indicators derived from a (sometimes though fragmentary) Input-Output Eco Balance. These instruments of environmental performance measurement today mainly are used for external reporting. First approaches to external environmental company ratings are to be found, concentrating on the evaluation of environmental reports and the included information on management procedures and on performance measurement.

Not clearly elaborated is here the distinction between eco-efficiency and eco-effectiveness, that is how to distinguish between the efficient improvement of production (e.g. emission per product unit) and the overall and absolute reduction of environmental damage (e.g. total amount of emission). It will be one of the main tasks of the future to introduce and methodologically improve this distinction between the eco-efficient and the eco effective company for the valuation, rating and taxation of companies, globally.

A second future task, representing equally ongoing achievements, is to include environmental aspects into everyday management decision making.

Environmental controlling so far has been the separate task of the environmental officer. It is necessary that every manager in every decision takes into account the environmental consequences to be expected from his decisions, decisions concerning e. g. investments, production procedures, purchasing processes, building construction, logistics.

This integrated environmental decision making needs more detailed information support than environmental controlling of the past, based mainly on corporate input-output-data, was able to provide. It needs controlling data from every relevant point along the flow of material, from every point where material is transformed, used more or less efficiently, turned into either productive material or residuals, waste, waste water, emissions, heat, noise etc.

This is why environmental controlling, as a basis of decision making, now is working on new methods and tools of material flow analysis.

For engineers this is not new. They have optimized physical material flows in the past: but with the dominating view to improve the functioning of the product. They have neglected cost controlling, they have neglected environmental controlling. Both of the latter tasks where fulfilled by different people, with different educational back grounds, different languages and different targets. Material Flow Analysis, Material Flow Management today has to integrate these different views, has to improve transparency of material flows in terms of technical functioning, costs and environmental aspects simultaneously. This is the present and future challenge.

Categorically academic or corporate projects working in this direction distinguish between a macro level and a micro level focus. Material flow oriented projects with a macro level view consider aspects of supply chain, forward and reverse logistics, life cycle analysis, questions of material cycles and reuse projects. Projects with a micro focus consider corporate production processes, material efficiency in the production process, material and energy losses, material or energy substitution. The ongoing endeavours to these projects again fall apart into two further categories: environmental projects, focussing on flow analysis in physical terms and managerial projects, focussing on monetary terms. The environmentally oriented projects are sponsored by environmental departments, agencies or ministries. Results are taken into account by environmental officers, only marginally by corporate line managers. Managerial projects are supported by line departments, business associations and ministries for trade, commerce, economy.

This separation has to be overcome. Physical and monetary terms are two sides of one coin. Line managers have to be supplied with both types of information, physical transparency, which means material efficiency and environmental consequences, as well as monetary transparency, meaning value, cost and revenue consequences.

Some environmental projects in the last five years started to bridge this gap by taking up cost information. Unfortunately many of these endeavours trapped itself in the co-called "Environmental Cost Accounting" debate, not only in Germany. Counterproductive to environmental interests these endeavours tried to show the costs of pollution prevention measures. The data were used by industry to show to the public how much money was spent for environmental protection. Internally the consequence of these - now transparent - high figures was to cut down on these, sometimes tremendous costs where possible, which means to cut down on environmental protection.

Another branch of projects works on the modelling of material flows.

These projects mostly try to use software tools or work explicitly on the development of corresponding software tools (tools like AUDIT or Umberto). These tools too started form the environmental point of view, modelling physical material and energy flows and providing environmental controlling indicators visualized in charts. These tools are add-on software to the ERP-systems (SAP etc.) the line manager used. Only recently they began to introduce into the add-on tools cost information to increase relevance and acceptance by line managers. But these cost information where derived by hand from various sources and equally fed into the add-on tools by hand. The main use of these tools still was for purposes of the environmental officers, and here mainly for internal or external reporting.

Projects and corporate endeavors with the highest future potentials therefore today try to use the standard management information systems, the enterprise Resource Planning (ERP-)Systems, to provide from these the material flow information every line managers needs within his operational responsibility, in physical and in monetary terms. Material Flow Cost Accounting (MFCA) today in Germany is developed as an instrument

- that gets its information from within the existing or newly introduced ERP-systems.
- For this purpose existing or introduced ERP-systems have to be restructured to provide the necessary information in physical and monetary terms.
- Main purpose is to achieve physical and monetary transparency of material flows at all spots of movement, storing or transformation,
- in order to increase material efficiency and by this cut down costs and reduce resource consumption and pollution simultaneously.

To enable the line manager to improve his every day decision making processes in this direction is the core of the present MFCA projects and the challenge of the future.

In the coming years these necessary data will be derived by data mining out of the companies data warehouse. The material flow data then can be packed for a wide range of decision making and reporting purposes, for production control, quality management, environmental reporting etc.

(For full text, please refer to page 52.)

6. Using Process Maps and Other Tools to Improve the Use of Flow Cost Accounting - The North American Experience

Robert B. Pojasek

The Flow Cost Accounting model has successfully combined a number of accounting methodologies to provide a useful tool for improving work processes in a variety of different industries. This methodology has been tested extensively in Europe and Japan. In the United States, Mexico and Canada, the Systems Approach has been used for similar applications. It uses a hierarchical process mapping technique to describe the work in a consistent fashion and links the resource, material and cost flows to these maps using object linking and a popular visual software tool.

On 11 September 2001, the developers of these techniques met at Harvard University to begin the comparison of the techniques. This paper reports on how the two methods are quite complementary and can work together to yield superior process improvement services to the companies that use these methods.

Process mapping is highly structured and can be applied consistently over any industrial or service sector. Supporting processes are linked to the main process using accounting sheets. These sheets are object linked to the process map at the lowest available level in the hierarchy. A resource accounting sheet

tracks all the resources used in each process step by taking a 360-degree look at the work performed in that step. Each resource used and lost in the operation can be assigned a cost on a spreadsheet linked to this sheet. An activity accounting sheet examines all the functional activities that are needed to manage each work step and the losses associated with that work step. A spreadsheet is linked to this sheet. Allocations of the resource and activity costs associated with the supporting processes can be assigned to each work step in proportion to their use. The two spreadsheets can be combined to prepare a cost accounting sheet. This process characterization element of the Systems Approach can be deployed using the Flow Cost Accounting model structure. In a similar manner, each technique can be successfully interfaced with available management information systems (e.g., the SAP enterprise resources planning software) to provide the information needed to analyze the process. By combining the methods, a superior process improvement opportunity assessment tool can be produced.

The Systems Approach goes beyond the analysis of the process to detail a systematic framework for facilitating the process improvement opportunities discovered through the use of the Flow Cost Accounting model or the hierarchical process mapping and accounting methods. Furthermore, the Systems Approach offers a means for converting the improvement program into a performance-focused effort that will help the company using it to outperform financially the companies that are not using this approach.

(For full text, please refer to page 62.)

7. Panel Discussion Overview

Under the theme of "How will Material Flow Cost Accounting Contribute to Better Eco-Efficiency?", a panel discussion was held at the end of the symposium. The panel session consisted of 2 parts:

○PART-1 Case Studies of Material Flow Cost Accounting (MFCA)

Business and the Environment Project, conducted by IGES Kansai Research Center, has actively been engaged in researching the methodology of environmental management accounting. As part of the research activities, the MFCA project was carried out with cooperation from Nippon Paint and Shinogi. Project teams were formed for each case study with selected members from IGES and respective companies that worked together.

In the symposium, Mr. Okajima of Nippon Paint and Mr. Kokuryou of Shionogi reported their efforts at introducing MFCA into their factories. The two following abstracts were distributed as handouts to the participants on the day of the symposium.

○PART-2 Panel Discussion

Based on presentations in the second session and two case studies on MFCA, the panel discussion was conducted with Prof. Kokubu as chairperson.

First, Prof. Wagner and Dr. Pojasek expressed their views on the two case studies respectively. Then, discussions were initiated by questions from floor. The questions were related to technique, examples and application of MFCA and Process Mapping, and panelists responded to each question with a concrete explanation quoting their experiences.

(For full text, please refer to page 70.)

8. IGES KANSAI Research Project: Material Flow Cost Accounting Case Study I : Nippon Paint

Jun Okajima

Nippon Paint was founded in March 1881. In the subsequent 121 years, we have developed, manufactured and sold paints and coatings for abroad range of industrial sectors, including automobiles buildings, industrial products and ships. We are the leading company in the Japanese paint industry. Our environmental management ideology is to become "a worldwide cachet as an environment-conscious company that contributes to protecting the environment and reducing the consumption of resources and energy".

1. Overview Project:

In December 2001 researchers explained Material Flow Cost Accounting (MFCA) to the key division staffs. The factory study tour of the trial was carried out in Osaka. The project team (the environmental quality headquarters, the accounting department, the manufacturing section, the center of engineering, and the safety emergency section) was organized to oversee this project.

A concrete trial was first made to prepare to introduce a water based paint manufacturing line in the Osaka factory from summer 2002.

Material Flow Cost was applied to the total range, with a data collection period of two months.

It has a manufacturing line "Mixture", and moves to the "Dispersion" process which makes the degree of quality of a grain equal when stirred with main raw material. Next, additives are poured and completed in the product through the "Dissolution" process. The filtration to remove the impurities of that completed product and so on is done, and 18 litre containers are filled and shipped.

It is composed of about ten kinds of raw materials, (mainly water, pigments, additives, vanishes, and water based paints) that become products by finally being filled into the 18 litre container as environmentally friendly goods.

Washing is made after each process is completed because other products are manufactured using this line, as well. Washed materials are recycled each time the next same product is manufactured. The quality is equal from the mixing process to filling up the pipe, ensuring that the liquid will not leak out halfway. The main raw material is a powdered body, and the powdered dust which appeared in the mixed process is recycled, with partly becoming waste. The paint which sticks in this pipe isn't left in the pipe. It is removed by the pushing out utensil (Pig), and it comes to be pushed out of the final process.

Therefore, material loss which becomes final waste in this manufacturing process is little. For example, it is collected, and that powdered dust is recycled, and only a small part is waste though powdered dust appears a little in the mixed process because main raw material is a powdered body.

The purpose of this project is to find out what made the process where the waste of the raw material was hardly lost from the trial. Future development was taken into account by verifying how to be aware of this process (like the amount of material from the viewpoint of cost), it decided to work with the understanding of the MFCA technique.

Furthermore, focus was put on electric power as a new subject in MFCA research, and the amount of electric power consumption of each equipment was measured by the sample. The number of the electric power measurement machine made 1 equipment one time a principle from being limited. The whole of the equipment was covered by measuring it with more than one manufacturing lot, and electric power consumption with 1 manufacture lot of each equipment was measured.

And, it was decided to consider how applications could use the measured amount of electric power consumption as MFCA based on data.

2. Result of this project

(1) Material Flow Cost Accounting Information

The loss of raw material is about 5,000 yen in about 0.14% from the viewpoint of the amount of money as well to understand if the flow cost matrix is seen.

This is about 150,000 yen even if it is made 30 manufacturing lots a year by around 1 manufacturing lot. The improvement point which needed urgent

Flow cost matrix (unit : yen)

	Material cost	System cost	Energy cost	Disposal cost	Total
Product	3,467,205	389,556	13,554	—	3,870,315
Material losses	4,917	1	0	—	4,918
{Recycle}	{154}	—	—	—	{154}
{Disposed}	{4,763}	{1}	{0}	—	{4,764}
Packaging	—	—	—	1,268	1,268
Total	3,472,122	389,557	13,554	1,268	3,876,501

Material loss cost ratio 0.127%（Total material losses/Total products）
0.142%（Material losses/Total material cost)
0.137%（Disposed material losses/Total material cost）

attention could verify that the improvement which reduced material loss when it can be judged that it was attained like the amount of material from the viewpoint of cost as well as in MFCA.

(2) Sample, the measurement of the amount of consumption of electric power in the manufacturing process

The thought is that electric power is measured for every equipment, and a trial is being made at present. However, the subject which hadn't been solved was how that electric power data was measured and being available as environment control account information in MFCA. That measurement value is compared with that, and it is the problem of whether it is suitable to calculate the energy loss though the consumption of electric power and if it can be measured by using the measurement machine. In this project, the power factor was considered as one of the solutions. As for the power factor, it is shown how concerned electric equipment throws electric power effectively toward the function of the electric equipment.

$$Power\ Factor = \frac{\text{The electric power which actually made electric equipment function}}{Voltage \times \text{Electoric current}} \times 100$$

This power factor was calculated by the measurement machine for every equipment. Even though the power factor of 85% was established as standard, the result was lower than was found in the plural as a result.

We decided to make use of it for future loss improvement by totaling the amount of electric power of the electric power loss and a cost on every equipment, with the amount of quantity center as logically calculated:

An injection electric power x (1— the power factor) = Electric power loss.

（Full text (page 72) was co-authored by the Nippon Paint MFCA project members.）

9. IGES KANSAI Research Project: Material Flow Cost Accounting Case Study II : Shionogi

Yoshitsugu Kokuryo

1. Outline of Project

Preparations / Examination to introduce Material Flow Cost Accounting (MFCA) began in July, 2002. Kanegasaki Factory held the first trial. The members of IGES went to this factory at the end of July, 2002 to explain the introductory experiment and to do concrete investigations of the production process. The project was operated by the staff of the Environmental Management Unit from the head office and the Kanegasaki Factory.

The trial product was a drug substance. The trail range intended for a serial production process of drug substance manufacturing, formulating and packaging. The investigation was from importing of materials into a factory to exporting of a product from a factory. Furthermore, sewage processing facilities were included, too. The data of a material flow were based on data of plural batches with a material flow per batch.

A production process consists of next processes. The first is a drug substance manufacturing process for synthesis of drug substance, and the second is a formulating process to mold a so-called tablet or a

granule, and the third is a packaging process wrapping the molded product. A drug substance manufacturing process includes synthesis, extraction, separation and drying. Also there is pelletizing and molding in a formulating process, as well as packaging it in a box, the filling up and packaging in a packaging process. They are set as a quantity center.

A drug substance manufacturing company must prepare to the "manufacturing control standard code" in the "Good Manufacturing Practice (GMP)" from the Ministry of Health, Labour and Welfare in Japan. Mass balance information in a production process is added up and recorded as needed. A master formula of production process is given by Shionogi & Co., Ltd. in more detail. The mass balance of each production process is understood by a material name and the amount of materials of input and output in the master formula. In addition, the mass balance has revised with a change of a production process. In the introduction of MFCA, it was essential to match an output with an original input material.

Data collection was expanded while being based on existing data. Moreover, it was assumed that the present mass balance was reexamined with MFCA. There was only the amount of materials data in the master formula, but, in MFCA, a new Kaizen point was going to be found by understanding the origin of output and its cost evaluation.

Furthermore, it was aimed at dealing with an open question of MFCA technique. In MFCA, it is basic to trace the flow and stock of materials in a company with input materials that are bought from other companies. This point is a characteristic of MFCA. However, it is a problem whether it is appropriate that a production process always recognizes a quality product and material loss as the first input material in a case with a chemical synthesis.

For example, the carbon dioxide is recognized as each input material which included carbon (C) and oxygen (O_2) constituting it in MFCA theoretically when carbon dioxide (CO_2) is exhausted out of a production process. In the case of a chemical synthesis, however, quality product and material loss are different from input material quite materially. It was examined how material costs of a quality product and a material loss should be calculated, and it found one of the solutions.

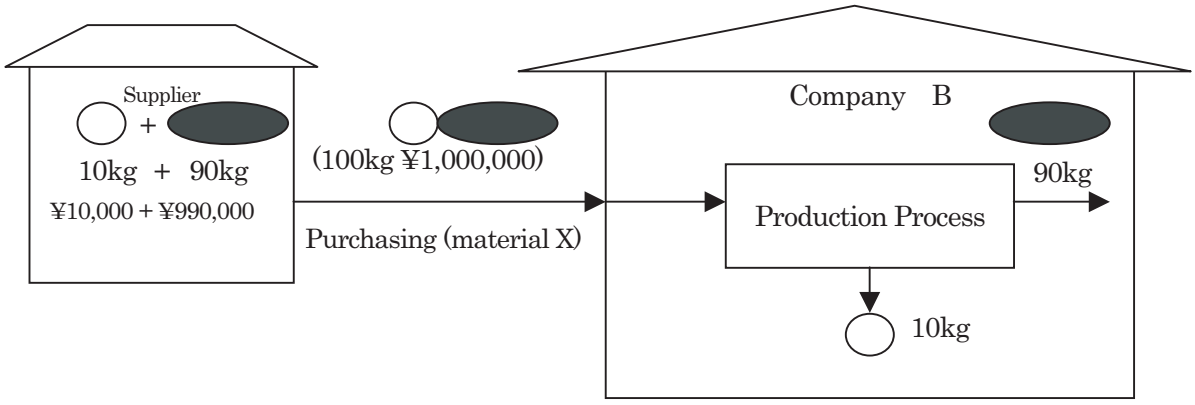
Moreover, it was considered to propose CO_2 emission information as new information of MFCA. CO_2 emission is calculated for each quantity center. An emission amount of CO_2 was measured and evaluated. This information in MFCA is relevant environmental management information to reduce an emission of CO_2 in each quantity center and for the whole company.

2. Project Result

(1) A calculation method of material costs in a chemical synthesis

In Company B in the above example, material X (100kg purchased for 1,000,000 yen) occurs as a quality product 90kg with a material loss 10kg. In this case 1,000,000 yen was distributed basically by the weight ratio, and it was estimated as quality product 900,000 yen / material loss 100,000 yen.

However, the material purchase price is generally decided in consideration of the composition when a chemical industry purchases materials from supplier of raw materials. In the given case, the material "○" serves only as the protector of the material "●", and its actual price is as low as 1,000yen per 1kg.



It is unsuitable to do this with the weight ratio in such a case, and it is appropriate to evaluate material loss "◯" with 10,000 yen per 10kg.

Therefore, all output was recognized as input material in this project, but the costs were evaluated at a purchase price (an estimate) for the composition, instead of principle of the weight ratio, on the basis of thought mentioned above.

In this case, production information of the supplier becomes necessary, as well. In particular, the development of MFCA to supply chain extends the possibility of MFCA.

(2) Material Flow Cost Accounting Information

The standard yield rate and actual yield rate of finished products for each process, (drug substance manufacturing, formulating and packaging), are understood and managed with physical measures. In MFCA, however, the yield rate and the losses could be evaluated obviously with financial measure, and the losses can be reduced into elements and places.

We can find new Kaizen points on the ground of MFCA information.

(Full text (page 81) was co-authored by the Shionogi MFCA project members.)

(unit : thousand\)

		Material Cost	System Cost	Energy Cost	Waste Disposal Cost	Sum
Product		8,867	1,967	200	—	11,034
Material Loss		3,150	373	—	29	3,552
Bd	Recycle	1,416	—	—	—	1,416
Bd	Material Loss (disposal)	1,711	—	—	—	1,711
Bd	Packaging Loss (Disposal)	23	—	—	—	23
Total		12,017	2,340	200	29	14,586

Bd=Breakdown

Material Loss Cost Rate 24.3% (Material Loss Cost per Total Costs)
26.2% (Material Loss Cost per Total Material Cost)
14.4% (Material Cost of disposed Material Loss per Total Material Cost)