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The New Management Accounting Field Established by Material Flow Cost Accounting (MFCA)

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Advanced enterprises which promote Sustainable Management positively emphasize to attain simultaneously both of the enhancement of corporate profits and the reduction of environmental impact. The management tool which attains them simultaneously is Environmental Management Accounting. One of the concrete tools is Material Flow Cost Accounting (MFCA). MFCA has brought a great result as Environmental Management Accounting to enterprises whose objective has been the pursuit of profit. Firstly, this paper states what sort of usefulness by manufacturing form MFCA has. Secondly, it explains how MFCA functions as Environmental Management Accounting and what sort of possibilities MFCA has as Management Accounting which contributes to corporate profits.

Keywords: Environmental Management Accounting, Material Flow Cost Accounting, Production Management, and Sustainable Management

1. Introduction

Material Flow Cost Accounting (MFCA) has been introduced by some enterprises in Japan as a tool of Environmental Management Accounting, and has led improvement activities and production innovation to attain simultaneously both of the reduction of environmental impact and the enhancement of economy, and has produced concrete results (cost reduction). On the other hand, questions have been asked about what is different from the conventional Production Management information or management accounting information, or if they are the same. In addition, some critics say that the reduction of environmental impact in MFCA means the enhancement of resource

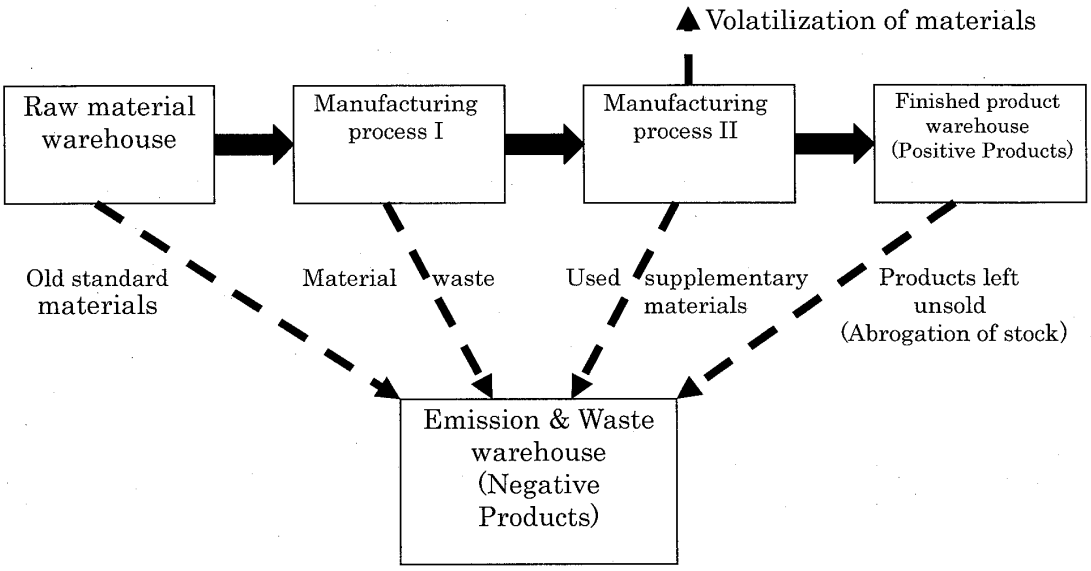
productivity such as minimization of input materials and that environmental impact is therefore only partly dealt with in MFCA. Furthermore, it is also a fact that only the management accounting aspect which Environmental Management Accounting also has, that is to say, usefulness concerning the enhancement of economy such as the effect of reduction of manufacturing costs is paid attention to. MFCA, however, has steadily attracted attention as a corporate Sustainable Management tool. Theoretical explanation is necessary to promote future spread.

Firstly, this paper states what sort of usefulness MFCA has in each manufacturing form. Secondly, it states how different MFCA is from the traditional Production Management and management accounting information, based on the corporate case studies and introduction experiences that have so far been seen. Then, it explains the new usefulness in which MFCA functions as a management accounting technique as a result. Furthermore, it refers to possibility that Environmental Management Accounting, and in particular, MFCA, will make "New Management Accounting" which surpasses traditional management accounting, and will further develop.

By the way, MFCA has not yet generally fully spread, but when an enterprise attempts to obtain knowledge on environmental accounting and environmental management, it will come across Material Flow Cost Accounting which is a tool of Environmental Management Accounting. For example, the Nikkei Ecology 'Special Edition 2: New "Measure" of Sustainable Management' (Nikkei BP (2005) pp. 81-93) has introduced MFCA together with corporate cases as a new "measure" of Sustainable Management which is utilized within corporations, and also as a tool of environmental management accounting for the purpose of attaining simultaneously the reduction of environmental impact and the enhancement of economy.

In MFCA, if the subject of introduction is a production process, firstly a material flow figure of such manufacturing process as, for example, Figure 1 will be prepared in detail and accurately, and then costs will be evaluated in accordance with the material flow

information. In practice, the material flow and the amounts of costs towards "negative products", that will not become products in such manufacturing process will be calculated by totaling them by location and product together with the material flow and the amounts of costs of "positive products", which are good products. Then, the calculation result of MFCA will be processed and provided as cost management information in a useful form that will be appropriate for the objective of management.



The "old standard materials", "used supplementary materials", "volatilization of materials", and "products left unsold" are "negative products" in each process (which is called the quantity center in MFCA) are negative products.

Figure 1 Material Flow, and Positive and Negative Products

If simply expressed, the cost evaluation method of MFCA is a method to evaluate the costs[1] of two kinds of products, that is to say, positive products and negative products, while, in the conventional method of cost accounting, costs were calculated, as if one kind of products were manufactured. For example, if the manufacturing

[1] The data of the quantity of materials which are the basis of cost evaluation are collected by mass balance, and the cost evaluation of MFCA is therefore different from the conventional cost accounting, for example, general class cost accounting.

process of MFCA is analyzed and cost evaluation is carried out on the basis of the material composition of both kinds of products, that is to say, positive products and negative products, the actual state seen from MFCA of such manufacturing process is clarified as in Figure 2. Negative products which cannot be sold in the market are evaluated to be manufactured at a manufacturing cost of 17% (200 million yen) in such manufacturing process. In this connection, there are "material waste" and "used supplementary materials", etc. which flow into "emission & waste warehouse" as breakdowns of material costs in negative products in Figure 2, and costs are evaluated and totaled on the basis of the data of the quantity of materials[2].

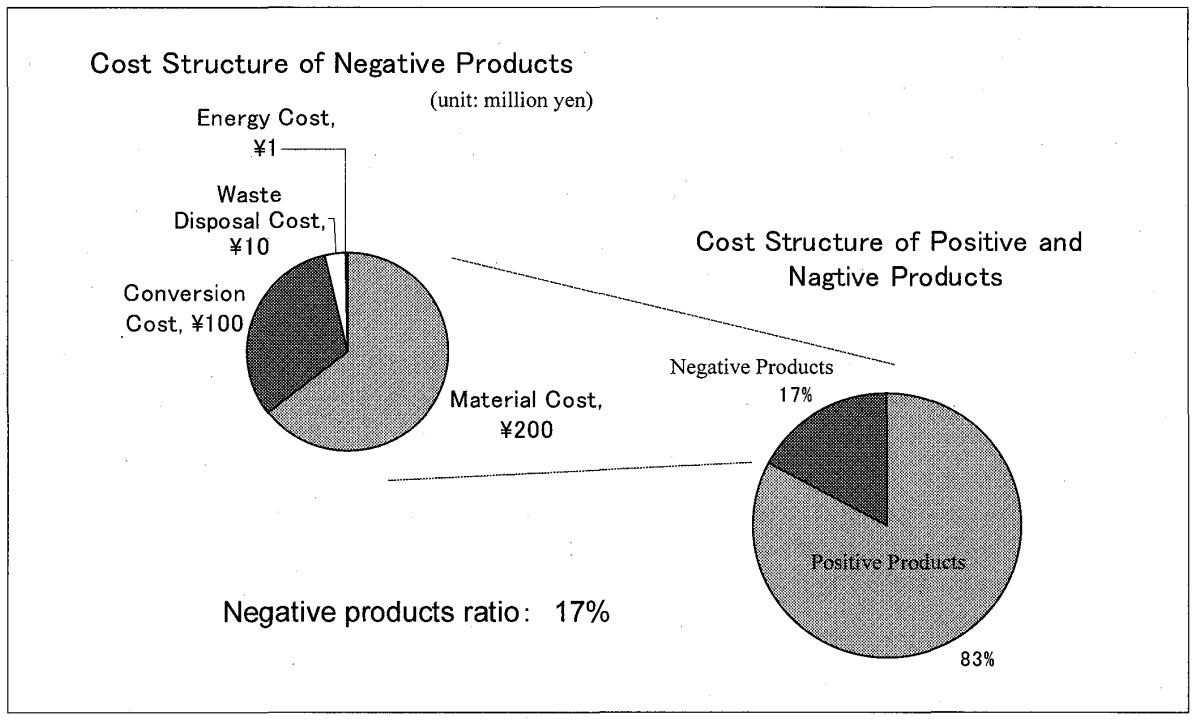


Figure 2 Cost structure of positive and negative products clarified by MFCA

[2] Please refer more detailed explanation of technique and calculation method of MFCA to reference bibliography (Nakajima and Kokubu (2002), etc.)

2. Evolution of Japanese Material Flow Cost Accounting

Since the concept of MFCA was introduced in Japan in 2000 and MFCA was used by an enterprise (Nitto Denko), more than 50 companies have carried out examination or trial introduction of MFCA in the last two/three years. Furthermore, the general purpose of the use of MFCA is for special cost studies at present, but some enterprises utilize it as a daily management tool or an management accounting information system.

As a result[3] of the case studies that have so far been made, many Japanese enterprises have started to recognize that MFCA is a useful Environmental Management Accounting tool to attain simultaneously the reduction of environmental impact and the enhancement of corporate profit. In practice, enterprises are attempting to attain reduction of environmental impact, which is an enterprise issue, and costs by reducing wastes and losses in the manufacturing process.

However, examination of cases of enterprises which were interested in and have introduced MFCA shows that enterprise opinions are divided concerning the detailed practicability of MFCA. For short, cost evaluation of MFCA is to measure and record the movement of materials within the scope (for example, a manufacturing process, factory, enterprise, supply chain, etc.) of the introduction of MFCA on the basis of mass balance of the measurement points (the Quantity Center in MFCA) and evaluate costs in accordance with its flow.

Accordingly, for example, in the case of the scope of a manufacturing process, data of the quantity concerning consumption (movement)

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[3] For example, the latest results of MFCA Project sponsored by the Ministry of Economy, Trade and Industry are summarized in the Japan Environmental Management Association for Industry (2004). In this connection, reports which have been published annually since fiscal 2000 show the development of MFCA as a project of the Ministry of Economy, Trade and Industry. In addition, the results of an MFCA project by IGES (Institute for Global Environmental Strategies) Kansai Research Centre were written as the IGES Kansai Research Centre (2003). Enterprises which have introduced MFCA include Nitto Denko, Canon, Tanabe Seiyaku, Takiron, Nippon Paint, Shionogi & Co., Shimizu Printing & Packaging, Toshiba, Matsushita Electric Industrial Co., and so forth.

of materials within the manufacturing processes is understood in the cost accounting system of enterprises in general, and it is therefore considered to be easily possible to examine the introduction of MFCA. However, it cannot be said that material quantity information (information satisfying mass balance) necessary for MFCA is not sufficiently available in data in the general cost accounting system or Production Management information, and it is therefore necessary to measure data anew of the quantity of materials necessary for MFCA. In such a case, it is difficult to force workers on the site to collect data at the phase where benefit of data collection (cost) is not clear, and in reality the introduction of MFCA appears to be often postponed for another opportunity.

Although the usefulness of MFCA is recognized (expected), a full-scale introduction of MFCA is not carried out for such a reason. On the other hand, enterprises which have so far introduced MFCA have seen major results, and there are also enterprises which have started to make efforts to make full-scale introduction of MFCA as well as enterprises which have obtained MFCA information relatively easily.

The ease of collection of information necessary for MFCA depends on the abundance and accuracy of information on the site. According to the experiences so far available, where the on-the-sites shop management is carried out on the basis of the data of the quantity of materials, superficial management information does not appear to have the rigid information necessary for MFCA, but in fact almost all (more than 90%) necessary information is included. However, on this point, it is necessary to obtain understanding and cooperation on the side of the information provider and at the same time enthusiasm towards MFCA with willingness to collect information is required. This "information and data" varies depending on whether the subjects are enterprises, factories and on-the-sites, and it is therefore impossible to explain uniformly.

The following is the summary of classification by business line concerning the results of MFCA so far experienced. These results will contribute to increasing the number of enterprises which will judge

that the benefits exceeding costs that will be accompanied by introduction will be obtainable.

3. Classification of Material Flow Cost Accounting in Japan

Classification as in Figure 3 is possible from the results of enterprise cases in MFCA so far experienced.

Business line or manufacturing form	Features of business line by MFCA	Expected result of MFCA
Processing industry	Product price is higher than material price. Yield management by standard rate Waste disposal cost is relatively large.	Review of usual yield (mass balance analysis) If yield increases, waste (disposal costs) will also be reduced.
Manufacturing process of parts or materials	Purchased material quality and customer demand quality vary widely. Yield management is on the basis of the quantity of finished products. Waste disposal quantity is relatively large.	Expansion of analysis towards upstream and downstream (supply chain analysis) Review of usual yield management (mass balance analysis) Reduction of waste will lead to increase in products.
Assembly process	Pursuit of production of accepted orders (adaptation to market) is an issue. Yield management (operation loss) is on the basis of the quantity of finished products. Waste disposal quantity is relatively large. (materials, stock and elimination of products)	Expansion of analysis towards upstream and downstream (supply chain analysis + LCA) Review of usual yield management (mass balance analysis + system loss analysis) Material flow analysis including procurement and sales
Small- and medium-sized enterprises	In many cases, one product per one manufacturing process is enterprise size. Yield management is based on experiences. Burden of waste disposal is relatively large.	Estimation of financial effect Quantitative yield management (mass balance analysis) Visualization of material flow stock

Figure 3 Features of MFCA by manufacturing form (NAKAJIMA (2005), p.162)

Enterprises in process industry such as pharmaceutical manufacturing companies manufacture targeted products by carrying out careful manufacturing and extraction from raw materials. The first feature of such enterprises is that product prices are clearly higher than material prices. Under such conditions, only a small increase in the revenue ratio of products will lead to a major increase in profit in many cases. However, on the other hand, even if the yield rate is relatively low, profitability of product manufacturing are still high. In addition, in cases of pharmaceutical products, management of product quality in processes is strictly regulated by the Ministry of Health, Labour and Welfare in Japan, and a small mistake in packaging can be a cause of a faulty product at present. In past experiences, quality improvement in processes and appropriate recycle of faulty products (For example, where only a package is faulty, a pharmaceutical product which is the content of the product has been re-input in a manufacturing process in an appropriate manner.) has been carried out, and enhancement of material yield has been made. However, because raw material prices are relatively low compared to product prices, in some cases material yield management is not adequate as a case of MFCA.

Furthermore, yield management of products is managed by the difference between standard rate and actual rate. In this case, standard rate is an average in the past in many cases, and in the comparison of the actual results in the past (average) with the current actual results, whether or not they are appropriate and whether or not the current rate has achieved the target (or average) are usually the subjects of management. The target is not the eventual revenue ratio (100%) as in MFCA.

Additionally, waste disposal costs are relatively large. Waste liquid, exhaust or the like will occur in a process in the process type industry which is accompanied by chemical reaction and refining, and in many cases a large amount of expense is required for investment in disposal facilities and disposal expenses to dispose of them outside factories. In this case, the purpose of waste disposal management is enhancement of disposal ability including detoxification and reduction of disposal expenses. However, management is not carried out from

the viewpoint of MFCA that if emission (waste) itself is reduced, waste disposal itself is unnecessary. In general, the reason is that no information like MFCA is available and that management emphasizes how treatment like an end-of-pipe should be carried out efficiently with emission as a given item in information separated from a manufacturing process where emission is produced.

In the next manufacturing process of part materials, the quality of purchased materials and quality of customer demand fluctuate, and products of the same name vary in quality, and it is difficult to reflect accurately the actual state by a standard index which is fixed for a certain period. Nevertheless, because management had been carried out by setting up standards based on information for a past period, MFCA analysis clarifies the actual state which had not been seen before in many cases. In addition, the yield management by the quantity of finished products is used in general, and, for instance, where a certain form is taken out from a processed board of own company, yield management is made on the basis of the quantity of finished products that can be taken from a processed board. However, in MFCA the scrap remains (edge materials) are also the subjects for analysis (negative products).

Furthermore, the waste quantity of such scrap materials is relatively large and it is difficult to make many enterprises dispose of them at a price in many cases. However, because such scrap materials are expected to become products from the MFCA viewpoint, it is very important to actualize that loss.

In the case of reducing such material loss, analysis which incorporates the supply chain including upstream and downstream in its scope is necessary and effective.

In MFCA, in an assembly process which follows, not a negative flow of materials in a business line in the past but material loss concerning stock is actualized. MFCA has been said to be suitable for an industry where raw materials are processed into something, for example, process industry and part or material manufacturing industry,

and that application of MFCA does not lead to actualization of loss because so-called material loss does not occur in an assembly industry where parts are purchased and assembled without using raw materials such as the assembly industry. However, the pursuit of product flow in the assembly industry clarifies that the flow of failed products or the like is actualized and further that stocks are clarified between processes, thus losses of parts, failed products and intermediate products are clarified.

In addition, MFCA analysis has clarified that production plans in the assembly industry with an objective of establishing an ideal production of accepted orders have been carried out in recent years, but that production has not been carried out smoothly. The cause has sometimes been expressed as deterioration of yield due to operational loss in the past yield management information on the basis of the quantity of finished products, but MFCA analysis shows that it is an occurrence of a loss due to a production plan, and operational analysis of MFCA shows that extremely inefficient operation is carried out in some cases. In this way, it has been ascertained that because the existing yield management is carried out on the basis of part of the element, which is a finished product, the state of an actual assembly operation visualized in MFCA is not seen, and MFCA has been discovered to be useful also for assembly industry.

Furthermore, because the quantity of wastes of purchased parts due to model change in products and products (intermediate products) is relatively large, new material loss (economic value which has not been realized in the market) is visualized by carrying out MFCA analysis of both aspects of stock and flow. Analysis including sales (customer use) is necessary to reduce such material loss, and use of supply chain analysis to upstream and downstream and LCA analysis, and further, in-house expansion to MFCA analysis including design, procurement, manufacturing and sales are now examined.

Lastly, regarding MFCA in small- and medium-sized enterprises, one product and one manufacturing process is sometimes the whole of an enterprise, because they are relatively small in terms of the size.

In addition, yield management is carried out on the basis of experiences, and Production Management is not necessarily carried out scientifically. In addition, the effect of burden of wastes is great in many cases, although the size of wastes itself is smaller than those of major enterprises.

If MFCA is introduced under such conditions, it is possible to have a relatively easy demonstration of the financial effectiveness of MFCA. Where material loss is visualized by MFCA analysis, it is easy to have actual feeling of the substance of the material loss, and because the handled data quantity is small and the distance between data and the actual state is closer, one is willing to carry out improvements which will bring about an effect of a relatively small amount. However, surplus human resources are not necessarily available. In that respect, a management support system is required.

In addition, regarding places to put waste and waste disposal expenses, the larger the enterprises (factories) the less the surplus capital and space. In MFCA analysis, reported material loss includes waste disposal cost, and cost benefit analysis will be easy, and its improvement can be carried out in a highly positive manner.

In this way, the usefulness of MFCA by classifying by business line is stated in consideration of experiences in the introduction of MFCA in the past. Issues and problems which respective businesses and individual enterprises face are different, as are the actual states and problem points which are discovered by MFCA. However, what is common throughout all types of businesses is that they have not succeeded in reflecting the actual state accurately by the conventional yield management and standard cost management. It can therefore be said that the flow of negative and positive products in MFCA and respective cost information are superior to management information in the past both in applicability and usefulness in management decision making.

Furthermore, MFCA information is information concerning the actual state of an enterprise (including people who work for an

enterprise), and MFCA functions as a management tool which enables cross over communication which extends the whole enterprise to Sustainable Management.

4. Usefulness as in Management Accounting in Material Flow Cost Accounting

As explained above, there is a general tendency of understanding that information obtainable from MFCA is information concerning raw material yield by process at the time of product manufacturing, and is information where the existing Production Management information and the cost evaluation technique based on the conventional product cost accounting technique are merged. In addition, negative product information visualized by MFCA at the time of set-up of design values at the time of commencement of development and manufacturing of products has already been analyzed as material yield information and the analysis of effect against expense in cost evaluation has naturally been carried out, and so MFCA is judged in many cases as not being new product management information.

However, it is my view that if MFCA is introduced and analysis is carried out in a manufacturing process of an enterprise, negative products which had not been previously recognized as Production Management information will be brought forward as an issue (greatness of the cost) more important than the enterprise expected. Furthermore, there are companies where improvement to reduce the exhaust of materials comprising the negative products was carried out, by which reduction of volume of input materials per product unit, for instance, became possible and the manufacturing cost by that time was reduced by several percentage points, thus the companies attained the enhancement of the yield rate of products corresponding to its reduction.

For instance, *CANON Sustainability Report 2005* (p.46) shows the following results under MFCA.

"Material flow cost accounting is being introduced throughout the Canon

Group. Canon Chemicals began implementing the system at all its workplaces from 2004 in tandem with workplace-oriented environmental assurance activities. This approach has provided an accurate profile of the materials and funds lost and the processes in which losses occur. Using the information gained, employees working in small groups reduced the levels of generated waste by remarkable margins.

In 2004, the resource efficiency improvement activities developed under the accounting system led to an 1,800-ton reduction in the amount of waste discharge (40% decline), and a savings of about 120 million yen in the amount of materials used (materials purchased) due to a large decrease in waste disposal costs and reductions in the loss. The resulting improvement in capacity utilization rate has also led to higher production, lower capital spending, and other derivative benefits."

As above, the report says that the quantity of input resources per product unit was reduced, and the cost reduction because of that raised the product yield rate. It is considered that an increase in profit figures was attained as a result, and the enhancement of productivity was also achieved. Practical and detailed contents are not stated, but this does not mean that Canon[4] and Cannon Chemicals had carried out careless Production Management before that, but that probably they were making efforts to carry out improvement activities which can be described as "wringing a dry floorcloth". However, such improvement activities were found which contributed to obtaining the above results under MFCA.

5. Limitation of traditional Production Management Information and Management Accounting Information compared to MFCA

One may wonder why it was possible to find such major improvement points by introducing MFCA, although one has had a good command of traditional Production Management technique. It is considered that there is a limitation in the existing management accounting and Production Management technique, and that MFCA is

[4] MFCA was introduced in the lens manufacturing process at Canon, and a major result was obtained. In connection with this introduction case of MFCA, please refer to publications, the Ministry of Economy, Trade and Industry (2002), Kokubu (2004), etc.

a technique which surpasses the limitation. The limitation points include (1) non-alliance between Production Management information and product cost accounting, (2) limitation due to divided and isolated information of the quantity of materials and (3) limitation in depending on cost information.

(1) Non-alliance between Production Management information and product cost accounting

Where MFCA is introduced, for instance, the data of the quantity of materials is theoretically required with respect to all materials of input and output based on mass balance. In traditional product cost accounting (for example, process cost accounting), material costs are obtained by the amount of consumption of raw materials multiplied by their unit price. Input, which is the quantity of their consumption, is known. However, for instance, in MFCA, indirect raw material costs such as supplementary raw materials, which are not differentiated from direct raw materials as materials, are managed by the whole manufacturing processes as indirect costs of manufacturing. Data collection for MFCA is required separately. However, in actual introduction cases, mass balance information required for MFCA is scattered at production sites, etc. However, it is true that data exists at one site or another, but the data is not systematized as one theory, for instance, as one system based on mass balance like MFCA. In other words, this means that the existence of the data is one thing and that management carried out systematically on the basis of that data is another. This is ascribed to the fact that product cost accounting does not require data of the quantity of materials as accurately as mass balance information.

(2) Limitation of divided and isolated management information

Additionally, for instance, material quantity information and monetary value information in a manufacturing process exist as Production Management information and cost management information. Management decision making is carried out on such information. However, much of such structured information is divided per manager's responsibility unit (scope) by job ability or function in its management in many cases. If divided like this,

material quantity management and cost management are always carried out within their divided and isolated scope, and it is impossible to see such scope from a wider viewpoint as the whole enterprise or the whole manufacturing processes as can be seen in MFCA. In addition, managers are not required to have a view outside the scope of their own responsibility. When a manufacturing process is designed or a product plan is set up, manufacturing information is analyzed and set up at each process with an overall view to manufacture products. However, dealing with manufacturing products which changes in line with daily (every moment) changes is carried out in the respective divided and isolated scopes, and no overall adjustment is made. Furthermore, it appears that the present state is that where the performance of a designed job is the responsibility of workers and managers, and even if unconformity in the whole manufacturing processes occurs, it is not seen and they make efforts on the site looking for some sort of conformity.

By the way, it is said that if the whole optimization can be understood as a theory, adapting to daily change is difficult in reality. However, in view of the progress of information system technology today, a system design where it can be harmonized between the whole and parts simultaneously will be possible. The aim for the optimization of the whole is systemization, and management by computers does not mean systemization.

(3) Limitation in depending on cost information – making little account of resource productivity

Monetary value information represented by cost information is important and it is a yardstick of decision making in Production Management and other management decision making as well. Monetary value information within an enterprise such as a manufacturing process is calculated by the cost evaluation technique of cost accounting and management accounting. These costs are evaluated as an amount of money on the basis of data of the quantity of materials such as consumption of materials and workload. It is therefore understood as that which represents change and effect in the dimension of the quantity of materials as in

MFCA. However, in reality individual data is standardized, and it is the understanding of the present state or expression of an actual state on the assumption of a design value. The deviation between the standard and the reality will become larger with the passage of time. In addition, because cost information is mixed data of the quantity of materials and monetary value, change in the aspect of monetary value such as unit prices is misunderstood conveniently as a change in the actual state. Furthermore, for instance, because standard cost based on the standard unit as shown above is the basis of product cost, and the enhancement itself of standard cost is the standard of the cost objective and will become the subject of management which will be linked to the attainment of profit objective, and the material which is the subject of MFCA will become the subject of secondary management, and not the enhancement of resource productivity but cost reduction will become the objective.

While such traditional Production Management information and management accounting technique concentrate on management information with an emphasis on cost (monetary value), MFCA is useful for cost reduction as management accounting as a cost management tool based on data of the quantity of materials which is hidden in management information. The management accounting technique represented by traditional Production Management and standard cost accounting originally had management information in the dimension of the quantity of materials as MFCA, but in reality its function has been lost. In addition, it is considered that a merger of this dimension of the quantity of materials and that of the monetary value can be attained only by the concept of a merger of mass balance and cost evaluation of MFCA. This merger is the source of usefulness of MFCA as a new management accounting tool.

6. Possibility of new management accounting field established by Material Flow Cost Accounting

As mentioned earlier, the usefulness as that of management accounting in MFCA is considered to respond to an issue that is a merger of management of the quantity of materials and monetary value management which are principles of management accounting. Accordingly, MFCA can be evaluated as a management accounting tool rather than an Environmental Management Accounting tool.

Nevertheless, where Environmental Management Accounting is compared to the existing management accounting, Environmental Management Accounting, especially MFCA, is a tool exceeding the scope of the existing management accounting, and it is considered to be a management tool which will develop a domain of new management accounting. The domain of the existing management accounting has so far focused on the usefulness in future-oriented calculation against past-oriented calculation, corporate internal use against external report and so forth. However, in reality, as one of the future-oriented calculation methods, standard cost accounting which is the calculation of estimates by standard set-up reflects the past standard or the theoretical reality as mentioned before, and cannot be to represent the present or the future. In addition, these days management subjects between other enterprises such as supply chains are currently under discussion as coming within the scope of management accounting, but in general it is a decision making support tool to attain an objective of profit maximization within the scope of individual enterprises.

Compared to this, how accurately the material flow at "the immediate moment" will be shown is the first work in MFCA, and the purpose of MFCA is to give useful information on current activities by evaluating the present state in terms of costs. Naturally, everything as at the present moment is changing minute by minute towards the future, so change in material flow in line with that change is observed, and MFCA information corresponding to the change will be provided. Dealing with such Just-In-Time (JIT) information is considered to be

attainable through systematization.

Additionally, from the viewpoint of Environmental Management Accounting, MFCA pursues material flow and enhances resource productivity with the objective of resolving wastefulness. Accordingly, in principle, it does not have an assumption of setting up a limited scope which is the maximization of profits of individual enterprises (monetary value). For example, the subject of MFCA stretches from resource excavation to scrapping products and even to recycling, like a lifecycle. However, MFCA for individual enterprises evolves, because in reality and in many cases MFCA is introduced by setting up a subject which attains the enhancement of resource productivity together with an enterprise. Accordingly, introduction of MFCA by individual enterprises has naturally started to extend the scope of its analysis to individual enterprises as a result of introduction of MFCA to individual enterprises. If resource productivity is enhanced, costs will generally decline, which will reduce wastefulness of materials of individual enterprises. Corporate activities have therefore increased to find causes of wastefulness by extending MFCA to upstream and downstream of enterprises. However, when a place where wastefulness of resources occurs and a place where the cause of that wastefulness exists spread over two or more enterprises, for instance, the person paying the cost for eradicating the cause and the person benefiting from the resolution of that wastefulness may belong to different companies. That adjustment must therefore be made. In consideration that such adjustment is necessary, it may seem unrealistic but there are cases of making efforts in a positive manner with an objective of enhancing resource productivity from the viewpoint of environmental conservation.

Environmental Management Accounting has so far been located at a point of contact between the existing management accounting and environmental management as in Figure 4, and MFCA has been evaluated as its useful tool. However, as explained in this paper, Environmental Management Accounting, especially MFCA, easily surpasses the scope of traditional management accounting and can simultaneously create profit opportunities between other enterprises

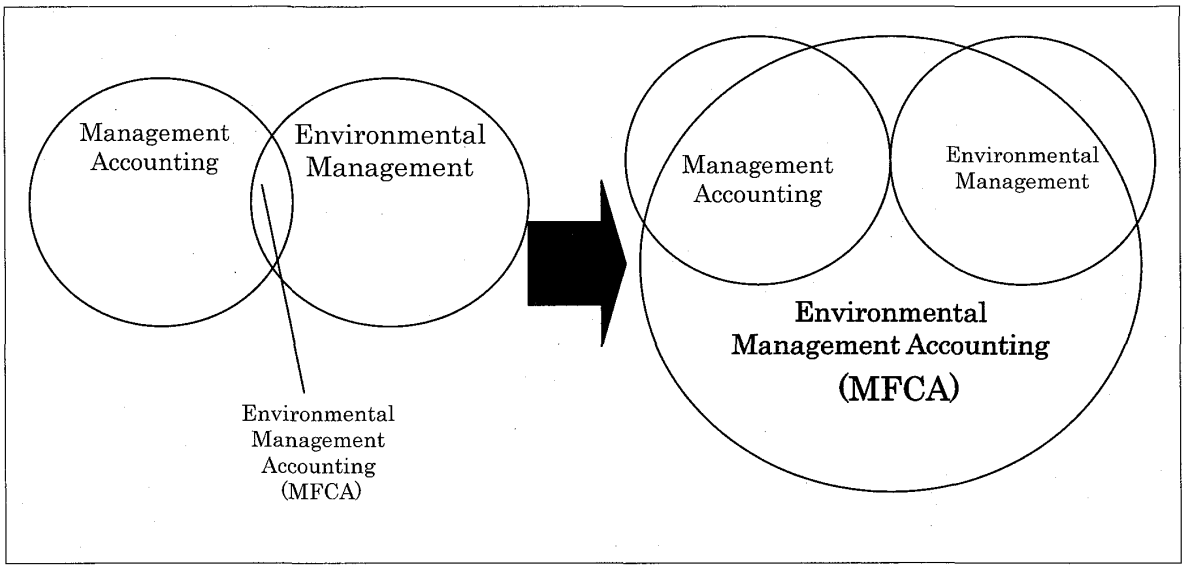

Figure 4 Change in positioning Environmental Management Accounting

or supply chains. In addition, because MFCA can be introduced in the scope of material flow, it is considered that management accounting information, where consumers who are the subjects at the time of use and societies (including international society in theory) which bears social costs, can be provided. In that sense, an opportunity to develop conventional management accounting means development of Environmental Management Accounting. As a result, more refined management accounting with a wider scope will be formed using the tool of MFCA. However, needless to say, this new management accounting is management accounting with a function to resolve an issue called environmental conservation in Environmental Management Accounting.

7. Conclusion

This paper firstly explained the features and the basic concept of MFCA, and also explained the usefulness of Environmental Management Accounting, especially MFCA, as a management accounting technique by arranging it on the basis of classification of manufacturing forms. In addition, it also explained the enhancement of resource productivity as a key point by providing concrete cases where the

reduction of environmental impact and cost reduction are attained simultaneously and that profit contribution in the enhancement of product profitability is great for enterprises. The many actual successful results will be created and reported near the future also by the Projects to promote Material Flow Cost Accounting carried out by JMA Consultants, Inc. and the Organization for Small & Medium Enterprises and Regional Innovation, Japan, sponsored by the Ministry of Economy, Trade and Industry.

It is already mentioned that limitation points of the existing Production Management and management accounting information where MFCA and general Production Management and management accounting are compared to each other and examined. As a first point, because different data of the quantity of materials is required for Production Management information and product cost accounting respectively, each functions independently, and although each of them has the majority of data which is the subject of MFCA, they do not function together in an integrated manner. As a second point, because the subject of MFCA is mass balance in the dimension of the quantity of materials, the information appears to be duplicated with the existing Production Management information, but that in reality, data of the quantity of materials is managed, being divided per management responsibility unit, and that systematic analysis of the whole like MFCA is not routinely carried out. Lastly, because enterprises aim for profit maximization, they rely on or are affected by cost information showing in monetary values in many cases, and because originally standard costs are evaluated on the basis of material flow similarly as in MFCA, the standard cost shows material flow. However, these costs cannot show the quantity of materials and its change precisely, and because standard set-up and review are not carried out on a daily basis, originating from the present moment, the limitation which is deviated from the real material flow is explained.

MFCA which does not have such a limitation has been considered to be one of the small domains of management accounting where environmental management and management accounting have so far been integrated, but that as a result of the theoretical and practical

development of MFCA, MFCA has expanded to cover most of the management accounting field. Nevertheless, because there has not been a set-up domain in management accounting from the beginning, MFCA would exist as a tool which evolves the existing management accounting to a new phase, and that new management accounting based on MFCA will evolve.

Furthermore, environmental problems have not yet been resolved, as there are important issues outstanding. Enterprises positively support attaining the objective of reducing environmental impact in environmental management of MFCA from the viewpoint of enhancing resource productivity. Near the future MFCA will need to be improved towards even more reduction of environmental impact.

It will be the first step of Sustainable Management and Corporate Sustainability to try MFCA which is useful in corporate practice in a positive manner and to have a real feeling of its usefulness.

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Bibliography

1) Bennett, M., J.J. Bouma and T. Wolters, eds. 2003. *Environmental Management Accounting: Informational and Institutional Developments*, Klumer Academic Publishers.
2) Bundestmweltministerium Umweltbundesamt (Hrsg). 2003. *Leitfaden Betrieblishes Umweltkostenmanagement*, Berlin.
3) Canon Inc. 2005. *CANON Sustainability Report 2005.* (English version).
4) IGES (Institute for Global Environmental Strategies) Kansai Research Centre. 2003. *Cutting Edge of Environmental Accounting for Corporate Management and Environmental Conservation, — Environmental Accounting in Japanese Corporate Management and Potentialities of Material Flow Cost Accounting —.* (Proceedings of International Symposium on Environmental Accounting 2003).
5) Japan Environmental Management Association for Industry. 2004. *Report*

on Research and Study of Environmental Business Development Promotion, etc. entrusted by the Ministry of Economy, Trade and Industry in 2003.

6) JMA Consultants, Inc. 2005. *Research Report on 'Project 2004 of Sustainable Management System with Energy Use Rationalization (MFCA Introduction Joint Model Project for Major Enterprises)'.*

7) Kokubu, K. and M. Nakajima. 2003. "Position of Material Flow Cost Accounting in Environmental Management Accounting – towards systematization of environmental management accounting – ," *Kaikei*, Vol. 164, No. 2, 267-280.

8) Kokubu, K., ed. 2004. *Introduction to Environmental Management Accounting*, Japan Environmental Management Association for Industry.

9) Kokubu, K. and M. Nakajima. 2004. "Development of Environmental Management Accounting, Focused on Material Flow Cost Accounting," *Disclosure Forum*, Financial Accounting Standards Foundation, No 3, 74-85.

10) Ministry of Economy, Trade and Industry. 2002. *Workbook of Environmental Management Accounting.* (This can be downloaded from http://www.meti.go.jp/policy/eco.business/index.html).

11) Nakajima, M. and K. Kokubu. 2002. *Material Flow Cost Accounting*, Nihon Keizai Shimbunsha.

12) Nakajima, M. 2004. "On the Differences between Material Flow Cost Accounting and Traditional Cost Accounting – In Reply to the Questions and Misunderstandings of Material Flow Cost Accounting – ," *Kansai University Review of Business and Commerce*, Faculty of Commerce, Kansai University, No.6, 1-20.

13) Nakajima, M. 2005. "Environmental Management Accounting and Material Flow Cost Accounting," Yamagai, T., A. Mukouyama and K. Kokubu, eds., *New Evolution of Environmental Accounting*, Hakuto Shobo, 156-168.

14) Nikkei BP. 2005. "Special Edition 2 New 'Measure' of Environmental Accounting," *Nikkei Ecology*, September 2005, 81-93.

15) Organization for Small & Medium Enterprises and Regional Innovation, Japan. 2005. *Report on Joint Study Model Project of Material Flow Cost Accounting.*

16) Seiler-Hausmann, J-D., C. Liedtke and E. U. von Weizsaecker, eds. 2004. *Eco-efficiency and Beyond: towards the Sustainable Enterprise*, Greenleaf Publishing.

17) Strobel, M. and Redmann, C. 2001. *Flow Cost Accounting*, Institut für Management und Unwelt, Augsburg Germany.