

Evolution of Material Flow Cost Accounting (MFCA): Characteristics on Development of MFCA Companies and Significance of Relevance of MFCA

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Introduction

At the general meeting of ISO/TC207 in 2008, Working Group 8 was officially established and the work started to publish the ISO standard (ISO14051) concerning Material Flow Cost Accounting (MFCA) in 2011. The author has participated in this work as a Japanese expert. This proposed standard has been suggested from Japan, and the background for such suggestion is that there are case studies and experiences in Material Flow Cost Accounting among Japanese enterprises. From these experiences and knowledges, this paper will discuss the characteristics on successful cases of Material Flow Cost Accounting and its relevance as sustainable management.

The History of Material Flow Cost Accounting has begun from 2000 in Japan. The purpose of the project that started in 2000, sponsored by the Ministry of Economy, Trade and Industry (METI) Japan, was to understand what was Material Flow Cost Accounting. In the following project in 2001, introduction processes of Material Flow Cost Accounting and collection/style/processing method of data were sorted out by applying the basic concept of Material Flow Cost Accounting to a manufacturing process of each enterprise and carrying out an analysis, with the cooperation of four enterprises (Nitto Denko, Tanabe Seiyaku (presently Mitsubishi Tanabe Pharma), Cannon and Takiron).

There are different kinds and characteristics of raw materials input in each manufacturing process. In addition, manufacturing processes varied, as some were accompanied by chemical reactions, recycling systems, etc. As a result, the subjects and problems necessary to be sorted out and developed theoretically to enable practical application were clarified. Nevertheless, each enterprise case study was once completed as a project sponsored by METI. Development of Material Flow

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Cost Accounting within companies thereafter may be researched, but decisions relating to the introduction and implementation of Material Flow Cost Accounting by the enterprises were left to each enterprise.

This paper will explain the summary and characteristics concerning the three enterprises which have implemented and developed Material Flow Cost Accounting by themselves independently even after the experience of this trial introduction in METI Project. The three enterprises have voluntarily published concerning the development of Material Flow Cost Accounting within the respective enterprises to the fullest extent possible. The purpose of this paper is to consider not an experimental application of Material Flow Cost Accounting within enterprises but its relevance as an environmental management accounting tool or a sustainable management tool, on the basis of such published development information within enterprises.

2. Development of Material Flow Cost Accounting at Nitto Denko¹⁾

Nitto Denko is an enterprise which introduced Material Flow Cost Accounting as a trial for the first time in Japan. Through the trial introduction for the first time in Japan in 2000, the relevance of Material Flow Cost Accounting was discovered, and in fiscal 2001 when other three companies newly introduced Material Flow Cost Accounting as a trial, Nitto Denko examined whether or not it was possible in practice to make management decisions regarding its intention towards improving its material loss figures, using information provided by Material Flow Cost Accounting.

In manufacturing processes which are the subject of analysis, occurrence of a material loss of more than 30% was clarified by an analysis of Material Flow Cost Accounting in the initial year. Firstly, verification of whether the analytical results show abnormal values or a normal state was carried out by expanding the scope of data to several months, and it was confirmed that a loss of approximately 30% was an ongoing occurrence. Furthermore, analysis of causes of a loss was also carried out at the same time. As a result, the causes of the occurrence of losses shown on the right of the following Figure 1 were clarified. However, although this Figure shows the quantity of occurrence by cause of occurrence in bar graphs, the causes of occurrence are not clarified concretely to the outsiders.

Improvement measures for the causes of the occurrence in a large quantity in Figure 1 have been examined, and the concrete countermeasures are listed on the left of the above Figure respectively. Some of the improvement countermeasures

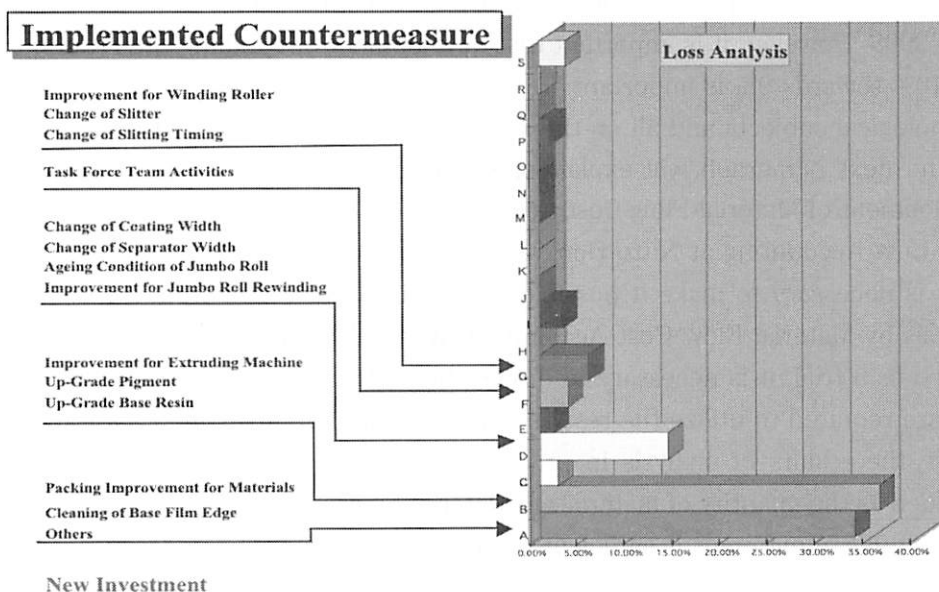


Figure 1. Causes of Loss Occurrence and Improvement Countermeasures at Nitto Denko (Furukawa (2006) p.75)

are relatively easy and some are accompanied by capital investment. Nitto Denko has taken improvement countermeasures to reduce a loss of over 30% by stages that was clarified in fiscal 2000.

As a result, the loss rate to input was reduced from over 30% to little more than 20% in fiscal 2004 and is expected to be reduced to 10% in fiscal 2008. According to a newspaper report (on page 5 of the Sankei Newspaper dated February 20, 2005), Nitto Denko made capital investment amounting to 700 million Japanese yen to realize such loss reduction.

Decision of the intention was made naturally after analyzing cost of this investment of 700 million Japanese yen. The result of the analysis of Material Flow Cost Accounting does not explain all of the cost and effectiveness. However, occurrence of the present loss and effectiveness of the investment (reduction of loss = profit improvement) are clear as economic data, as the results of the analysis of Material Flow Cost Accounting, thus having been utilized relevantly in making the investment decision.

Nitto Denko plans to utilize Material Flow Cost Accounting even more in the future as an environmental management accounting tool. Future results are therefore being awaited with interest. For example, development to other products and

workplaces is also expected. A loss rate of 10% is estimated for these products for fiscal 2008. However, it is important that development of handling the reduction of this 10% towards 0% is important. To realize this, improvement activities through technological subjects and all on-the-spot processes are considered necessary.

The next paragraph will explain the main points for the purpose of relevant development of Material Flow Cost Accounting, out of the development of Material Flow Cost Accounting at Nitto Denko.

It is necessary to make it possible to examine investment from the results of analysis by Material Flow Cost Accounting. Where Material Flow Cost Accounting is used as a trial, it is necessary to discern beforehand how much data and precision are required to utilize the results as basic data of an investment case in order to use the results of analysis in practice. In addition, losses are measured and recorded as the quantity of materials in Material Flow Cost Accounting. Totalization of quantities of materials is sufficient in the sense of visualizing negative products²⁾ and giving the impact to the whole management. However, it is necessary to measure and totalize losses by classifying them by cause of occurrence in order to reduce losses. Furthermore, for example, mass produced products whose costs are large are the most suitable, if impact on management is made by visualizing negative products at the time of selecting products to which introduction is made. However, the results of analysis of Material Flow Cost Accounting clearly show that capital investment is required to significantly reduce losses. It can therefore be said that it is desirable that promising products whose sales are growing in the future should be selected as the subject for Material Flow Cost Accounting at the time of making capital investment.

3. Development of Material Flow Cost Accounting at Tanabe Seiyaku (presently Mitsubishi Tanabe Pharma)³⁾

The headquarters office and the factory both clearly understood the major role of recovery processes (recycling processes) in manufacturing processes, massive waste disposal costs and the causes which make them necessary from the results of analysis of Material Flow Cost Accounting in the form of occurrence of negative products. As a result, examination of improvement measures for waste disposal immediately started and capital investment was made in May, 2003.

In more detail, it was possible to change the waste disposal method used at that time to a safer and more environment-conscious method, if chloroform included in the waste could be recovered. For that purpose, capital investment was

necessary. An investment scenario that costs can be recovered in approximately one year was prepared on the basis of an analysis of the cost effectiveness of cost reduction that could be made by the capital investment and the improvement of losses according to the results of the analysis of Material Flow Cost Accounting, and 66 million Japanese yen investment in chloroform absorption recovery facilities was made. As a result, for example, until then waste liquids were disposed of by incineration, but this capital investment enabled change to the existing activated sludge method. The incineration disposal costs were reduced. Economic effects amounting to 54 million Japanese yen per annum including re-use by recovery of chloroform are estimated.

Tanabe Seiyaku implemented development of Material Flow Cost Accounting throughout the whole company, because such successful results were achieved. Partly because the timing of the introduction of SAP/R3, which is one of ERP (Enterprise Resources Planning) systems, coincided the introduction of Material Flow Cost Accounting as a trial in fiscal 2001, the possibility of an alliance of SAP/R3 and Material Flow Cost Accounting was examined, and the Material Flow Cost Accounting system was constructed in February, 2004. This enabled Tanabe Seiyaku to make Material Flow Cost Accounting analysis of data by product with respect to all products and by quantity on a monthly basis from fiscal 2000.

Loss quantities and loss amounts as shown on the screen of the system in the following Figure 2 shall be shown by Material Flow Cost Accounting by name of product. In addition, this data is totaled each month by quantity center, product item, used product item, manufacturing version and manufacture directions number.

This enabled easy data totalization, and input of data has been systematized, which enabled totalization and analysis of data by Material Flow Cost Accounting at all company levels. Because of this, Material Flow Cost Accounting was located as one of the management systems of Tanabe Seiyaku, and reduction of negative product percentages has been recognized by all parts of the Company which are involved in production as a managerial issue. In addition, an “MFCA Actual Results Reporting Meeting” for analysis and loss improvement by Material Flow Cost Accounting takes place once a year with the participation of top management. Material Flow Cost Accounting has been systematized, and a Material Flow Cost Accounting System has been constructed by a PDCA (Plan-Do-Check-Action) cycle for setting up targets and evaluating actual results.

In the sense of the coverage of all production bases, Material Flow Cost Accounting has been introduced and developed at the Onoda factory⁴⁾ and Tanabe

Name of product

Names by production volume & used volume

Quantity of loss

Value of loss

Tantalization report screen

Name of product	Names by production volume & used volume	Quantity of loss	Value of loss
0000000000	出庫高	2,785	2,785
0000000000	使用高	754,940	754,950
0000000000	使用高	2,889	2,785
0000000000	使用高	2,083	2,785
0000000000	使用高	2,397	2,785
0000000000	使用高	2,089	2,785
0000000000	使用高	579	555
0000000000	使用高	1,353	2,785
0000000000	使用高	1,354	1,354
0000000000	使用高	2,089	2,089
0000000000	使用高	2,089	2,089
0000000000	使用高	2,089	2,089
0000000000	使用高	2,089	2,089
0000000000	出庫高	2,364	2,364
0000000000	使用高	1,181,120	1,180,000
0000000000	使用高	2,375	2,364
0000000000	使用高	2,364	2,364
0000000000	使用高	2,484	2,364
0000000000	使用高	250	250
0000000000	使用高	250	250
0000000000	使用高	2,483	2,364
0000000000	使用高	2,425	2,364
0000000000	使用高	53	53
0000000000	使用高	70	53
0000000000	使用高	64,080	44,339
0000000000	使用高	5,300	4,916
0000000000	使用高	1,380	4,916
0000000000	使用高	2,364	2,364
0000000000	出庫高	2,019,350	2,007,000
0000000000	使用高	2,019,350	2,007,000
0000000000	使用高	2,330	2,330
0000000000	使用高	2,329	2,329
0000000000	使用高	2,340	2,330
0000000000	使用高	2,354	2,330
0000000000	使用高	2,355	2,330
0000000000	使用高	117	116,350

Figure 2. Screen of Material Flow Cost Accounting System of Tanabe Seiyaku (from P.63, Kawano (2006))

Seiyaku Yoshiki Factory⁵⁾, which is a related company. Tanabe Seiyaku Yoshiki Factory is a related company in charge of packing medical products manufactured by Tanabe Seiyaku, and the introduction of Material Flow Cost Accounting into Tanabe Seiyaku Yoshiki Factory can be located as a case of introduction of Material Flow Cost Accounting into a supply chain.

Tanabe Seiyaku Yoshiki Factory has introduced Material Flow Cost Accounting, and the results show that negative product costs (material losses and system costs) were 73 million Japanese yen for fiscal 2005, and an analysis was carried out by cause of the negative products. In particular, negative product costs of 22 million Japanese yen have been incurred at granule subdividing package lines. This corresponded to approximately 30% of the total losses. By examining the causes, it was discovered that it was caused by materials used, which came from the upstream pharmaceutical bulk manufacturing. As a result, an approximately 6 million Japanese yen cut is said to have been made in 2006 on 2005 through the improvement such as change in raw materials by carrying out a joint examination

of Tanabe Seiyaku and the Onoda factory (presently Yamaguchi Tanabe Seiyaku Factory).

This is an example showing that introduction of Material Flow Cost Accounting into a supply chain is extremely effective, although it is a case of a related company. Tanabe Seiyaku Yoshiki Factory, the paid-in capital (as of the end of March 2008), sales (actual results for fiscal 2007), and the number of employees (as of the end of March 2008) of which are 400 million Japanese yen, 3.7 billion Japanese yen and 65, respectively, is classified as a small- and medium-sized enterprise. This case is important as an introduction of Material Flow Cost Accounting into a small- and medium-sized company. For example, it has been reported that the effect of the reduction of the loss in the supply chain, which is represented by this 6 million Japanese yen, has enhanced recurring profits for fiscal 2006 by 12%. The amount of the cost cut is small in this case, but it can be said that there is a great potential of the contribution of Material Flow Cost Accounting to profits of small- and medium-sized companies. In addition, it can also be said that this is a superior case where a downstream enterprise and an upstream enterprise carry out a joint improvement of resource productivity from the viewpoint of the environment. Material Flow Cost Accounting will lead to the strengthening of manufacturing processes, and functions as education of employees. It is therefore adequately relevant to small- and medium-sized companies.

Tanabe Seiyaku carried out handling of Material Flow Cost Accounting and reduction of emissions of CO₂ simultaneously. In the review of waste disposal at the Onoda factory which was explained as above, the effect of energy saving (reduction of heavy oil and electricity) was generated as a result of the complete abolition of disposal by incineration, and emissions of CO₂ will be reduced. According to Tanabe Seiyaku, an annual reduction was computed as 2,328 tons of CO₂, which corresponds to approximately 41% of the target reduction of 10% (5,647 tons of CO₂ per annum) on 1990. It is important to see not only cost effectiveness of energy saving but also reduced emissions of CO₂ by Material Flow Cost Accounting in this way. For example, there must be cases where there is an important effect from the viewpoint of reduction of CO₂ emissions, despite a small amount on the cost front. Material Flow Cost Accounting will become able to be utilized as an important tool for reduction activities of CO₂ emissions in manufacturing processes.

As above, the case of Tanabe Seiyaku is considered to be a superior case where Material Flow Cost Accounting was introduced into all parts of the Company including related companies and the supply chain, and was further incorporated in

the daily management system. Some matters can be raised as such successful points. Firstly, the scope of data collection was set up to correspond with the same as the management period or year. As a result, preparation of an improvement scenario and decision-making have been carried out smoothly. In addition, the handling was carried out not only for the factory, but also at all company levels under the joint ownership of data with the Company's headquarters office. An IT system was utilized to carry this out. There is no convenient software yet. It is essential to construct an IT system for Material Flow Cost Accounting to introduce Material Flow Cost Accounting at all company levels.

Furthermore, Tanabe Seiyaku holds the MFCA Actual Results Evaluation Meeting with the top stratum of management in alliance with results evaluation by individuals and the sections of the Company. Understanding of Material Flow Cost Accounting has been enhanced at all company levels due to the discovery of losses, implementation of improvement activities, and joint ownership of the evaluation results at all company levels. At the same time, discovery of losses between a number of parts within the Company and joint loss improvement, and extension of Material Flow Cost Accounting activities to the supply chain were carried out smoothly. Further, the results of Material Flow Cost Accounting were clearly evaluated as economic effects. It is an important point that manufacturing bases and small- and medium-sized companies are applying Material Flow Cost Accounting with confidence on the basis that Material Flow Cost Accounting activities have been widely recognized as activities directly linked to corporate profit improvement, and that they are then recognized as an implementation of green production management which enables both economy and the environment to stand together.

4. Development of Material Flow Cost Accounting at Canon⁶⁾

Canon applied Material Flow Cost Accounting to lens processes as a trial introduction in fiscal 2001, and glass sludge which had not been seen by the prior yield management (management by the number of completed processed products) has been visualized as a material loss. The loss, which corresponded to approximately 30%, was large, and the impact on the Canon factory management was great. Because it was recognized as the discovery of a new loss, Material Flow Cost Accounting analysis started to be introduced where necessary at all company levels.

Because Material Flow Cost Accounting is not generally fully understood, the

Material Flow Promotion Section was set up in 2004, as a section which promotes the introduction and analysis of Material Flow Cost Accounting within the Headquarter of Canon, and introduction, analysis and support, which had been carried out in Japan, started in 2004 also at the globally scattered production sites. Introduction of Material Flow Cost Accounting had been made at 15 bases in Japan and 9 bases in overseas as of December 2007. This section in the Headquarter has been renamed as the MFCA Evaluation Section in fiscal 2008.

Such global application and the results of the analysis of Material Flow Cost Accounting are, for example, reported in the *Canon Sustainability Report 2008* (pp.47-78). According to the Report, the economic effect of the introduction of Material Flow Cost Accounting is computed as 100 million Japanese yen for fiscal 2004, 620 million Japanese yen for fiscal 2005, 1.0 billion Japanese yen for fiscal 2006, and 1.3 billion Japanese yen for fiscal 2007, respectively. The figures are not large, for the size of the Canon group. It can be considered that the statement of Mr. Masaaki Hirooka, who is the following representative director/president of Canon Chemical Inc.⁷⁾, explains the impact and relevance of Material Flow Cost Accounting at Canon.

What is the most interesting to Hirooka(2008) himself as a president of factory is the effect of introduction of Material Flow Cost Accounting. Hirooka(2008) has mentioned that the reduced amount of raw materials (reduction of purchased costs) due to the improvement of a Material Flow Cost Accounting project for three years from 2004 to 2006 amounted to 7.40 million Japanese yen with the reduction of waste being 780 tons, and that the overall economic effect including waste disposal costs was greater than his expected. It is estimated that improvement activities discovered by Material Flow Cost Accounting were felt not as a temporary effect, but as a major relevance which could lead to continuous improvement activities on the spot where improvement activities had been carried out as if they were wringing a dry duster.

The point stressed by Canon as to the relevance of Material Flow Cost Accounting is workplace-based environmental assurance activities by Material Flow Cost Accounting. Environmental assurance activities at manufacturing locations are usually for saving paper, rubbish and electricity, and are difficult to assess for manufacturing itself. The reason is that the manufacturing location is responsible for working on and processing products designed as products in accordance with the process design. Accordingly, working procedures are standardized, and working

in accordance with the decided order is required. Waste is not considered to be revealed in the manufacturing processes themselves, so long as workers work in accordance with the planned order. Environmental assurance activities at the locations stress reducing paper, rubbish, electricity (illumination, etc.) which are created as waste (consumed) in accompaniment to manufacturing in many cases.

Nevertheless, Canon locates the implementation of visualizing negative products in each manufacturing process by introducing Material Flow Cost Accounting, clarifying the quantity of materials of negative products and costs, and reducing their occurrence as workplace-based environmental assurance activities which simultaneously achieve both reduction of environmental loads and cost reductions. Canon Chemical Inc. and Nagahama Canon Inc. have a person in charge of Material Flow Cost Accounting at the bases, and carry out and develop Material Flow Cost Accounting at manufacturing workplaces. Workplace-based environmental assurance activities are carried out by a PDCA cycle shown in Figure 3.

As shown in Figure 3, the purpose is to realize the maximization of resource productivity which enhances the ratio of positive products by locating Material

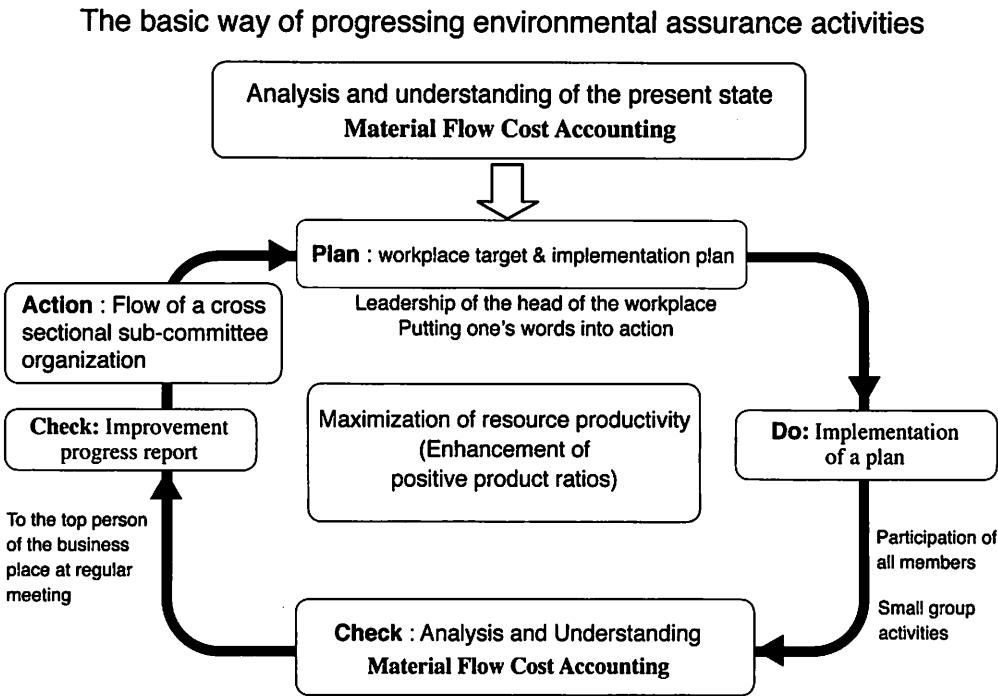


Figure 3. PDCA Cycle of Workplace-Based Environmental Assurance Activities at Canon (Anjo (2006) p.49 extract from a part-addition)

Flow Cost Accounting as a management tool of the plan (P) and check (C).

Canon is attempting to lead these activities to revolution by expanding QCD activities (Q: quality, C: cost, and D: delivery) into EQCD activities which incorporate environment (E). Canon is aiming to realize environmental activities which embrace all employees of manufacturing workplaces. In addition, Canon plans to evolve these activities to activities of the trinity by covering not only production bases but also the development division and the technology division as shown in the following Figure 4.

Firstly, the issue is how to make these activities take root deep into the manufacturing location, which is also common in cases of the other companies, and it is important to make these activities take root deep not just into some employees but into all of the employees' awareness of developing products. By so doing, changing awareness of developing products by Material Flow Cost Accounting will be realized. In addition, what is important is not only a change in awareness. The motivation is achievement of (major) improvement from the viewpoint of innovation. To achieve this, it is necessary and essential to have an alliance and the joint ownership of data with the development division and the technology division on the basis of the results of analysis of Material Flow Cost Accounting.

Material Flow Cost Accounting visualizes flows of materials and, for example, makes them extended to a supply chain. Furthermore, as seen in the case of Canon, visualization of flows of decision making is progressed, and the decisions

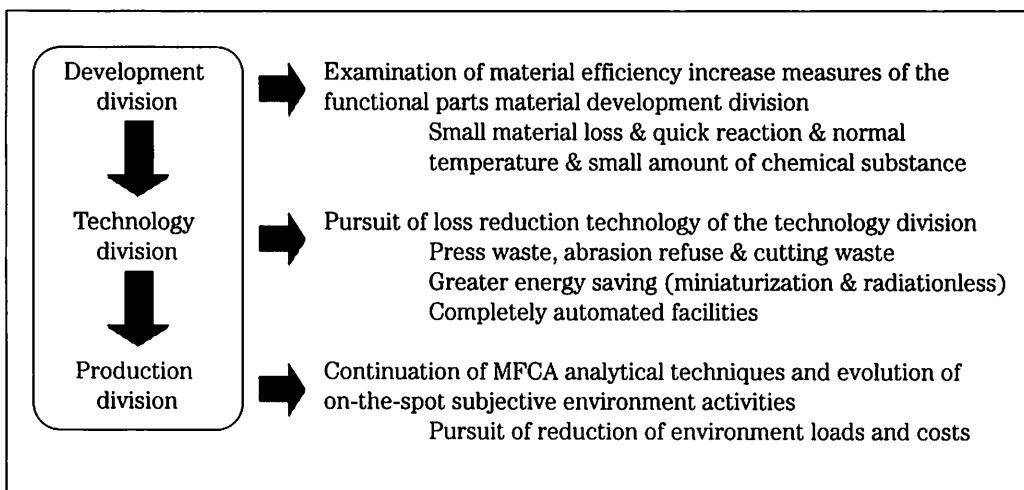


Figure 4. Activities of Trinity by Material Flow Cost Accounting at Canon (extract from Hirooka(2008),p67)

made which generated a loss are actualized and, flows of functions of an enterprise, for example, flows of product development, product planning, product design, process design, product technology, and manufacturing, and additionally, sales become important. It is important to pursue causes which become an impediment for the maximization of resource productivity without compromising with the perceived sanctity of the core process.

5. Case Study of Material Flow cost Accounting at Small- and Medium-Size Company: Shimizu Printing Inc.⁸⁾

What is worth paying attention to as a case of Material Flow Cost Accounting of a small- and medium-sized company is the introduction case of Shimizu Printing. Shimizu Printing is a small company with the paid-in capital and the number of employees being 38 million Japanese yen and 40 (as of October, 2008), respectively. The company draws people's attention for its printing processing for which superior advanced technologies such as environment-conscious non-water UV super precision printing are used.

The encounter of Shimizu Printing with Material flow Cost Accounting was when the company and the author (Nakajima) met in the autumn of 2002 by the introduction of the Ernst & Young Shinnihon Environment & Quality Institute Co., Ltd.⁹⁾. When the author paid a visit to observe printing processes at that time, the printing processes were integrated in a single piece of machinery (the size of which is about the size of a car). In short, the author was worried it might not be possible to visualize a loss which had not been seen before in reality, by carrying out a Material Flow Cost Accounting analysis to a single piece of machinery, where input paper came out when printing was completed.

However, hidden losses in regular work carried out by craftsmen as usual were visualized. When printing is to be made, preparation of ink on paper is made until the printing quality (colour, estimation, etc.) is adjusted to the craftsman's satisfaction. This preparation of ink on paper is a negative product from the viewpoint of Material Flow Cost Accounting. Concrete losses are paper loss, ink loss, loss of facilities including electricity fees, and loss of working hours.

As shown in the following Figure 5, these losses can be seen by how many pieces of paper went through paper processes.

The number of pieces of paper means the total number of pieces of paper which go through the machine. Spare paper used before product quality is deemed good at the time of the commencement of printing is considered spare. In reality,

- Through number of pieces of paper = products + spare + 'Yare'
 products: the actual number of pieces of paper delivered to clients
 spare: white paper for preparation
 Yare: preparation paper (used paper in the previous printing)

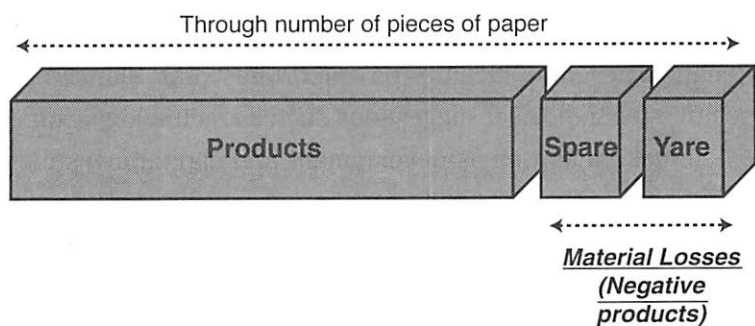


Figure 5. Discovery of Material Losses at Shimizu Printing Paper Manufacturing (Provided by Shimizu Printing Paper Manufacturing, partly changed)

in many cases, this spare is not sufficient and preparation paper called 'Yare' is additionally used. Yare is leftover paper which did not become a product, that was used in the previous printing (paper used for preparation of ink on paper). This is an idea on the spot in a sense.

These spare and Yare were visualized as negative products by Material Flow Cost Accounting, and loss costs of ink fees, electricity fees, labour costs, which are variable costs, were evaluated. As a result, it was clarified to be a larger loss than estimated (by the president). The handling of reduction of the number of pieces of paper used for preparation of ink on paper (both spare and Yare), which is the cause of the loss, started.

Concretely, in review, etc. of preparation of ink on paper, etc. (estimation adjustment, colour adjustment, etc.), a rule which produces a loss, in which people has believed blindly, is visualized and is changed to a new rule including change in the workers' awareness. In addition, changing to ink which can be matched to the list of the sample colours even when using only a small amount of spare paper and utilization of various options to stabilize colours have been examined.

It is possible to lead to skills increases for all of the workers by jointly owning detailed quantities and costs, reviewing skills and customs, and creating more refined working standards at the location where there are many craftsmen with craftsman's spirit. In addition, like cases of major enterprises, improvement of

Year	2003	2004	2005	2006	2007
Loss rate	6.5%	5.8%	5.5%	4.5%	2.5%

Table 1. Trend of reduction of negative product costs at Shimizu Printing (Provided by Shimizu Printing)

production technologies and facilities is important, and Shimizu Printing has carried out positive technological suggestions such as technology examination with printing machine makers as well as development and capital investment.

Shimizu Printing has systematically carried out collection and analysis of data necessary for MFCA since April 2003. As a result, the loss rate showing the proportion of negative product costs has been certainly and largely reduced as Table 1 shows.

It is impossible to understand simply that “loss reduction = profit increase” in cases of small- and medium-sized companies. However, as a result of the development of products where the results of such handling are strengthened, and because that is further evaluated as environment-conscious development of product of enterprises, it is necessary for such enterprise efforts to be highly evaluated in the market.

6. Conclusion: Towards Further Enterprise Development of Material Flow Cost Accounting

The author always feel from studying research of enterprise development of Material Flow Cost Accounting that Material Flow Cost Accounting is a tool and its function is like a CT scan (computed tomographic scan).

“How to use” is important in the sense that it is a tool. It is possible to realize a certain visualization, if Material Flow Cost Accounting is introduced, and the part that had not been seen previously will be visible, and a certain result will be able to be obtained. However, without the spirit of the user of the tool, in other words, the intention of the user of the tool, it is considered that the results will be left to chance. This research explained the very important points on the matters seen from the commencement of the experimental introduction to the stage of the utilization at all company levels. It is not considered that application of all these as they are will simply lead to success. However, It is found what is common in all the three companies is that they understand the relevance of Material Flow Cost Accounting and use it well by adapting it for their own purposes. The characteristic

of the tool is not the intention. The important thing is that managers have a purpose in Material Flow Cost Accounting activities with the intention.

The author often hear (negative) evaluation that the effect of Material Flow Cost Accounting is not so great compared to the number of man-hour needed for analysis, even if it is introduced, or that Material Flow Cost Accounting itself does not have a tool for improvement. However, in my own view, where it is necessary to carry out accurate diagnosis into detailed parts of a company, the author find problems on the side (for example, the factory) which receives the diagnosis, rather than in the cause of the tool. The loss to be visualized by Material Flow Cost Accounting is hidden behind the existing traditional management, and that often deeply. The technology of the medical CT scan has been advanced, and the time required for a diagnosis must have been shortened. However, it will not be the same as a stethoscope. However, the longer time is spent on a CT scan diagnosis, the deeper the affected part is visualized. Easy application of Material Flow Cost Accounting has been attempted as what is common in the three companies in this paper. However, these companies started with visualization untiringly and succeeded in the incorporation of the results into daily management systems. It is not simple, as is said "there is no golden road to improvement". The author consider that these success cases will become our good guide.

Material Flow Cost Accounting has now been stepped up from the state of the understanding of Material Flow Cost Accounting itself and the preparation as a tool, to the state of development and further development as a relevant enterprise management tool. Material Flow Cost Accounting was discovered as one of the environmental management tools, and a structure to realize the simultaneous achievement of both reduction of environment loads and cost cuts has been actually proved in enterprise case studies by the enhancement of resource productivity, thus the level of completeness as a tool having been enhanced.

Such research activities and results have been introduced in research reports, literatures, etc. and various kinds of enterprises have showed an interest in Material Flow Cost Accounting. More than 150 enterprises have started to have a concrete examination or have carried out its introduction at present, which is estimated by data collection, etc. made by the METI. Among them, Sekisui Chemical Co., LTD¹⁰⁾ has introduced Material Flow Cost Accounting as one of its management tools at all company levels, and Canon has introduced Material Flow Cost Accounting into not only the bases in Japan but also its overseas bases.

By looking at such practical development, it is possible to discover a new potential of Material Flow Cost Accounting. If Material Flow Cost Accounting is

introduced into a manufacturing process, the present state of resource productivity with a process (for example, the state of the occurrence of material loss) is clarified. Accordingly, Material Flow Cost Accounting is understood as an environmental management tool to reduce material loss (waste) in a manufacturing process. However, this understanding is a wrong understanding originating from the word, material loss, and the scope of introduction, and does not represent the essential management power.

7. Supplementary Discussion: Visualization of “Non-Visualization of Losses” due to Negligence of Resource Productivity

Although companies were freely using traditional production management techniques (standard cost accounting, TPM, failure cost, etc.), why were such major improvement points discovered by the introduction of Material Flow Cost Accounting? It is considered likely that there is a limitation in the existing management accounting data and production management techniques, while Material Flow Cost Accounting is a technique which surpasses the limitation of the traditional management accounting data. It is necessary to explain non-visualization of losses which is caused by negligence of resource productivity which is the limitation because of the dependence on cost data, as the problems of the traditional management accounting and production management which are revealed by the introduction of Material Flow Cost Accounting.

Monetary value data represented by cost data is important in production management and other management, and is an important yardstick of management decision making. Monetary value data within an enterprise such as a manufacturing process is computed by evaluation technique by cost accounting and management accounting. This cost is evaluated as an amount of money on the basis of the quantity of materials such as consumption of materials and workload. Accordingly, the existing cost data is understood to be data representing the change and the effect at the dimension of the quantity of materials such as Material Flow Cost Accounting.

Nevertheless, in reality, standardization of individual data has been made. Because it is the understanding of the present state or the representation of the actual state based on the design values and the average values, the differentials between the standard value and the actual value will be widened with the passage of time. In addition, because the existing cost data is mixed data of quantities of materials and monetary value, change in the amount of money such as a unit is

conveniently misunderstood as change in the actual state (in the dimension of the quantity of materials). For example, standard costs are generally the basis of product costs. It is therefore the enhancement of the standard cost which is the basis of cost targets, and will become the subject of management which will be linked to achievement of profit targets. Materials which are the subject of Material Flow Cost Accounting will become a secondary management subject. Further, cost reduction, and not the enhancement of resource productivity, will become the primary target.

As clarified by an Material Flow Cost Accounting research case, it is understood that the only way to reduce material costs is to lower the unit price of materials, because the amount of input of resources is decided at the time of design. At the actual production location, reduction of loss of raw materials (spoilage, etc.) is carried out only by yield management. Here is non-visualization of material loss (waste) which is clarified by Material Flow Cost Accounting. A material which does not become a product will all be recognized as a material loss by Material Flow Cost Accounting.

As shown in Figure 6, relationship of “loss=mistake=abnormalcy” in the traditional cost management exists. Management is, therefore, attempted to be made by visualizing costs originating from an abnormal incident. Accordingly, there is no loss in normal working, and traditional management is carried out by considering that elimination of all of this abnormalcy means the minimization of costs. However, manufacturing processes visualized by Material Flow Cost Accounting are irrele-

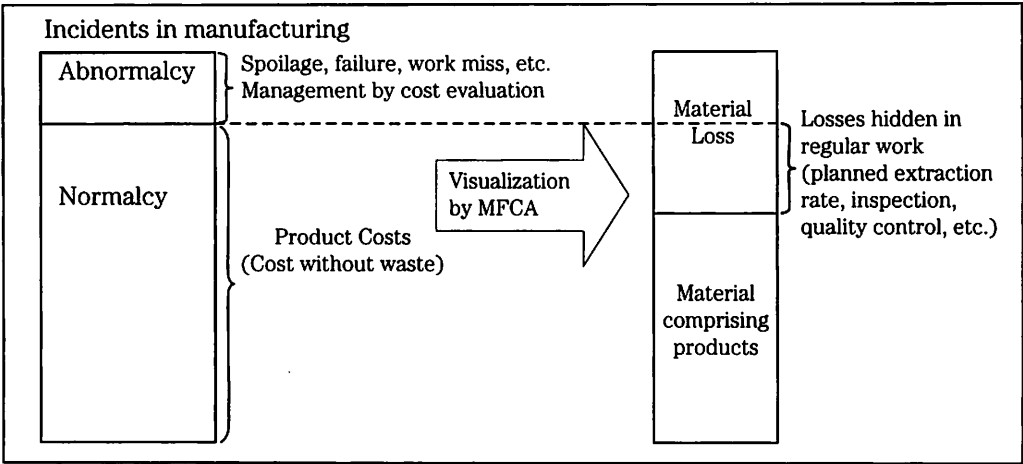


Figure 6. Limitation of Existing Production Management and Visualization of Material Flow Cost Accounting (MFCA)

vant to the viewpoint of normalcy or abnormalcy. In Material Flow Cost Accounting, the material extraction rate (for example, refuse extracted from the press and the consumption for an inspection necessary for working procedures and maintenance of quality) are also material losses. Losses hidden in so-called regular work are actualized. It can be said that actualization of a loss hidden in this regular work clarifies the image of environment-conscious products from the viewpoint of resource productivity.

In such traditional production management data and management accounting techniques, management data where costs (monetary value) are considered important is emphasized. Material Flow Cost Accounting is relevantly useful for cost cuts applicable for the age of the environment as management accounting as a cost management tool based on material quantity data, which must have been considered and is hidden data. Management accounting technique represented by traditional production management and standard cost accounting had management data at the dimension of the quantity of materials. However, in reality, that function appears to have been lost. Today, fusion of this dimension of the quantity of materials and the dimension of monetary value will become able to be achieved only with the concept of fusion of mass balance of Material Flow Cost Accounting and cost evaluation. This very fusion is the source of relevance as a new management accounting tool that Material Flow Cost Accounting has.

Notes

- 1) <http://www.nitto.com/>
- 2) In Material Flow Cost Accounting (MFCA), material loss is recognized as a product, called 'negative product'. The cost of negative product is calculated by product costing of MFCA. See Nakajima (2004) for details.
- 3) <http://www.mt-pharma.co.jp/e/index.php>
- 4) This incorporated into the Tanabe Mitsubishi Seiyaku factory on October 1, 2008 through Yamaguchi Tanabe Seiyaku, the Osaka factory (presently, the Seiyaku Headquarters Osaka factory).
- 5) <http://www.yoshikikojo.co.jp/> (only available in Japanese)
- 6) <http://www.canon.com/index.html>
- 7) <http://www.canon-kasei.co.jp/> (only available in Japanese)
- 8) <http://www.shzpp.co.jp/> (only available in Japanese)
- 9) Presently Ernst & Young Shinnihon Sustainability Institute Co., Ltd.: http://www.ey.com/global/content.nsf/Japan_SAAS_J/Home (only available in Japanese)
- 10) <http://www.sekisuichemical.com/>, in this HP, Corporate Social Responsibility Report 2008, including some issues of Material Flow Cost Accounting, can be downloaded.

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