

"Business and the Environment" International Symposium Series

**Business and the Environment Project: International Symposium 2003**

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**Development of Environmental Management Accounting  
and Green Supply Chain Management**

March 2004

Institute for Global Environmental Strategies (IGES)

IGES Kansai Research Centre

***IGES Kansai***

Proceedings from  
**International Symposium**  
**“Business and the Environment”**  
Development of Environmental Management Accounting  
and Green Supply Chain Management

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Global Environment Forum-KANSAI, Kansai Council, Kansai Economic Federation, The Osaka Chamber of Commerce and Industry, The Federation of Chamber of Commerce and Industry in Hyogo Prefecture, Hyogo Prefectural Federation of Societies of Commerce and Industry, The Hyogo Industrial Association, Hyogo Environmental Advancement Association, Hyogo Prefecture Association for Corporate Environmental Conservation, The New Industry Research Organization

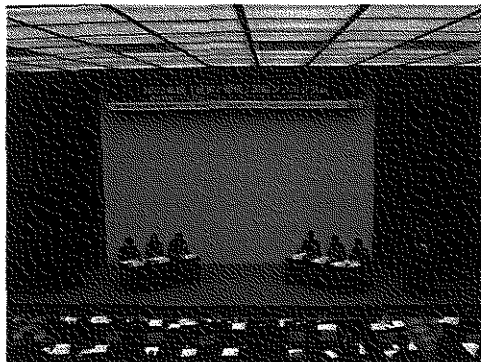
## International Symposium 2003 "Business and the Environment"

**Development of Environmental Management Accounting and Green  
Supply Chain Management**

The Business and the Environment Project at IGES Kansai Research Centre, which wrapped up its three years of research activities with this international symposium, relayed information on cutting edge environmental management accounting (EMA) to the general audience in attendance at the conference centre, as well as strengthening its network of Japanese and overseas researchers.

First, the Project Leader Katsuhiko Kokubu raised the issue of the system of EMA and the possibilities for its expansion. For the keynote speeches, two distinguished researchers from the Tellus Institute in the USA were invited. Deborah E. Savage Ph.D gave a presentation about International Trends and Activities in Environmental Management Accounting, and Mark Stoughton Ph.D delivered a speech about the new developmental trend in EMA of Green Supply Chain Management.

Following these speeches, Fujitsu Ltd. and Tanabe Seiyaku Co. Ltd. reported on practical ways to apply EMA. Takeshi Mizuguchi, assistant professor at Takasaki City University of Economics, submitted his views and analysis on the spread, promotion and improvements of EMA from a wider perspective. At the panel discussion, a lively discussion took place on the subject of "Frontier Environmental Management Accounting" in Japan and the US. There were many positive questions and opinions from the floor reflecting a high level of interest for the future development of EMA.



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Katsuhiko Kokubu

*Panelists:*

D. Savage, M. Stoughton, Takeshi Koga, Yuji Kawano, Takeshi Mizuguchi

## **Environmental Management Accounting -System and Development**

**Katsuhiko Kokubu**

IGES Kansai Research Center  
Kobe University

I have served as the first project leader of "Business and the Environment Project" at IGES Kansai Research Center for these 3 years. This Project finished this March when 3 years had just passed. To give general overview of this Project, I feel honored to present the International Symposium on Environmental Accounting. I am very pleased to have you here on Kobe Port Island today to join the Symposium.

I have been involved with studies of environmental accounting and environmental management accounting for 3 years at IGES Kansai Research Center. First in 2001, on the theme of "development of environmental accounting and environmental management accounting in the Asia Pacific region" and "international development of environmental management", we invited speakers from UK, Germany, South Korea, Philippines and USA to give presentation at symposiums. In 2002, we focused on material flow cost accounting and presented the International Environmental Accounting Symposium in Osaka. And this year, the last year of the Project, we have continued our studies here in Kobe, in terms of the system and future development of environmental management accounting.

As for environmental management accounting, various methods have been developed and utilized at companies. At this Symposium, I would like to make clear what methods are available, how they contribute,

and what relation exists among methods.

Besides that, in order to improve environmental accounting and environmental management accounting in the future, it is necessary to develop them into new methods applicable to new fields. Today, as one of possible directions, please let me make mention of green supply chain. How we should give environmental considerations to a general supply chain, how environmental management accounting methods are expected to work efficiently, and what merits and challenges the companies where environmental management accounting methods have been actually introduced are faced with. These are the subjects of today's presentation.

I would like to speak and raise some matter about how environmental accounting and environmental management accounting have been generally developed so far, what methods are presently available in Japan, what relation exist among methods and what the directions of future development is.

### **< International Trends of Environmental Accounting and Cases in Japan >**

First, as far as international trends of environmental accounting are concerned, Ms. Debora Savage and Mr. Mark Stoughton kindly accepted our invitation to speak today. In USA, environmental management accounting is often referred to as EMA. Both of them have actively pursued EMA in USA. Since

1992, USEPA (US Environment Protection Agency) has conducted Environmental

### International Trends of Environmental Accounting

- USA: USEPA launched an environmental accounting project in 1992. EMARIC was established.
- Germany: Environment Ministry and Agency intend to promote environmental cost - management project
- United Nations: Division for Sustainable Development intends to promote environmental management accounting.

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Accounting Projects in USA, and research activities are presently being continued at Environment Management Accounting Research Information Center (EMARIC) set up on Terrace institute's premise. For detail, Ms. Debora Savage will deliver speech later. In Germany as well, Environment Ministry and Agency have been promoting Environmental Costing and Cost Management Projects. United Nations has the Division for Sustainable Development where projects to promote environmental management accounting have been promoted. The progress of these projects will be also explained later.

### Environmental Accounting in Japan

- Ministry of the Environment (MOE)
  - 1999- Proposal of Guidelines on Environmental Accounting
  - 2000- Publication of Guidelines on Environmental Accounting
  - (2001- Publication of Guidelines on Environmental Reports)
  - 2002- Revision of the Guidelines on Environmental Accounting
  - Establishment of environmental accounting study group
- Ministry of Economy, Trade and Industry (METI)
  - (2001- Publication of Guidelines on Environmental Reporting )
  - 2002- Publication of Environmental Management Accounting Workbook

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In Japan, on the other hand, Ministry of the Environment (MOE) and Ministry of Economy, Trade and Industry (METI) are both involved with environmental accounting projects. In 1999, Ministry of

the Environment published "Guidelines on Environmental Accounting". In 2002, Ministry of Economy, Trade and Industry published "Environmental Management Accounting Workbook". Ministry of the Environment set up an environmental accounting study group and the study group is presently discussing how the Guidelines should be used and how they should be revised as the occasion arises. While Ministry of Economy, Trade and Industry is now preparing manuals to disseminate the METI-published Workbook and searching best practices.

Deviating a little from today's subject, I would like to talk about what I found during our studies in IGES for 3 years and what I recognized our challenges to be overcome. That is, the practice of environmental accounting in Japan so far has focused on disclosure of external information by disclosing environmental accounting information on the environmental report like this. In contrast to that, environmental accounting and environmental management accounting for internal management have not been sufficiently developed. For this reason, we considered it necessary to develop the methods of environmental management accounting in such a way that environmental accounting practices would be further disseminated and promoted and environmental accounting practices would be given the status of the tool to promote autonomous activities for environmental conservation within companies. For that purpose, we have continued research activities mainly on material flow cost accounting.

**< Major Environmental Management Accounting Tools and Characteristics >**

### Major Environmental Management Accounting(EMA) Tools

- Environmentally conscious capital investment appraisal
- Environmental budget matrix
- Environmental target costing
- Environmental Activity Based Costing (ABC)
- Environmental conscious corporate performance evaluation
- Material flow cost accounting
- Life cycle costing

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Information here shows you major environmental management accounting tools. Almost all tools are described in the METI Guideline, which I will explain later. Now please let me explain how to understand these major tools for environmental management accounting. Unlike environmental accounting methods published by MOE, these environmental accounting and environmental management accounting for internal management are intended to be used for any purpose. I think many corporate people are here today, and what I would like you to know is that you don't have to introduce all tools. Rather you should choose some useful tools to solve the problems you are faced with from among these tools here.

### Two Types of EMA tools

- |  |   |
|--|---|
| <ul style="list-style-type: none"> <li>■ Tools with Information database</li> <li>■ Material flow cost accounting (MFCA)</li> <li>■ Life cycle costing (LCC)</li> <li>→ Environmental (Management) Accounting</li> </ul> | <ul style="list-style-type: none"> <li>■ Individual tools</li> <li>■ Environmentally conscious capital investment appraisal</li> <li>■ Environmental budget matrix</li> <li>■ Environmental target costing</li> <li>■ Environmental ABC</li> <li>■ Environmental conscious corporate performance evaluation</li> <li>■ The MOE Guidelines on Environmental Accounting</li> <li>→ Environment + Management Accounting</li> </ul> |
|--|---|

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Environmental management accounting tools are divided into 2 types. One is the environmental management accounting tools with information infrastructure supported

by database. Another is the existing environmental management accounting tools plus individual tools and database taken from other sources. Material flow cost accounting (MFCA) and life cycle costing (LCC) are included in the information infrastructure. While individual tools include environmentally conscious capital investment appraisal, environmental budget matrix, environmental target costing, environmental ABC (activity-based costing) and environmental conscious corporate performance evaluation. The MOE Guidelines on Environmental Accounting are also one of individual tools.

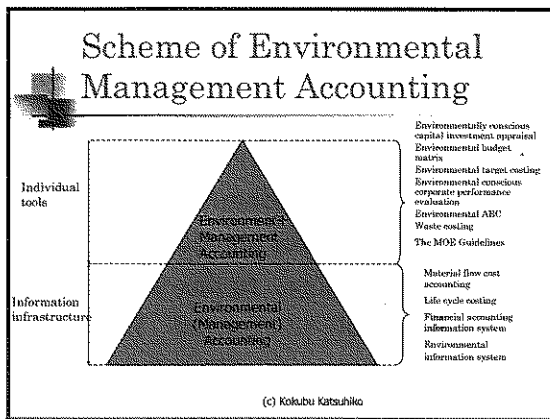
Today, we would talk about corporate cases from the viewpoint of material flow cost accounting. Then we would emphasize how this idea of accounting will be expanded to green supply chain management.

First of all, I would like to tell you how we should understand these tools. As I said, environmental management accounting tools are divided into the tools with database information infrastructure and the existing management accounting tools plus environmental elements. What we see here is the existing management accounting which companies have traditionally adopted, plus additional environmental elements.

Taking environmentally conscious capital investment appraisal for example, some Japanese companies use payback period method and/or calculate present value with discounted cash flow. To these conventional methods, let's add environmental elements so that we could invest in the environmentally conscious ways. We can summarize it like this. Environmental budget matrix is a little different from this. Considering a general budget, let's introduce environmental elements





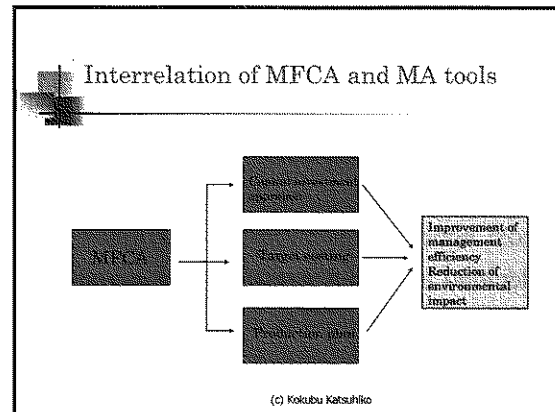


When indicating accounting methods I have mentioned in a pyramid model, environmental management accounting tools include the tools with information infrastructure supported by database such as material flow cost accounting and life cycle costing. Although not being included in environmental management accounting when it comes to database, information system and environmental information system of financial accounting are also available. In the sense that material flow cost accounting and life cycle costing contains information of management accounting in environmental accounting, I describe it as “environmental (management) accounting”.

On this environmental accounting with database, individual tools as mentioned before “environment + management accounting” exist. I suppose that environment and information should be taken from the database I talked about and put into management accounting tools and schemes to use such individual tools.

When corporate people try to introduce “environmental (management) accounting” tools, they don’t have to make up all in a pyramid model but may choose and adopt some specific tools. To grasp it more efficiently, however, what can be calculated just by tools and what need to accumulate data in parallel should be separated from each

other. The scheme is structured in such a way that once lower part (information infrastructure supported by database) is made up, the database facilitates calculation of upper part (individual tools). This structure may explain one of schemes of “environmental (management) accounting”.

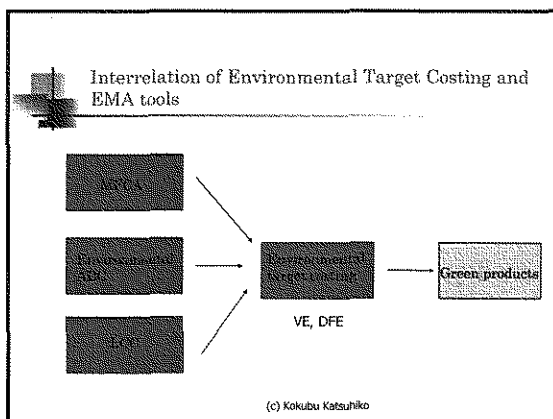


Taking MFCA (material flow cost accounting) for example, I have already talked about it as the tool expected to function as information infrastructure of environmental accounting. In this method, as Tanabe Seiyaku, Co., Ltd. will speak later, flow of materials and raw materials is traced by quantity and money and consequently the value of waste is obtained at each spot. When you grasp waste generation by the amount of money, not just by the quantity done before, you understand how much cost is required to eliminate waste. So far, you may have thought “no way to eliminate this volume of waste”. But if that volume of waste is indicated by the amount of money, it means that the amount of money will be zero by eliminating the volume of waste. Therefore you will save that amount of money. This kind of information will support planning of new activities. Such relationship will be established.

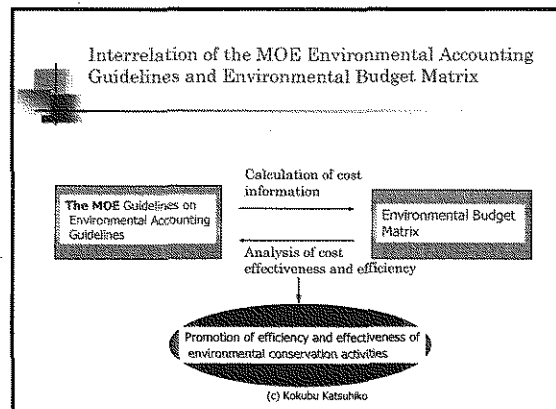
To be more precise, you will make a decision “okay, then let’s reduce wastes by changing capital investment”. This is the case

of Tanabe Seiyaku. You will also have some options. For example, "let's introduce target costing by changing the design of products." "Let's reduce waste by changing the design of products." Or "let's reduce waste by changing production plan." In the case of Fujitsu we will speak later, the volume of waste is expected to reduce with other tools as well. As a result of waste reduction, management efficiency may be improved and consequently environmental impact may be controlled. Based on information from material flow cost accounting, capital investment will be decided in such a way as to reduce waste. Or product design will be changed to prevent the generation of waste. Or production scheme not generating waste will be constructed. However, these changes are generally expensive, so managers on production site are not willing to accept. If material flow cost accounting provides enough information to give them a good reason that such a change is worth costing, the use of existing management accounting will lead to better management and eventually reduce environmental impact. This is a general picture.

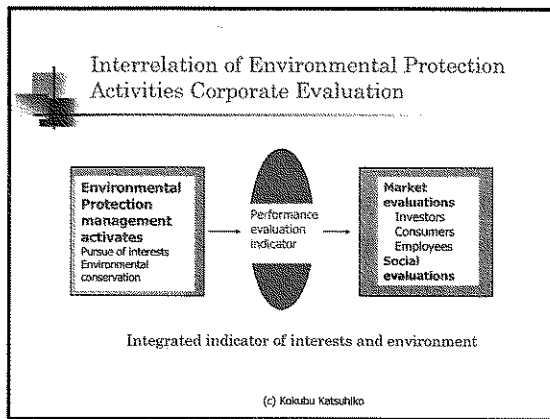
introduce environmental elements to costing at the designing and development stage of products. In other words, we will examine the possibility of replacing materials expected to give large environmental impact with different materials, or introducing more easily demountable design. In this way, the design of products will be changed. However, the more environmental elements are taken into costing, the more costly it is. Then for thinking how to reduce cost, you can use a variety of information from environmental ABC, life cycle costing and/or material flow cost accounting. By marshaling data, you will get the point of improvement needed for environmental design change of products.



I will show you another case. How about introducing environmental target costing, when you plan to manufacture environmental products (green products). Environmental target costing is the idea to



Also, I understand that you may have various problems when following the MOE Guideline. From the standpoint of working level, you may question if this method actually contribute to corporate operation, and/or if this procedure is making internal environmental conservation activities efficient although you understand the importance of information disclosure. In such cases, by making up environmental budget matrix based on the MOE Guideline and analyzing cost effectiveness, you can improve the efficiency of environmental conservation activities.



Performance evaluation is another important issue. Eventually environmental issues should be evaluated by the market and society. As read for Mr. Sano, Economic Division manager of Ministry of the Environment, when the society gets matured enough to support companies giving considerations to the environment, corporate environmental activities will go on voluntarily. To support such companies, however, it is definitely necessary to evaluate with some indicators. For this purpose, indicators such as intensive indicator to summarize environmental report, general indicator of profit and environment, environmental operation-related indicator and so on are available. This is a rather future task, but some companies are conducting environmental performance evaluation to clarify the future direction. As external function, on the other hand, Eco-fund tends to work as a tool to evaluate the environmentally sound companies. All I can say is that performance evaluation is a basis to combine both sides.

Here I have just shown you a part of relationship of various environmental accounting tools. By using various environmental management accounting tools and management accounting tools comprehensively, it becomes possible to

improve environmental conservation activities as well as improve economic efficiency. This, I believe, is a systematic utilization of environmental management accounting.

### < Possibility of Expanding the Scope of Environmental Management Accounting >

#### Possibility of Expanding the Scope of Environmental Cost for EMA

- ① Environmental conservation cost (← Covered by the MOE Environmental Accounting Guideline)
- ② Materials and energy cost
- ③ Processing cost for waste
- ④ Processing cost for products
- ⑤ Energy cost when using products
- ⑥ Recycling and disposal cost for products
- ⑦ Environmental impact (Social cost: Externalities)

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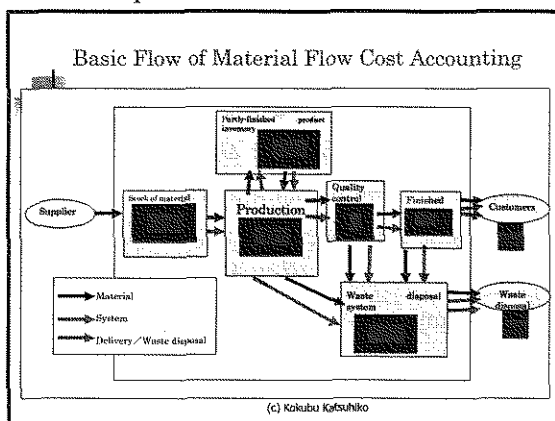
Now I would like to point out another important issue today. That is, environmental management accounting is to be expanded. Environmental issues are not just problems a company is faced with but rather social and global problems, and thus the management just by a company has a limitation. Therefore, management tools and targets need to be developed continuously. Continuous management while expanding the scope will be the most effective and efficient way to reduce environmental impact.

Then, from the viewpoint of accountancy, what cost item should be targeted on? Company is a profit-seeking organization, so it is necessary to understand any problems by converting into economic values. For example, environmental conservation cost is subject to the MOE Guideline, and this cost makes up just a few percentages in any companies. Environmental cost is not only environmental conservation cost. Raw material / energy cost is related with the environment in terms of natural resources, and so is processing

cost for waste. Additionally, aggregated cost such as energy cost when using products, recycling and disposal cost for products and social cost expected to be environmental impact eventually should be subject to environmental management accounting tools. ① - ④ on the slide are corporate cost, ⑤ and ⑥ are life cycle cost and ⑦ is social cost. The targets of financial accounting are only corporate cost ① - ④, and expanding to life cycle costing include ⑤ and ⑥. Full cost will include ⑦. In this way, the scope of environmental cost can be expanded in stages. And we should go for it ultimately.

As one of methods to expand, Dr. Mark Stoughton will talk about the concept of green supply chain. So I would like to talk about the possibility of expanding the scope of environmental cost with material flow cost accounting.

As I said, material flow cost accounting is the method to estimate the flow of raw materials in terms of quantity and money. The concept of flow is as shown here.



Raw materials come from a supplier and pass through production process to reach customers. A part of materials become waste and go to waste disposal process. Concerning this flow, I talked in detail at last year's Symposium, and have published some writing. The material from a supplier

flows in this sequence and partially becomes waste. By cost accounting, the scale of waste becomes clear. To reduce this waste, various methods as I said such as changing capital investment, target costing and production plan are available. However, there appears to be a problem with this external framework.

Now we perceive external framework as corporate framework. By eliminating this framework, however, it will be possible to manage supply chain more efficiently. For example, from global point of view, waste generation at company A reduces. If the reason for waste reduction is that the waste has moved to other companies upstream or downstream, there is no point in the waste reduction from the viewpoint of global environment. What is needed is to reduce environmental impact in the entire supply chain. To that end, it is necessary to understand where waste is generated and how much it costs in the entire supply chain. I suppose that material flow cost accounting is the very effective tool for this purpose. We will talk over this on panel discussion.

**<Cost Covered by Environmental Accounting>**

I have just talked about the need to expand to supply chain. Now focusing attention on environmental accounting, as I showed you earlier, environmental cost subject to environmental management accounting include not only environmental conservation cost but also all cost related to the environment. So, I would like to tell you what it is supposed to mean to expand the scope of environmental cost.

### Cost Covered by Environmental Accounting

	Number of companies	%
① Pollution prevention cost	163	93.4
② Recycling cost	180	96.6
③ Global environmental conservation cost	181	97.3
④ Upstream / downstream cost stipulated in the MOE Guidelines	163	87.6
⑤ Administration cost stipulated in the MOE Guidelines	173	93.0
⑥ R&D cost stipulated in the MOE Guidelines	163	87.6
⑦ Social activities cost stipulated in the MOE Guidelines	163	87.6
⑧ Environmental remediation cost stipulated in the MOE Guidelines	156	84.2
⑨ Materials cost	40	21.5
⑩ Energy cost	82	44.1
⑪ Indirect costs such as the personnel cost allocated to waste cost and the depreciation cost	68	36.6
⑫ Life cycle cost accrued after sale of products	37	19.9
⑬ Social cost accrued as environmental load	35	19.2
⑭ Others	3	1.6

n=186 (c) Kokubu Katsuhiko

The findings I will tell you were obtained when we carried out questionnaire survey at IGES Kansai Research Center to the companies listed on the first section of the Tokyo Stock Exchange. We put a question "what is the scope of cost subject to environmental accounting". Then more than 80% of respondents replied that environmental accounting applied to cost items covered by the MOE Guideline. ① - ⑧ are environmental cost covered by the MOE Guideline. The ninth cost item ⑨ materials cost are included in environmental accounting by only 40 companies (21.5%). For companies, materials cost is much larger than environmental conservation cost. Besides that, all materials originate from natural resources, so they are environment-related cost. And that's not all.

The materials are processed to products and eventually transformed into waste to give impact again to the environment. For this reason, materials cost is the environmental cost with double-barreled effect, and therefore requires the most careful management. We have found that few Japanese companies included it in environmental accounting and environmental management accounting.

I have another important finding. We divided companies into 2 groups, the group

applying environmental accounting only to ① - ⑧ environmental cost covered by the MOE

### Scope of Environmental Cost and Effectiveness of EMA


	Scope of environmental cost covered by environmental accounting	
	Scope of cost 1~8	Scope of cost 1~8+9+10
Effectiveness of EMA-- Contribute to corporate management	2.44 (n=57)	2.9 (n=39)

n=96 t=3.169 p=0.002 (Both sides)

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The former group has 57 companies and the latter has 39 companies. As a result that we researched which group produced higher effect on internal management with environmental accounting, we found that the company group with larger scope of cost had higher effect on internal management with environmental accounting. First we asked through the same questionnaire if environmental accounting was helpful for internal management or not, and evaluated answers on the scale up to 4. The figure "2.9" and "2.4" were obtained in this way. I know this subjective judgment has a limit, however, the result showed that companies with larger scope of cost had higher effect with environmental accounting. We also found that when conducting mean difference test called "t test", if t value is high and statistically significant at 1% level, the mean difference is also significant. I believe, these findings suggest that it is more effective to expand the scope of cost beyond the MOE Guideline.

**<Conclusion - Purposes of the Symposium>**

 Purposes of the Symposium

- Global development of EMA
- Incorporating EMA for the supply chain
- Development in corporate practices:  
Green process at Fujitsu  
Material flow cost accounting at Tanabe

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As I have presented, there are various methods of environmental management accounting, and those methods are related to each other. It's not that such relationships exist on a univocal basis, but they depend on business objectives of the companies. And basically, it may be no exaggeration to say that environmental management accounting

definitely needs to be developed and expanded. This is understandable by considering the difference between the frame of company and that of environment. At the Symposium today, we would like to discuss corporate practices in Japan and USA considering the future directions of development and both sides.

We have many corporate people joined today, so we would like to advance discussions on the cases of leading companies of environmental management accounting, Fujitsu and Tanabe Seiyaku.

I understand that it is my duty to raise the issue, so I will not necessarily suggest final conclusions. I hope that we will find directions of future development for the duration of the Symposium.

## International Activities & Trends In Environmental Management Accounting (EMA)

Deborah E. Savage, Ph.D.  
EMA Research & Information Center (USA)  
dsavage@emaric.org www.EMAwebsite.org

I would like to thank IGES for inviting me to speak at this symposium today. They have asked to me to speak on international activities and trends in Environmental Management Accounting, EMA.

### A Broad Definition...

Broadly defined...

EMA is the identification, collection, analysis, and use of two types of information:

- *Physical information on the use, flows, and fates of energy, water, and materials (including wastes)*
- *Monetary information on environment-related costs, earnings, and savings*

*EMA Expert Working Group of the  
United Nations Division for Sustainable Development*

Before beginning the remainder of my talk, I would like to give a broad definition of EMA. I'm sure if I asked 10 different people in this room to give me a definition of EMA, they might have different definitions. This is quite normal - to be expected. Different countries and different organizations have different definitions. But the definition I use when I am speaking is this definition created by the EMA Expert Working Group of the United Nations Division for Sustainable Development. This is an international working group with representatives from many countries working to promote EMA, who decided they needed a broad definition for international purposes. I wish to focus on the fact that this definition of EMA recognizes two basic types of information. One is physical information on

the use, flows, and fates of energy, water and materials within an organization, not only raw materials, but also waste materials. The second type of information is the monetary or cost information. All different kinds of environment related costs earnings and savings.

### The Globalization of EMA...

- 1992: US Environmental Protection Agency was first national government agency to establish a formal EMA program
- 1998: EMA Networks (EMAN) in Europe, Asia-Pacific, the Americas
- 1999: Expert Working Group on EMA convened by the United Nations Division for Sustainable Development (UNSD)
- 2002: International EMA Website
- 2004: EMA activities in over 30 countries
- 2004: International Guidance Document

EMA is of global interest today. But this was not the case 10 or 15 years ago. In 1992, the United States Environment Protection Agency (USEPA) was the first national government agency to create a formal program to promote EMA. And this program, of course, focused on promoting EMA primarily inside the United States. Since that time, interest in the subject of EMA has grown exponentially. In 1998, the first chapter of the EMA network was formed in Europe. There are now chapters in the Asia Pacific regions and in the Americas. I will mention these chapters again later during my talk. In 1999, the United Nations created the international expert working group on EMA. This was an attempt to bring government representatives from different

countries together. In 2002, the international EMA website was created. And as of 2004, this year, over 30 countries are actively involved in promoting Environmental Management Accounting. Another ongoing project this year is the development of an International Guidance Document on EMA, specifically for the international accounting community. I will speak about each of these international activities in a little bit more detail later.

very active - Japan, the Philippines, Korea, and Australia are perhaps the best examples.

**International Variation...**

EMA varies widely between different organizations and different countries...

- Language
- Definition
- Methodologies
- Applications


**EMA Around the World...**

**THE AMERICAS**

Argentina  
Brazil  
Canada  
Colombia  
Guatemala  
Nicaragua  
Peru  
USA

**EUROPE**

Austria, Czech Rep., Finland, Germany, Italy, Netherlands, Portugal, Spain, Slovak Rep., Sweden, UK



**ASIA-PACIFIC**

Australia  
Japan  
Philippines  
Rep. of Korea  
Singapore  
Taiwan  
Thailand  
Vietnam

**AFRICA**

Egypt  
South Africa  
Tanzania  
Zimbabwe

These lists are not comprehensive...

This slide is just intended to show a number of different countries where there are EMA activities around the world. In some of these countries, government is taking the lead role in promoting EMA but there are many, many private companies working hard to do EMA research and implementation in these countries also. You can see many different regions of the world - Europe, Asia Pacific - and many different countries within each region. And not only the more technologically developed countries but also some developing countries are very, very interested in EMA. I think in Europe the most active countries have been Germany, the U.K. and Austria, and in the Americas, the most active countries have been the USA and Canada. Activities in Latin America are just beginning, and activities in Africa are also just beginning. In Asia-Pacific of course, activities in some countries are just beginning but clearly some countries are very,

There is, of course, a lot of international variation between countries and between organizations on EMA language, EMA definitions, methodologies, and applications. For example, with respect to EMA language, there have been so many different phrases or terms used to describe

EMA. In some places it is called "Full Cost Accounting", in other places, it is only called "Environmental Accounting". This has led to a lot of confusion. If two people are having a conversation and they are using the different words for the same thing, or the same words for two different methodologies, then it's very, very difficult to have the discussion. Definitions also vary between countries and companies. In some countries there has been a very specific focus on cost information but not very much focus on materials flow information. There are many different EMA methodologies and one methodology we will hear about today is Material Flow Cost Accounting. But there are also other methodologies widely practiced. And many different EMA applications. When I say applications, what I mean is, "what do you use the EMA information for?," "do you use the EMA information for supply chain management?" or "do you use that information for cleaner production or do you



use that information for your environmental management systems work?." There is a long long list of different environmental management and traditional management applications that EMA data can be used for and different companies and different countries have different priorities in terms of these EMA applications.

#### Example from North America...

##### United States EMA for Supply Chain Management

- Chemical Management Services (CMS) model
- EMA used to track flow of chemicals & chemical wastes within the company, and estimate all associated costs
- Information used to design and implement contracts with suppliers of chemical management services
- Model is spreading in the US
  - 50 - 80% of the auto industry
  - 35% of the electronics industry
  - 20% of the metalworking industry
  - 10% of the aerospace industry



#### Example from Asia-Pacific...

##### Philippines EMA for Cleaner Production (CP)

- EMARIC + Philippine Institute of CPAs (PICPA) + other partners
- Training course on Cleaner Production and "Environmental Cost Assessment"
- For practicing accountants & their non-accounting colleagues
- Course popularity led to incorporation of EMA into the academic accounting curriculum requirements



I want to give three very brief examples from different regions of the world to illustrate some of these differences. In the United States for example, one active application of EMA

data is to use EMA to inform supply chain management. Dr. Stoughton will be giving you more details of this use of EMA information later this afternoon. So I will not summarize much more about this example here. But, in terms of language and definitions, EMA is used to do supply chain management, but not very many people using it for supply chain management actually call it EMA. So again, every country has its differences.

In the Philippines, an example is shown here. We worked with the Philippine Institute of Certified Public Accountants (PICPA) to develop a training course on cleaner production and environmental cost assessment. The specific application of EMA information was for cleaner production purposes. The language used was not EMA, the language


used was "Environmental Cost Assessment." This was because the accounting association told us that many accountants were tired of doing accounting, they wanted to do something different, so please don't use the word accounting. So we said "OK, we will call it something different." But essentially it is EMA. This course was developed for practicing accountants in industry, and their non-accounting colleagues such as engineers and environmental managers. It was a very popular training course. Recently when the academic accounting curriculum was revised in the Philippines, they decided to create a requirement that EMA must be included in two of the core accounting courses taken by every accounting students in the Philippines. I believe the Philippines is the first country in the world to have this kind of academic curriculum requirement. This is a very exciting EMA example in Asia.

An example from Europe is, of course, Materials Flow Cost Accounting, which I will not describe here in more detail, because it will be discussed by other speakers. However, you will again notice different language - Materials Flow Cost Accounting - and this is just another example of how approaches have been different in different countries.

**Example from Europe...**

**Germany**  
**Materials Flow Cost Accounting**

- University of Augsburg and the Institute of Management & Environment
- Map materials flows and information flows in an organization
- Attach quantitative data on materials amounts and costs
- Look for information mismatches, missing materials, opportunities to save money, etc.
- Make information system improvements



**International Information Sharing...**


EMA stakeholders around the world are sharing information on a regular basis, via:

- The International Website on EMA
- The EMA Listserve
- The EMA Network (EMAN) chapters
- The UNDSO Expert Working Group on EMA

**EMA in Japan...**

How does EMA practice in Japan compare to the rest of the world?

- Japan is one of the most active countries in EMA
- Japan's EMA methodology has received much positive attention around the world
- EMA in Japan has a much stronger focus on external reporting than in other countries



Now, the individuals from organizations and countries around the world are now doing a lot of international information sharing. Several examples are shown here on the slide and I will discuss each of these a little bit more.

**The International Website on EMA (1)**

[www.EMAwebsite.org](http://www.EMAwebsite.org)

An international source of information on EMA principles, methodologies, tools, experiences, and activities that is intended to be:

- comprehensive
- centralized
- easily accessible
- easily searchable
- up-to-date

I asked myself the question, "how does EMA practice in Japan compare to the rest of the world?" I believe that Prof. Kokubu will ask me to talk about this again later so I will mention quite briefly now, that Japan is certainly one of the most active countries in the world on EMA. Japan's EMA is very impressive and its methodology has received much positive attention around the world. We are always very eagerly awaiting the English translations of reports and case studies and guidelines from Japan. Another interesting point is that EMA in Japan has had a much stronger focus on external reporting than any other country in the world. That's very unique about Japan's EMA practices. I will mention this again a little bit more later.

One example is the international website on EMA (<http://www.EMAwebsite.org>). And in your packet of materials I believe there is a two-page brochure giving you some more information on this EMA website. We developed this website because, when we were looking for EMA information on the World Wide Web, we realized that although some websites, for example the website of the U.S. Environmental Protection Agency, had some information on EMA, there was not a single website where you could get comprehensive information, especially where you could get comprehensive international information from the many different countries who are doing work in EMA. So our goal was to develop

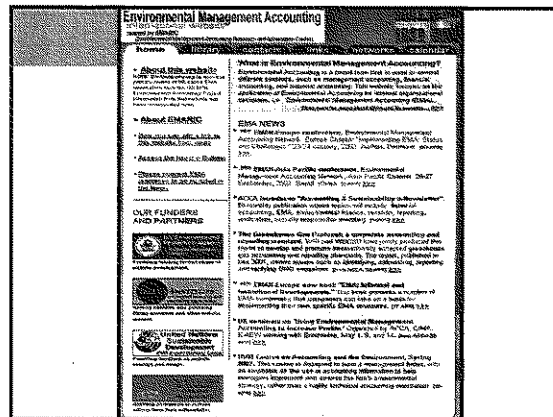
a website that was comprehensive, easy to access, easy to search for specific information and as up to date as possible. This has actually been very challenging because there is so much happening in this field that it's actually very difficult for us to keep up, and keep everything up to date.

**The International Website on EMA (2)**

- Searchable Database (International in scope)
  - Research reports, case studies, journal articles, books, guidance documents, training materials, software, etc.
  - Descriptive abstracts, downloadable documents (when possible)
- Contacts (Individuals)
- Links (organizations & websites)
- Networks (EMAN, EMA Listserve, etc.,)
- Calendar
  
- EMA News
- Periodic Email Newsletter with Updates

This slide shows some of the different types of information you can find on the website.

But I will describe these when I'm showing you the next slide which is the website homepage. On the homepage of the website, we include EMA news items so if there is a new publication or a new conference has been announced or something like this, we will put the items on the homepage. We also publish an e-mail newsletter - anyone who wishes to can sign up to receive this news letter. We send it out once every three months, approximately, to give you an update on new information on the website. So you can decide whether or not it's time to go back and look at the website again. We also have a searchable electronic library on the website where we try to include many different EMA documents, case studies, research reports, training materials, any materials that we can find. If possible, we allow you to actually download a copy of



that article. If that is not possible, we will tell you where you can go to order a copy of that article, or we will link you to someone else's website where you can find that information. We have a section on links, which is links to other websites around the world that include some significant amount of EMA information. We have a section on networks where we tell you about the EMA networks in different regions of the world and how you can contact them. Of course if you are interested in the Asia- Pacific network, you can talk to Prof. Kokubu. There is also an EMA lists serve, an e-mail discussion group for which you can sign up. If you have a question about EMA you can send it out and you will get five answers probably from five different countries, which is very nice. And there is also an EMA calendar, which would of course announce meetings like this one. You can see here our funders and partners, the United Nations, the Association of Chartered Certified Accounts, Tellus Institute, the U.S. Environmental Protection Agency and also the U.K. Environmental Protection Agency.

This is another way in which people in the international community are sharing information on EMA. The first chapter was founded in Europe five or six years ago. This chapter has meetings every year, in fact the

**EMAN Chapters...**

**EMAN = EMA Network**

- First chapter founded in Europe 5-6 years ago
- Asia-Pacific chapter founded 2-3 years ago
- Americas chapter founded 1 year ago
- General goals – EMA information sharing, networking, collaboration
- Open membership – industry, government, consulting, academia, etc.
- Activities include annual meetings, paper publications, etc.


European Chapter is meeting this week in Lueneburg, Germany. The Asia-Pacific Chapter was founded several years ago, and I'm sure that perhaps many of you are members. The Americas Chapter was founded only one year ago. In the United States, we have an existing network of people who are interested in EMA, but it has been a more informal network. We decided one year ago to formally adopt the EMAN name and to formally affiliate ourselves with the other EMAN Chapters to make international communications easier. The general goals of the EMAN Chapters are information sharing and networking, and also active collaboration on projects. It has an open membership - anyone can join - and there are members from industry, government, consulting, academia and NGOs. The activities include annual meetings and also paper publications. These networks have been a very effective and efficient way of learning what is going on in other parts of the world.

Another international effort to share information is being sponsored by the United Nations Divisions for Sustainable Development, UNDS. UNDS established an EMA working group in 1999. The members of this working group are government representatives from many different countries around the world. There are also some

non-government members. These members are invited representatives of other key organizations, such as accounting associations and academia. The main goal of this group is to help government promote EMA. But I would like to point out that many government agencies are interested in promoting EMA

**UNDS Expert Working Group on EMA...**

*UNDS = United Nations Division for Sustainable Development*



- EMA Working Group established in 1999
- Core members are government representatives from 30+ countries
- Other members include invited representatives of accounting associations, academia, etc.
- Group goal is to improve the role of government in the promotion of EMA.
- Group has met 7 times, each time in a different country

for use by industry. So even though it's a government-working group, it has focused very much on EMA practices that are useful for industry operations. The group has met seven times about once each year. Japan is a very active member of this group and Japan hosted one of our meetings several years ago. The Japanese representatives to these meetings have been Goto Shinichi and Sawami Kenji of the Japanese Ministry of the Environment and also Prof. Kokubu.

At each meeting of the United Nations group, there is a session where we give each other updates on the EMA activities in the different countries. The group has also commissioned technical workbooks on EMA procedures and principles and EMA policies and links. The group has also commissioned two very short introductory brochures on EMA: one for government and one for business. If you are interested in seeing copies of these documents, you will find them in the library on the EMA website. Ongoing work

**UNSD Group Activities...**

- Information-sharing
- Development of 2 technical workbooks on:
  - EMA Procedures & Principles
  - EMA Policies & Links
- Development of 2 introductory brochures on EMA – for government and business audiences, respectively
- Ongoing – EMA for the financial sector
- Ongoing – development of a guidance document for the international accounting community

of this group includes looking at EMA for the financial sector and also the development of a guidance document for the international accounting community, which I will talk about a little bit more later.

**EMA Guidance Document for the International Accounting Community...**

- Facilitator – UNDSO
- Funders – UNDSO as well as governments of US, UK, Japan, Germany, Austria
- Authors – EMARIC/Tellus (Boston US) and IOEW (Vienna, Austria)
- Reviewers – nominated experts, the UNDSO group, the public...
- Organizer of Public Review Process and Publication – International Federation of Accountants (IFAC) Board of Directors
- Plan is to publish before end of 2004

First of all, I would like to say that there are many guidance documents available on the subject of EMA and related topics. Some of these were written for specific countries such as Japan, Canada or the U.K. They have case studies from those countries in the guidance documents. Some guidance documents are more generally useful to people in different countries, but they might be a little bit out dated because EMA is changing and evolving so quickly these days. There is no guidance document that has been written specifically for the international accounting community that has been formally endorsed by an international accounting organization. So this project is an attempt to produce such a document. The

facilitator is the United Nations Division for Sustainable Development and the project has been funded by a number of different national governments, including the government of Japan. The document will go through two different review phases. One draft will be reviewed by EMA experts, which have been nominated by the different funding countries. Japan has two experts who are reviewing this international document, Mizuguchi Takeshi, who will speak later and Kurosaka Tomoko. There will also be a public review process where anyone who is interested including anyone who is here, if you are interested, you can review the document at that time. This review process will be coordinated by the Board of Directors of the International Federation of Accountants (IFAC). Assuming that everything goes well, and that the IFAC Board of Directors gives final approval, they would plan to publish this document before the end of 2004. In writing this document, we are very carefully reviewing guidance documents from different countries such as Japan to make sure that this international document as much as possible learns from all of the work being done by the different individual countries, and is as consistent with them as is possible.

I would like to now talk about some international topics of debate. Because there are so many different approaches to EMA and so many different countries, there have been some very active discussions on several issues. One issue is "what kind of information does EMA include?" "Is it only cost information or should it also include physical information such as materials flows?" Another issue under discussion has been the question how can EMA information be used or how should

**International Topics of Debate...**

The most widely debated issues have been:

**What kind of information does EMA include?**

- Only monetary information? Physical information also?
- Which environment-related costs?

**How can or should EMA information be used?**

- Primarily for internal management?
- For external reporting also?

**What are the best EMA implementation methodologies?**


EMA information be used. Is it really only for internal management decision-making or is it also intended for external reporting? A third issue is "what are the best EMA implementation methodologies?", because there has been a lot of experimentation on different methodologies. There is beginning to be some international consensus on some of these issues through the EMAN Chapters and through the work of the United Nations group.

**International Consensus (1)**

**What kind of information does EMA include?**  
Only monetary information?  
Physical information also?

**Growing international consensus – both**

*It is difficult to do good cost accounting without doing good materials accounting first (especially in manufacturing)*



On this question, "what kind of information does EMA include - only cost information? or does it also include the physical materials flow information?" The growing international consensus is - both. EMA should include both types of information, especially in manufacturing operations. It's very difficult to do good cost accounting without doing good materials accounting first because the cost of materials is often one of the greatest cost drivers.


On this related question, "which types of environmental costs should be included under EMA?" the growing international consensus is when an organization is first starting to do EMA, they should be comprehensive. When a government is publishing guidelines or when an accounting

**International Consensus (2)**

**Which environment-related costs?**

**Growing international consensus – be comprehensive**

*Do not leave out any potentially significant costs, earnings, or savings – especially the costs associated with wasted raw materials*



guidelines on EMA, they should try to be comprehensive. We want to be very careful, not to neglect, not to leave out any potentially significant costs - and the most common cost which is not included is the cost related to wasted raw materials. I think we will be talking about this a lot today because we are going to have a presentation on Material Flow Cost Accounting. But many EMA guidelines do not include this type of cost under EMA. If you work in a manufacturing setting where you do generate some waste, then the monetary value of lost raw materials can be very, very significant. And it is an environmental cost because when you create waste that creates an environmental impact. So the international consensus is you really need to be comprehensive. Once you have a comprehensive list of costs to work with, then individual companies can make decisions on which costs are the highest priorities for their particular company.


**International Consensus (3)**

How can or should EMA information be used?  
Primarily for internal management?  
For external reporting also?

Growing international consensus – both

EMA information can/does inform:

- Internal management decision-making (e.g. CP, SCEN, EMS, etc.)
- External reporting (e.g., financial, environmental, sustainability, statistical)




Another international consensus point is shown here; how can or should EMA information be used. Is it most applicable for internal management decision-making or for external reporting, or for both? The international consensus is growing that it is valid for both of these purposes. As I mentioned earlier, Japan has the strongest focus on the external reporting use of EMA information. But I think that other countries are also growing to recognize the value of EMA for this purpose.

**International Consensus (4)**

What are the best EMA implementation methodologies?

Growing international consensus – will vary from case to case, but some best practices can probably be identified



On the question of EMA implementation methodologies, it's very clear from the experience in different countries that there is not one single EMA methodology that will be the best one in all situations. This is because conditions and needs differ between different countries and organizations and also because EMA is useful for so many different kinds of applications such as budgeting, supply chain

management, cleaner production. It's a very long list. It's not possible to find one single EMA methodology that is best for all these situations. However I think the international community would now agree that some best practices could be identified. It is also very clear that Materials Flow Cost Accounting is one of those best practices. There are however others that are practiced more often in another countries.

**The Future of EMA (1)**

We need better consistency between EMA and other types of environmental accounting and reporting – and better coordination between the respective stakeholders involved, e.g.,

- Environmental Financial Accounting/Reporting
- Environmental/Sustainability Performance Reporting
- Environmental Statistical Accounting/Reporting

So for the future of EMA, one thing I believe that is needed is better consistency between EMA and other types of environmental accounting and reporting, such as financial accounting and reporting. In some countries, there are requirements to report different types of environmental information in the company's annual financial report. Environmental and sustainability performance reporting (this is voluntary performance reporting by companies) - clearly in Japan there is a very strong link and a very strong effort to report EMA information and these types of reports. A third type of environmental accounting and reporting is Statistical Environmental Accounting and Reporting. What I mean by this is - when individual companies report information to the national statistical agency and that information can also be reported to international agencies, such as the United

Nations, these agencies develop statistics to measure the environmental conditions and performance of larger geographic regions, such as a country or a particular ecosystem or the entire world. EMA information will also inform this type of reporting which is done by companies. And there is unfortunately not very much consistency right now between these different kinds of accounting and reporting, which can make it very difficult for a company that's trying to do three or four of them at the same time. So we need work for more consistency between these reporting systems, between the metrics that should be reported, and better coordination between the different organizations involved in the reporting systems.

**The Future of EMA (2)**

EMA may come to include other types of information not currently considered by many organizations

- Internal social costs, e.g., the costs of worker illness to the organization (via Sustainability Management Accounting)
- External costs, e.g., the costs of public health impacts of the pollution emitted by an organization

Another comment on the future of EMA. EMA may come to include other types of information, which are not currently considered. Prof. Kokubu mentioned this issue also in his presentation. For example, the first bullet here, internal social costs, are a type of cost which currently are not included under EMA. EMA focuses on environmental costs and it does not focus on internal social costs. Let me please explain what I mean by internal social costs - an example would be the cost of worker illness. This is a social type of cost, which the organization must pay in some fashion. I'm not talking about

externality costs yet, such as costs to public health, I'm talking about the internal social costs that affect the bottom line profitability of the company. There are people already doing research into including these types of internal social costs along with EMA information. So instead of calling this approach Environmental Management Accounting, it's being expanded to be Sustainability Management Accounting where environmental management accounting includes environmental and economic considerations. Sustainability management accounting includes economic environmental and social considerations. All from the company's own perspective. This is happening now. The next United Nations working group meeting will have sustainability management accounting as the theme of the next meeting. Another type of information that EMA may come to include is external costs. This was also mentioned by Prof. Kokubu. I think that for most companies this is further in the future.

**The Future of EMA (3)**

We need more widespread adoption of EMA

- Integration of EMA and related concepts into core course at universities, and into continuing education for accountants, engineers, environmental managers, etc?
- Endorsement by influential stakeholders?
- Required reporting of EMA information from large organizations?
- Dissemination to smaller organizations via the supply chain?

This is my last point on the future of EMA. One thing which is very much needed is more wide spread adoption of EMA. There are different opinions on the best way to encourage wide spread adoption of EMA, so I give some possibilities here. One very common approach being used in different countries is education and training that try to integrate EMA into core courses not only at universities but also



continuing education courses for practicing accountants and engineers and environmental managers in industry. Another approach is to try to obtain the formal endorsement of EMA by influential organizations such as the International Federations of Accounts.

Another possibility might be to require that some large organizations report EMA information. In the United States for example, the Toxics Release Inventory, a reporting requirement, requires companies to report materials flow information, not a complete

set of information - it's only a subset of EMA information. But it was very, very effective at getting some of those companies to recognize their environmental impacts, and to do something about it. Then, of course, another option for more wide spread adoption is to try and disseminate EMA practices to smaller organizations via the supply chain and that topic will be addressed in more detail by Dr. Mark Stoughton.

I thank you very much. Arigato Gozaimashita.

## Greening the Supply Chain Profitably: Applying Environmental Management Accounting Principles

Mark Stoughton

IGES Kansai Research Centre

Tellus Institute

Chemical Strategies Partnership

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Thank you very much. My name is Mark Stoughton. I am Dr. Savage's colleague at Tellus Institute and as was just mentioned, am also a visiting researcher at the IGES Kansai Research Center. It is a great pleasure to be asked to address this meeting.

I will be talking about external applications of Environmental Management Accounting. And although I stand here alone, I am presenting the results of the collaborative work of a number of colleagues, Dr. Savage not least among them. Please note that the printed materials contain slides and examples that I will not address in detail during my spoken remarks. Those slides are included for your information. Questions about them are welcomed later in this session or via e-mail afterwards.

### <Part 1: EMA for Supply Chain Management?>

**EMA:**  
A tool for internal management

- EMA usually viewed as an *internal management tool*
- EMA provides improved understanding of environmental performance, materials flow and energy utilization
- AND the costs associated with each
- Understanding is necessary for control environmental performance and costs, and more generally, for informed management decision-making

EMA is usually thought of as an internal management tool. As you have heard and know, EMA provides improved understanding of environmental performance, materials flows and energy utilization, and of the costs associated with each of those items. Such understanding is essential for sound management of internal operations.

Supplier performance is critical to customer performance

- BUT many of the environmental impacts associated with a product or process are in the supply chain
  - upstream, lifecycle impacts
- AND management of the supply chain is essential for competitiveness, profitability and control of liability

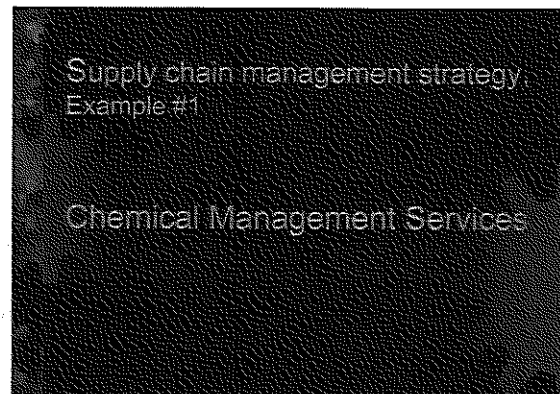
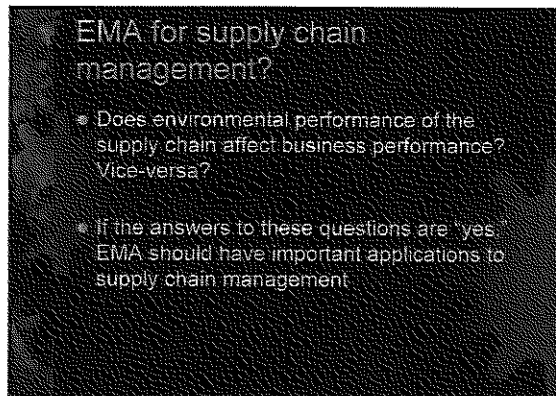
Diagram showing supply chain tiers: Tier 3 Supplier (Raw materials), Tier 2 Supplier (Supplier services), Tier 1 Supplier (Supplier services), Customer Company (Raw materials, Supplier services, Logistics, Production, Distribution, Sales, Marketing, R&D, Finance, HR, IT, Legal, Compliance), and End Customer (Retail, Distribution, Sales, Marketing, R&D, Finance, HR, IT, Legal, Compliance).

However, good business management is not limited to management of internal operations. Management of the supply chain is essential for competitiveness, for profitability, and for control of liability. From an environmental perspective, many of the environmental impacts associated with the product or the process lie upstream in the supply chain. These are the so-called upstream life cycle impacts.

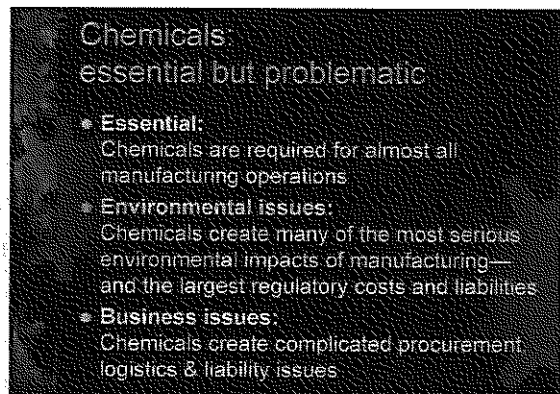
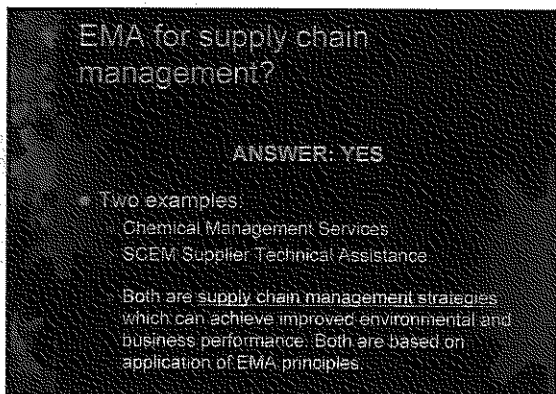
So, we have an obvious question. Does EMA have a role in management of the supply chain? Specifically, can the environmental performance of the supply chain affect

business performance? Is the reverse true? If the answers to these questions are "Yes," then

The first example is Chemical Management Services.



EMA should have important applications to Supply Chain Management.



Well, as you know the topic of my speech, it should be no surprise that I answer "Yes" to these questions. EMA does have a role in Supply Chain Management. We will look at two different examples. The first is Chemical Management Services. In this supply chain management approach, the supplier improves the customer's operations. Second, we will look at a supplier technical assistance model. In this model the customer improves the supplier's operations. Both examples are supply chain management strategies that can achieve improved environmental and business performance. Both are based on the application of EMA principles.

From a manufacturing perspective, chemicals are essential. They are used in almost all manufacturing operations. From an environmental perspective however, chemicals are extremely problematic; they are the source of most of the environmental impact of manufacturing. From a business perspective, chemicals are quite complicated. They have complicated procurement, logistics and they create substantial liability issues and compliance costs.

From the perspective of society and also of the purchaser of chemicals, there is a basic problem. The structure of chemical supply contracts creates incentives for suppliers to sell more chemicals. Why is that? In a typical chemical supply contract, the more chemicals the supplier sells, the more revenue they

<Part 2: Chemical Management Services (CMS)>

obtain. Contracts are usually based on unit cost per litre or kilogram of chemical.

**A basic problem**

- Basic structure of chemical supply contracts does not create incentives for reduced use of chemicals

**The best solution: restructure the incentives**

- In theory, contractual incentives can be aligned to promote use reduction

If we wish to address this fundamental problem, we could think about changing the incentives in the contract so that the chemical supplier is incentivized to reduce total chemical use. We could do that if we compensate the supplier on the basis of chemical service, not on the basis of the volume of chemicals.

**From theory to practice**

- Chemical Management Services (CMS)**  
A strategic, long-term relationship in which a customer contracts with a service provider to supply and manage the customer's chemicals and related services.  
Provider's compensation is based primarily on quantity and quality of services delivered, not chemical volume.  
CMS is more than invoicing and delivering product. CMS involves optimizing processes, continuously reducing chemical lifecycle costs and risk.

When we achieve such a change in

incentives, the result is something called "Chemical Management Services" (CMS).

CMS is a business model for chemical supply. It is a strategic long-term relationship in which a customer contracts with a service provider to supply and manage the customer's chemicals and related services. A defining characteristic of CMS is that the chemical providers' compensation is based primarily on services delivered, not volume of chemical. This means that the supplier takes over some chemical management operations previously executed by the user of the chemicals.

**Examples of CMS contracts**

- FLAT fees**  
Per automobile body painted  
Per circuit board cleaned
- GAIN-SHARING**  
When the CMS provider finds a way to reduce total chemical costs, savings are shared between provider and customer
- REQUIRED TOTAL COST reductions**

There are many different examples of CMS contractual models. You could imagine an electronics manufacturer, who pays a flat fee for every circuit board cleaned instead of paying a supplier per litre of cleaning solvent. You can think about gain sharing models, in which a supplier identifies cost reductions in the customer's operations and the resulting savings are shared.

**EMA principles: the core of CMS**

- CMS contracts are based on **TOTAL COST OF CHEMICALS**

Regardless of the precise contractual model, the contract is based on the total cost of the chemicals. For this reason, EMA is at the center of the Chemical Management Services model.

What are the total costs of chemical use? Chemical management begins with procurement. But it extends through many other activities: receiving inventory, internal distribution to point of use, use, collection after use, treatment and disposal. And across all of these activities, you have environmental health and safety compliance requirements and you incur legal liability.

As a result of this spectrum of chemical management activities, the total cost of managing chemicals is much more than the simple cost of purchase. In fact it costs at least one dollar to manage every dollar of chemical purchased. In some cases it costs ten dollars to manage every dollar of chemical purchased.

So, why must CMS rely on a total cost assessment? Well, the CMS provider is taking over certain chemical management functions. Those functions have a cost and when the CMS provider presents a proposal to the customer, the customer must be able to evaluate this on the basis of total cost.

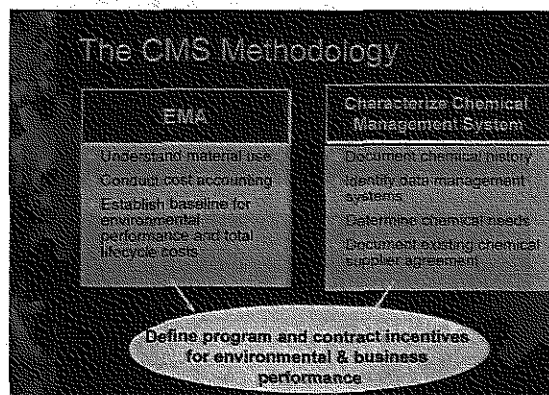
**CMS: Total cost illustration**

Accounting systems and CMS

Department	Chemical costs before CMS	Chemical costs after CMS
Procurement	1000	2500
Inventory	1000	0
Production	1000	200
EHS	1000	200
<b>True Total cost:</b>	<b>4000</b>	<b>2900</b>

For example, before a CMS program, total costs of chemicals might be divided between purchase, storage, use and environmental compliance. Under a chemical management contract, many of the inventory use and

compliance functions are taken over by the provider. All of those costs now become a contract cost under procurement. So if you compare only the procurement cost before CMS and after CMS, CMS does not look like a good business proposition. However, if you look at total cost, it does.



So, the CMS methodology is half EMA and a half a technical assessment of the chemical management system. The EMA component is a total cost assessment and a base line of environmental performance and total cost. The technical assessment component is necessary to achieve an understanding of the physical handling and use of chemicals in the facility. Together, the EMA and technical assessment component allow one to define a CMS program.

We have been quite fortunate to be able to do a significant amount of applied research with the CMS model. This research has been carried out via another non-profit organization called the Chemicals Strategies Partnership, or CSP. CSP was established to test and evaluate the environmental benefits of the CMS model and also to develop materials and methodologies. I won't go into much detail on the activities of CSP; in the printed materials you have a two-page brochure for CSP that describes the organization and its activities. I will only say that we have been able to do pilot studies, help

to design contracts and engage in CMS program evaluation.

### Applied research with CMS

- With California Environmental Associates (CEA), Tellus staffs the non-profit Chemical Strategies Partnership
  - Initiated to evaluate the environmental benefits of the CMS business model
  - Now works to reduce chemical use, waste, risks and costs via the CMS business model
  - Started 1998
  - Major initial funding by Pew Charitable Trusts & the Heinz Endowments
  - Tellus is technical manager

### Chemical Strategies Partnership (CSP)

- CSP Activities
  - More than 15 hands-on, in-depth collaborations with private sector and institutional partners
    - Silicon Valley Pilot Program, Western Pennsylvania
    - Company-specific: Raytheon, Noral
  - Case Studies
    - Motorola, Chrysler, General Motors, Ford
  - CMS Forum, a membership organization of CMS customers & suppliers
    - Industry participation: Ashland Chemical, Dow Corning, Shell, Haas, GM, Daimler-Chrysler, etc.
  - Workshops, events

### CMS case study: General Motors (customer) + HAAS Corp (Supplier)

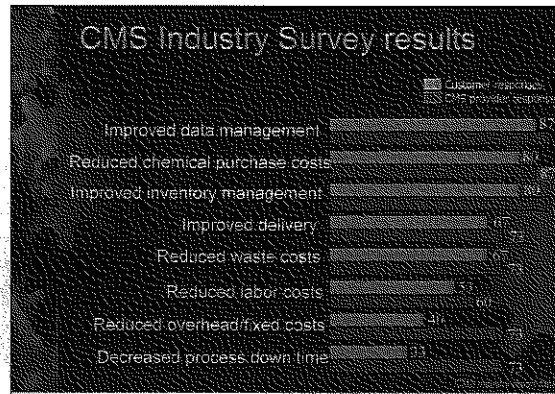
#### Paint booth maintenance chemicals

Reductions over 6 years in CMS contract with unit pricing:

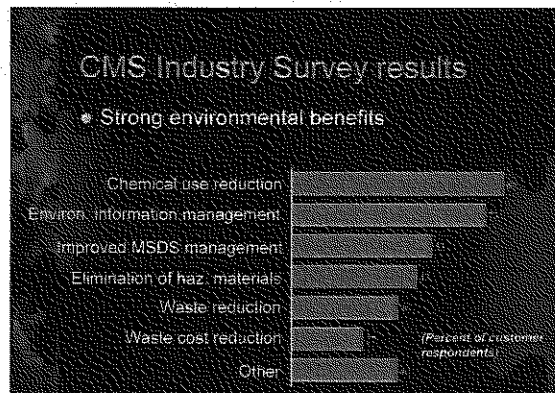
- 54% decrease in large solvent
- 77% decrease in paint stripper
- 30% decrease in solvent masking
- 78% decrease in VOC emissions
- 83% reduction in detoxification chemicals

### More CMS results

<h4>Semiconductor facility (first 3 yrs)</h4> <ul style="list-style-type: none"> <li>Reductions                     <ul style="list-style-type: none"> <li>Orbital chertab inventory by 50%</li> <li>58% of annual chemical consumption in 2 yrs</li> <li>6% of hazardous waste in 2 yrs resulting in savings of \$24,000/yr</li> </ul> </li> <li>Chemical substitutions saved \$120,000/yr</li> <li>Orange container size of chemicals resulting in savings of \$65,000/yr</li> </ul>	<h4>Aerospace facility</h4> <ul style="list-style-type: none"> <li>Savings of \$1.1 million (on \$1.6M of chemicals purchased)</li> <li>Key reductions                     <ul style="list-style-type: none"> <li>Costs by 15-20% due to chemical purchasing consolidation</li> <li>Streamlined and chemical right costs by 20%</li> <li>Hazardous waste generation by 15%</li> <li>Procurement cycle time from 15 days to less than 1 day</li> </ul> </li> </ul>
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And we do have a number of quite convincing results. Again, I will not go into these in detail. If you are interested, please look over the slides that are included. You will see very substantial reductions of chemical use under CMS programs; you will also see the results of a CMS industry survey of both customers and CMS providers, documenting the beliefs of each party regarding the performance of the CMS programs. Both suppliers and customers believe that CMS has offered substantial environmental and business benefits.



Why does CMS offer environmental benefits? The first reason is that the CMS provider is rewarded for chemical use reduction. The second is that the CMS contract requires the provider to carry out certain environmental management functions-for example, compiling environmental reporting data. So, via the CMS contract, a professional

The source of CMS's environmental benefits

- CMS provider is rewarded for use reduction
- The CMS contract requires provider to carry out certain environmental management functions (e.g., reporting)
  - The contract itself enforces environmental management requirements
- Handling of chemicals is standardized and professionalized.
- Quality of environmental information increases

standard of environmental management is enforced. In addition, the handling chemicals is standardized and professionalized under CMS. And almost inevitably, CMS increases the quality and quantity of environmental information.

CMS: Lessons learned

- Most chemical customers have **VERY POOR** understanding of their total chemical costs
- Other barriers exist for both suppliers and customers
  - Especially when supplier is also a chemical manufacturer
- Environmental benefits require a contract that:
  - Is based on total costs (not unit cost of chemicals)
  - Rewards reduction in chemical use

We have learned, via the CMS research, that most chemical customers have very poor understanding of their total chemical costs. And in almost all cases as you would imagine, CMS adopters have not implemented EMA systems before investigating chemical management.

There are other barriers that exist for both suppliers and customers. This is especially true when a supplier is also a chemical manufacturer. Obviously the profit of the manufacturing unit is driven by production and sale of chemicals. Profit of the service unit is not. In fact, additional sales of chemicals for the service units reduce profits. This can be a

difficult institutional problem for a chemical supplier.

<Part 3: Supplier Technical Assistance >

Supply chain management strategy  
Example #2

SCEM Supplier Technical Assistance

SCEM = supply chain environmental management

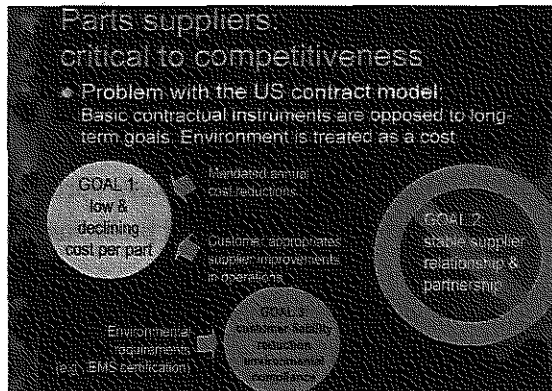
Parts suppliers critical to competitiveness

- For sectors that sell complex, mass-produced products in global markets, reliable, high-quality, low-cost parts suppliers are essential to competitiveness
  - Example sectors: automobiles, aerospace, consumer electronics
- Basic US contract structure for parts supply
  - Unit cost based on purchase volume & cost-of-manufacture
  - Quality and on-time criteria
  - Mandated annual cost reductions
- Suppliers are often SMEs

The next example is a supplier technical assistance approach.

If chemicals are essential to manufacturing, parts, and supply of parts are critical to the competitiveness of many industries. This is particularly true of industries that sell complex products that are mass-produced for global markets. Examples of such industries are automobiles, aerospace and consumer electronics. For these sectors especially high quality low cost parts suppliers are essential to competitiveness. Please note that I speak in this example specifically about the U.S. context; I apologize that I don't know enough about Japanese supplier-customer relations to make generalizations about the Japanese context. The basic US contract structure

for part supply is based on unit cost with discounts for purchase volume. The cost of manufacture is often known quite precisely by the customer. The customer includes quality and on-time criteria in the contract and often includes mandated annual cost reductions of five percent or more per year. The suppliers are often small and medium enterprises.



The basic problem with the US contractual model is this: Customers say that they have three goals. (1) Low and declining cost per part; (2) a stable relationship and partnership with their suppliers; and (3) environmental compliance and reduction of environmental liability.

Goal number one is addressed by annual cost reductions and by the customer appropriating or taking the benefits of improvements in supplier operations. Environmental issues (Goal 3) are addressed via separate environmental requirements. There is no contractual mechanism that consistently supports goal two, and in fact the mechanisms used to achieve Goals 1 & 3 often act against Goal 2. This is a problem, as customers agree that achieving Goal 2 is the basis of long-term competitiveness.

To address this basic problem, cleaner production or pollution prevention approaches can be "win-win-win" solutions. They can improve supplier profitability, lower the cost of parts and improve environmental performance.

### A role for P2/Cleaner Production?

- Cleaner production/P2 approaches focused on *INCREASED EFFICIENCY* and *WASTE MINIMIZATION* are win-win-win solutions. They can
  - improve supplier profitability
  - lower cost of parts, and
  - improve environmental performance
- Customers firms often have P2 capabilities that suppliers lack

### Customer support for supplier P2 is critical

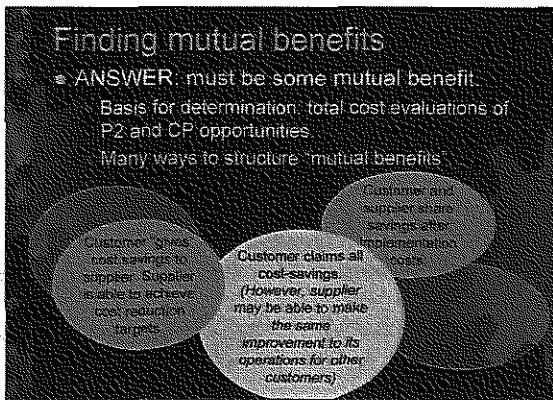
- Barriers to supplier CP/P2: In these industries, customer specifications are rigid. They often prevent suppliers from making changes to both parts & processes
- If supplier P2 is to be successful, it must be **ACTIVELY SUPPORTED** by the customer. Customer must be willing to make changes in part specifications and perhaps production processes. All such changes have costs.

**Key Question:** what incentives do customers have to support supplier P2/CP?

Using prevention-based approaches to improve supplier performance sounds like a great idea. There are two main problems. The first is that supplier firms-these small and medium enterprises-often have very low clean production capabilities. The second barrier is that in these industries, customer specifications are quite specific and rigid. They often prevent suppliers from making changes not just to parts but also to processes.

Therefore, if supplier pollution prevention (P2) or cleaner production is to be successful, it must be actively supported by the customer. The customer must be willing to make changes in parts specifications and perhaps in production processes. All such changes have costs. For example, it may cost an automobile manufacturer hundreds of thousands of dollars to certify a supplier part. A customer will not re-certify without a good reason.





So what incentives do customers have to support supplier P2? The short answer is that customers and suppliers must derive mutual benefits. The basis for determining and structuring mutual benefits must be total cost evaluations of pollution prevention and cleaner production opportunities. That is, total costs and benefits both on the supplier side and on the customer side must be calculated.

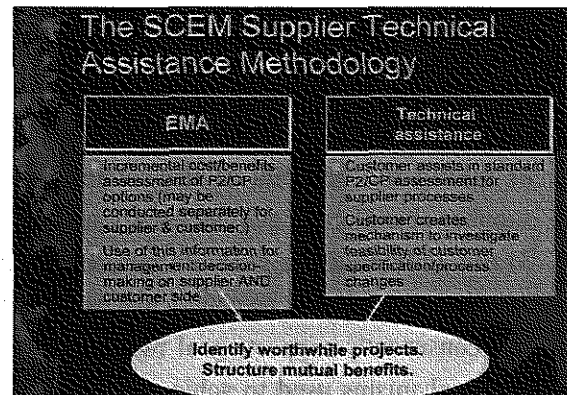
Once you understand total costs, you can think about different ways to share benefits. For example, perhaps the customer will choose to "give" all the cost savings to the supplier. The supplier is then able to achieve cost reduction targets without becoming unprofitable. Perhaps the customer and the supplier share savings after implementation of the cleaner production opportunity.



Now, many people believe that automotive parts suppliers or consumer electronics parts suppliers are already extremely efficient. Why?

Because they are pressured continuously for cost reductions. Our experience, however, is that these suppliers are not so efficient from a cleaner production perspective; improvement opportunities do exist. Here is one recent example from a facility visit to an auto parts supplier making a 60-dollar rubber window seal for a European automobile manufacturer. The supplier was throwing out 15 percent of its raw material stock; 50 percent of that disposal was occurring after the final production step. This constitutes a huge loss of value added and materials. In addition, there were particulate and volatile organic compound problems in the plant.

The source of both the economic and the environmental problem were coatings added to the rubber (both paint and surface textures). A partial solution to this problem would be better supplier process control. A full solution would require a change in customer specifications. As long as the customer insists on that particular surface coating, these problems will remain.



So, like CMS, this supplier technical assistance methodology is half EMA and half a technical component. EMA is required to understand the total cost and benefits of the cleaner production opportunities. That information must be utilized for management decision-making. On the technical side, a technical assessment of the supplier's operation

is required to identify improvement opportunities. (The customer may help identify these opportunities). The critical contribution of the customer, however, is creating an internal mechanism to investigate whether these cleaner production opportunities are feasible from the customer perspective.

### Implementing SCEM Supplier Technical Assistance

- GM/Saturn Pilot Project
  - Funded by US EPA and General Motors
  - Supplier recruitment by Saturn (GM division)
  - Technical assistance provided by US NIST
  - For the 4 supplier facilities that took part
    - 18 improvement opportunities identified
    - 11 customer controlled, 5 supplier controlled
    - 10 had environmental benefits at the supplier facility, 4 had environmental benefits at the customer facility
    - All 16 projects had financial benefits at the supplier facility, 5 had financial benefits at the customer facility

There has been a pilot project in the U.S. using this model. It involved a division of General Motors (the Saturn division) and was funded by US EPA. Saturn and its suppliers were able to identify mutually beneficial opportunities.

The pilot program in the U.S. is being expanded. There is international interest. For example, Tellus is involved with a project funded by the Korean government and its national cleaner production center.

These pilot efforts have been effective in applying the technical component. However, creative thinking about structuring mutual benefits—that is, about dividing savings between supplier and customer—is not mature. Creative thinking in this area is needed.

CMS contract models or other performance based contracting models can provide some insights for how to structure mutual benefits. It is certainly my opinion that large customer firms should be able to achieve significant increases in supply chain efficiency if they are able to (1) successfully help their suppliers

identify cleaner production opportunities and then (2) find ways to share benefits based on total costs. This is undeniably a challenge, but also a very large opportunity.

### For more information: CMS

- CMS Forum: A coalition of CMS providers, their customers, Tier II chemical suppliers, and other stakeholders interested in promoting chemical management services
- Mission: grow the awareness and practice of economically and environmentally beneficial chemical management services
- Mark Stoughton, Ph.D.  
stoughton@iges.org or jp.mstough@tellus.org

### Background Information: Tellus Institute

- Research institute (think tank) on environmental issues located in Boston, USA
- Established in 1976, ~45 researchers
- Areas of operations
  - Business and Sustainability
  - Sustainable Communities
  - Energy
  - International
  - US center of Stockholm Environmental Institute
- Works with government (national, state, local), industry, UN agencies, foundations, NGOs
- Focused on applied research: what is cutting edge and what has been implemented? How to make it better?

### Background: Tellus Activities on Business & Environment

- Supply Chain Management
  - Chemical Strategies Partnership (CSP)
  - Resource Management
- Environmental Business Accounting
  - Hosts Environmental Management Accounting Research and Information Center (US EPA support)
- Governance and Accountability
  - Global Reporting Initiative (GRI)
- Public Policy
  - Assessment of regulatory programs
  - Working with government to develop and pilot new approaches

Please note that the final slides in the printed materials contain contact information for further information about any of the topics in this talk.

I thank you for your attention and look forward to questions later.

## Fujitsu Green Process Activities

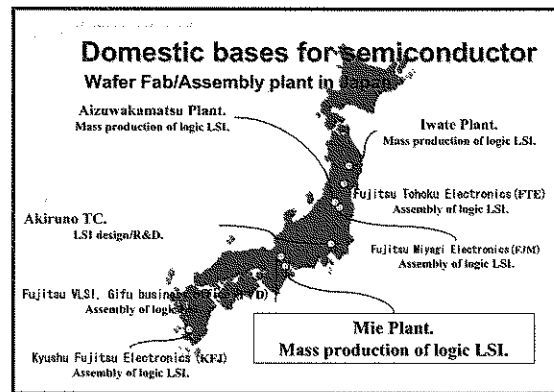
Takeshi Koga  
Fujitsu Limited

I would like to use some examples to give you a brief overview of how we utilize environmental accounting in the production lines at Fujitsu.

By nature, production lines are problematic, in that the bigger they get, the harder it is to tackle issues such as reducing the chemicals used in the line. This is because doing so will affect product quality, and in particular, it is not easy to reduce the use of energy. Therefore, the situation has been that manufacturers have been loathe to touch their production lines in terms of environmental management. It is a difficult problem indeed.

We therefore started by focusing our attention on semiconductor plants, which seemed to be the most difficult of all plants. A great many chemicals are used in the processes in these facilities, so we were facing a daunting task. However, we took the bull by the horns and thought about how we could reduce the use of chemicals.

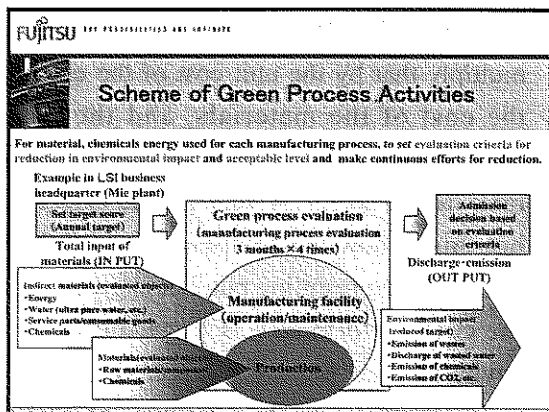
examined the output, that is, the percentage of the input that gets consumed. We did these basic examinations at each three-month term, which is the same as we use for our financial accounting. We evaluated the results, analyzed them, and basically thought of ways to create good quality products with a minimum quantity of material.



Fujitsu has semiconductor plants all over the world. Eight of them are in Japan. We focused on the largest, mass-production plant, the Mie Plant, which is massive in scale and churns out a great many semiconductors. There, we conducted activities and applications in our endeavor to somehow reduce the use of chemicals.

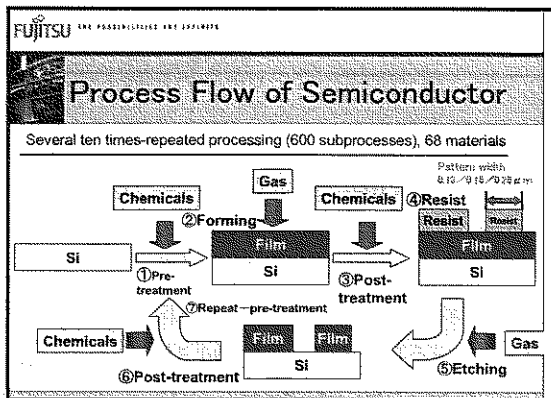
In our Internet society today, semiconductors are the most basic elements of the infrastructure. In other words, be they PCs or mainframes, the service that computers can provide is only as good as the function and performance of the semiconductor they house.

The core of the semiconductor, the most basic part, the most valuable part, is the minute silicone circuitry that is incorporated into the



As you can see from this slide, we examined the input, that is, the quantity that goes into the plant production line. We then

semiconductor, called the silicone wafer.



In order to make this circuitry, there are six processes involved, as you can see in this slide. Basically, a film is formed over silicone, etched, melted, and divided into minute patterns. There are also steps involving cleaning. Extreme precision is required in these processes, which are repeated several dozen times. In the Mie Plant, 68 chemicals are used in these numerous processes. A total of 600 processes are required to make the circuitry for one tiny semiconductor.

So with semiconductors, we go through all these steps, and the final step is the quality check. But when we talk about reducing the use of chemicals, it is not easy, because each of the specifications are very solid. We therefore thought about why we were trying to reduce the chemicals. Of course, reducing the amount of materials would reduce the impact to the environment. However, we also felt it was most important to reduce those chemicals out of the 68 that are fatal to humans, or extremely hazardous to human health. We therefore assigned a rank, from 1 to 5, to each of the materials used in the processes.

Needless to say, these ranks were not made up arbitrarily by Fujitsu. We looked for some degree of basis. For instance, take the impact on human health, rank 5. We investigated

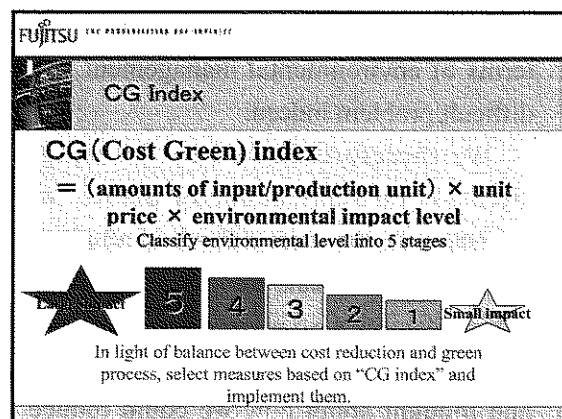
**List of Environmental Impact Level**

Environmental impact level (chemicals and gas)

Rank	Subject	Environmental classification	Note (related regulations)
5	Human	Carcinogen	ACQW, EPA, EU, IARC, Japan Association of Industrial Health
5	Human	Impact on human outside of business place	Environmental hormone Materials regulated by PRTR Law
5	Environment	Global environment (depletion of ozone layer)	EU-will-regulates, ODP
5	Environment	Global environment(global warming)	GHG
5	Environment	Global environment(water contamination)	Clean Water Act
5	Environment	Global environment (air pollution)	Air Pollution Control Law
5	Japan	Working environment	LSDN Industrial Safety and Health Law
Others	Others	Cost saving	

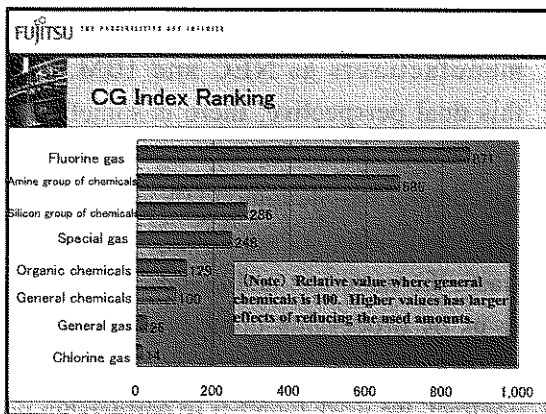
the US regulations, as Dr. Deborah Savage mentioned, as well as the regulations in Europe and Japan, to come up with these grades.

Next, we used this environmental impact to develop an indicator called the Cost-Green (CG) Index.



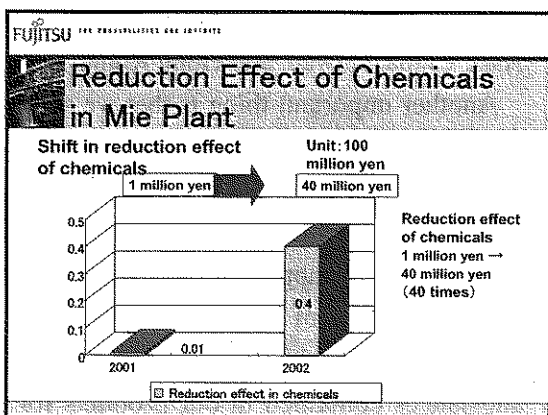
As shown in the slide, we first measure the amount of input, that is, the quantity of the chemical used in a single product. We then multiply that by the unit cost of the chemical, the cost of the materials, and the degree environmental impact I just talked about (a rank from 1 to 5). A very simple calculation, but this is how we computed the CG Index. Naturally, the resulting number is greater when the cost performance is large, or when the environmental impact is large. In short, the result should indicate a mixture of cost and environment.

We first made a list of the 68 chemicals multiplied by the CG Index.



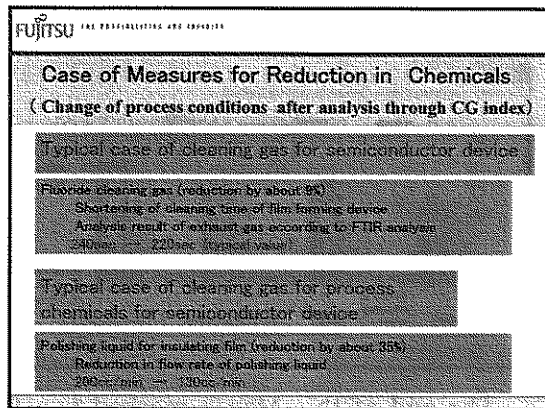
We found that the chemicals on the top of the list have large values: they are fluorine gas and the amine group of chemicals. There is a category called "general chemicals" lower down in the slide: these are basically chemicals that we ranked 3 or lower, those that have a relatively low degree of impact on the environment and human health. This meant the fluorine gas and the amine group of chemicals were more than 50 times greater in terms of cost and environmental impact. Through this process, we focused our analysis on those chemicals with high CG Index values.

As a result, we achieved some major results at the Mie Plant. Before using the CG Index, the reduction effect of chemicals was 1 million yen annually. After a year of using this index, we reduced chemicals costs by 40 million yen.



This was a 40-fold improvement. We found through our all-important analysis results that there was quite a lot of wastefulness. For

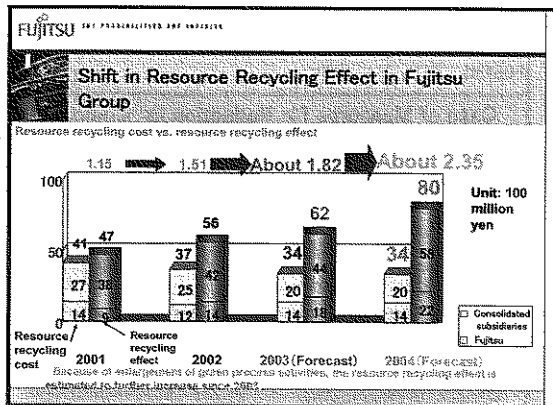
every semiconductor, the concern for having enough chemical to ensure quality was making us provide too large a margin.



I will explain using two examples. The fluorine gas that I talked about earlier, with the high CG Index value: these cause damage to the product when left on the product, even in minute amounts. We therefore used Fourier infrared spectrophotometry to do a thorough analysis of these residues, to determine the amount of residue we could leave on the product and still assure quality. To our surprise, we found that we could achieve a similar quality using 220 seconds of cleaning, instead of the 240 seconds that we had been using. When we shortened the cleaning time, we were able to reduce by 9 percent, the total amount of fluorine that was released and consumed.

In regard to the second case on the slide, the amine group of chemicals, we found through our verification that we could do with a water volume of 130 cc per minute of polishing, instead of the 200 cc that we had been using. With this lesser amount of water, we were able to reduce the total volume by as much as 35 percent. This does not apply only to semiconductors. We also have assembly lines, and so the production lines began to call for the application of these methods to affiliates and subsidiaries in Japan and abroad.

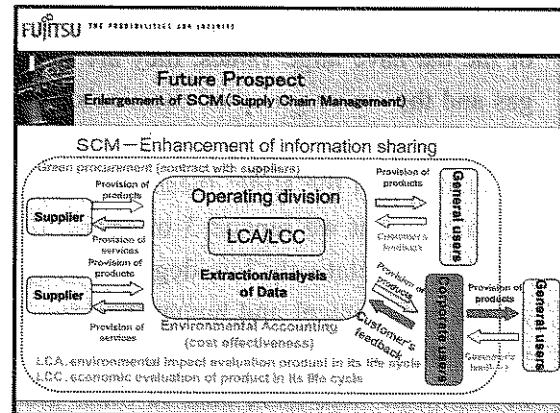
We provided support, as we embarked on the worldwide application of this endeavor.



The end of this March marked two full years since we started this project. On the left of each fiscal year on the slide, we have the cost of resource recycling, and on the right, we have the effect of resource recycling. In terms of cost effectiveness, the effect was 1.15 times greater than cost in fiscal year 2001. As a result of thorough analysis, we roughly doubled that efficiency: in fiscal year 2003, the effect was 1.82 times greater than cost. Just by extending this method to the entire processing system including the assembly line, we are expecting a very significant cost reduction of 8 billion yen on an annual basis in fiscal year 2004. Up to now, we had thought a cost reduction of 4.7 billion yen was the limit, but now we have been able to add 3.3 billion yen to that figure. These results are an outcome of not merely conducting analysis, but also changing the design conditions. Without making modifications this far upstream, it is difficult to obtain these kinds of results. We were able to achieve such major results only through the use of this environmental accounting.

Lastly, I would like to mention that Fujitsu is not only a manufacturer but also a supplier. In other words, we make computers, like PCs, to deliver to the customer, but we

also make semiconductors to deliver to such manufacturers as NEC and IBM. From this dual perspective, there is something we emphasize, which is very close to what Dr. Savage and Dr. Stoughton talked about earlier, and that is this: as suppliers, we should not waste the materials and components supplied to us by processing companies. And while complying with the Green Procurement contract, we work together in partnership with



our customers, to actually reduce costs for both parties. What is even more important, given the present context of suppliers having their backs to the wall because of environmental regulations, is to build more win-win situations, where the terms of purchase are improved by minimizing environmental impact, working together with our suppliers both in Japan and abroad, especially those in Asia, China, Taiwan, and Hong Kong.

Another important thing is that we achieved a significant result in terms of dealing with environmental issues, in that we were able to improve the level of customer satisfaction and respond to our suppliers' wishes by reducing the wasteful use of materials in our facilities, instead of just dealing with the harmful substances contained in our products for the purposes of supplying the products to the general public.

As a result, the total cost is going down,

as Dr. Stoughton talked about earlier. We are therefore freed from wasting costs. But if we are a set manufacturer, our suppliers must also acquire technical prowess. Our most significant method of support is not so much about cost, but instead consists of generously providing our suppliers with analysis and technology so that they can be

powerful members of our supply chain. This movement is expanding in a major way right now. Ultimately, we feel the most important thing for our future business is for us to share the information on supply chain management and further expand the network of win-win relationships.

## On Effective Application of Material Flow Cost Accounting in Strategic Environmental Management

Yuji Kawano

Tanabe Seiyaku Co., Ltd.

Today, I'd like to talk under the theme of "On Effective Application of Material Flow Cost Accounting in Strategic Environmental Management".

Our company is an R&D-based pharmaceutical firm with a capital of 44.2 billion yen and sales volume of about 180 billion yen.

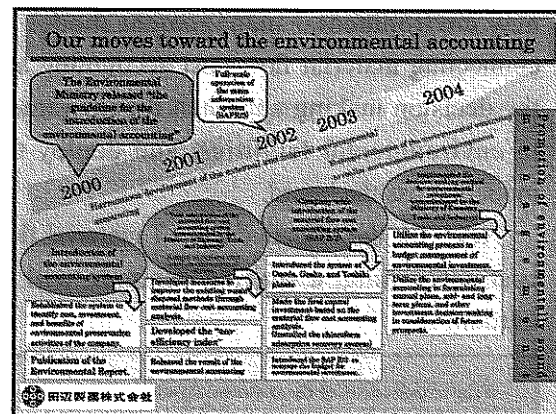
Company overview	
Foundation	1678
Corporate philosophy	Contributing to the health and comfort of people around the world
Line of business	Manufacturing and sales of ethical drugs, OTC drugs, diagnostic agents, chemical compounds
Capital	44 billion 261 million yen (as of September 30, 2003)
Turnover	182 billion 250 million yen (consolidated sales for fiscal 2002)
No. of employees	4,605 (as of September 30, 2003, on consolidated basis)

Our company has promoted environmental management actively. The "environmental management" can be defined as "management that contributes to forming a sustainable and sound material-cycle society with less environmental load." In promoting the environmental management, companies are required to address various problems surrounding them, for example, by bearing the environment conservation costs increased by the compliance with relevant laws and rules, meeting their social responsibilities, and so on.

So, what is needed is a management accounting approach for promoting the environmental management with efficiency. Recently, environmental accounting as one of such approaches has attracted public attention

and a lot of practical case examples have been presented from environmentally advanced companies.

Here is a figure for showing our company's activities on environmental accounting.



The number of companies incorporating environmental accounting into their environmental reports has increased substantively, with Ministry of the Environment's publication of the guideline for the introduction of environmental accounting system in the fiscal 2000 as a turning point. As shown at the lower-left part of the figure, our company firstly systemizes environmental accounting for external disclosure, secures exhaustibility and accuracy of environmental accounting data and then discloses it through the third-party review by an auditing corporation.

In the fiscal 2001, commissioned by Ministry of Economy, Trade and Industry (METI), our company introduced Material Flow Cost Accounting on a trial basis under the Japan Environmental Management Association for Industry. Through the fiscal 2002 to



2003, we carried out next best measures and also completed the system for calculating material flow cost accounting automatically (February 2004), and we are now making its analysis. Further, in this year, as a member of the Working Committee of Decision Making Approach for Investment in Environmental Facilities, we have continued to work with the effective use of the decision making approach for investment in environmental facilities. Specifically speaking, we intend to devise a new environmental management model by connecting material flow cost accounting and the decision making approach for investment in environmental facilities, and deploy the model across the board.

Next, for the effectiveness of material flow cost accounting, a specific example will be introduced.

**Trial introduction of the material flow cost accounting**

Participated in the Material Flow Cost Accounting Project initiated by the Japan Environmental Management Association for Industry under a commission from the Ministry of Economy, Trade and Industry

(1) Project started	July 2001
(2) Model plant	Onoda plant (main plant)
(3) Measured production line	A product group (pharmaceutical) on a single production line
(4) Data collection term	One year (from April 2000 to March 2001)
(5) Scope of data collection	Material cost Energy cost System cost Waste disposal cost

田辺製薬株式会社

The project started July 2001 in the Onoda plant, which is our main plant, as a model plant. The measured objects were manufacturing processes of medicine for one production line and one group of products. The computation period was determined to be one year and data covered full flow cost computed based on financial performance data. That is, we included all of material costs, energy costs, system costs and waste disposal costs as the measuring objects.

Material flow cost accounting is a "method

of dividing costs of raw materials, energy costs and overhead costs that spent during production into flows to products and wastes to keep track of these costs from the both aspects of quantity and amount of money on a basis of process". A main feature of material flow cost accounting is that amount of loss can be found accurately by process because the spent raw material costs are calculated separately for defective products and non-defective products rather than regarded as initial costs altogether according to the conventional cost accounting. This is one of main differences between the conventional cost accounting and material flow cost accounting. The idea of material flow cost accounting is to calculate loss by material costs, system costs and costs of distribution and waste disposal and pinpoint expenditures of a wasteful character, thereby to use raw materials and energy efficiently for cost reduction.

Next, I'd like to describe the actual computing method.

**Calculation of material cost, system cost, and waste disposal cost**

(1) Material cost → Recognize the difference between the calculated (based on the molecule's volume) and actual values of materials as losses. However, for the material which will totally be wasted will be identified individually. With regard to packaging materials, losses are identified by using the theoretical yield used for the loss calculation of principal agent in the packaging process.

(2) Energy cost → After allocating energy consumption at each division to each distribution center (process) in terms of machine hour, losses are identified in relation to the weight of raw materials. (Machine hours standard machine hour per lot x no. of production lots)

(3) System cost → Recognizes it in terms of man-hour by distribution center and losses are identified in relation to the weight of raw materials.  
Equipment cost → Includes depreciation and repair cost of machinery. Recognized the cost center booked on the current depreciation cost after the implementation of SAP R/3. Allocated the equipment cost to each distribution center based on machine hours. Then calculated the losses using the following equation.  
Equipment cost per distribution center x fi - (machine hour / 24 hours x 365 days)

Others → The amount of production overhead subtracted by labor, equipment, energy, and waste disposal costs.

(4) Waste disposal cost → This cost is reported per distribution center based on the volume of waste water disposal and combustion.

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Firstly, for material costs, because physical objects are chemicals, we recognize difference between theoretical value obtained by molecular calculation applying mass balance and actual value as loss and individually grasped what became loss in full in the inputting process, for example, solvent.

Basically, energy costs and system costs

are also allocated at weight ratio of raw materials as a loss. However, for costs of equipment, the loss is set in consideration of costs of equipment by distribution center and operating hours of equipments (in the trial implementation stage). On the presumption that 24-hour operation is in full operation, in the case of 8-hour operation, 16 hours are calculated as a loss.

A specific material flow model is intended for a typical full flow in drug manufacturing companies, synthesis - refining - bulk drug - weighing - formulation - packaging. Recovery I and recovery II among them are recycle process of recovered material. The recycle process can improve the final loss rate improved by 30%.

The compiled analytical results are represented as a flow cost matrix. Please note that the underlined part in the figure. The amount of the costs of disposed materials is 346 million yen and the disposal cost for disposing the materials is 157 million yen. These two kinds of costs are now come under closer scrutiny. We intend to find remedial measures against this problem.

A further detailed matrix shows a breakdown (synthesis, refining, etc.) of

Flow cost matrix				
(in thousand yen)				
Production cost	Material cost	System cost & utility cost	Waste disposal cost	Total
Quality products	371,748	1,296,154	0	1,667,902
Material loss	586,761	625,345	157,896	1,372,942
(Waste in material loss)	(346,210)	( - )	(157,896)	(504,046)
<b>Total</b>	<b>888,509</b>	<b>1,924,480</b>	<b>157,896</b>	<b>3,040,825</b>

Material loss cost ratio: [The ratio of material losses caused by materials failing to be made quality products in one cycle against the total input cost.]  
 47.8% (3,137,942,000 ÷ 6,562,984,000)

Final waste cost ratio: [The ratio of final waste cost against the total input cost.]  
 17.8% (504,046,000 ÷ 2,836,779,000)

Note: The total input cost: Because the main balance is calculated per distribution center, the total packaging input cost of 23,662,980,000 is used here.

By utilizing the recovery process, waste has been reduced by 20.1% from 47.8% to 27.7% to help achieve better corporate management.

Material losses							
(in thousand yen)							
Distribution center / Type of cost	Synthesis	Refining	Bulk pharmaceutical	Weighing	Drug product manufacturing	Packaging	Total
Material cost	¥289,530	¥207,896	¥34,483	¥20,437	¥23,737	¥40,778	¥586,761
(Recovery process in above)	(¥125,610)	(¥88,793)	(¥2,116)	(¥19,591)	(¥3,038)	(¥1,685)	(¥240,591)
(Waste in above)	¥163,921	¥119,103	¥32,369	¥8,846	¥20,709	¥39,093	¥346,210
System cost	¥118,776	¥21,526	¥113,800	¥24,404	¥113,228	¥213,744	¥617,070
Utility cost	¥7,041	¥898	¥5,174	¥8	¥81	¥167	¥11,276
Waste disposal cost	¥182,058	¥2,100	¥23,865	-	¥1,941	¥3,978	¥187,896
<b>Total</b>	<b>¥511,189</b>	<b>¥244,437</b>	<b>¥174,853</b>	<b>¥44,827</b>	<b>¥188,947</b>	<b>¥288,556</b>	<b>¥1,372,942</b>

loss in each distribution center. It clearly demonstrates that the synthesis and refining processes cause a significant loss of material costs and waste materials in the synthesis process generates a large amount of waste disposal costs.

### Overhaul of the waste disposal method

The incineration cost of waste water containing chloroform in the synthesis process was significant (1.26 million yen/year).

Implement countermeasures

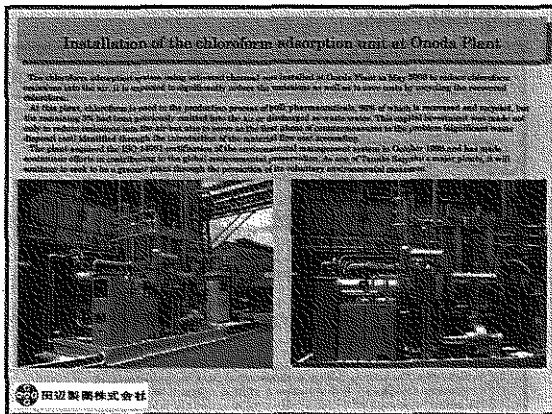
1. **Waste water treatment cost reduction by recycling chloroform**
  - Capital investment: Installation of the chloroform absorption recovery system (in May 2002) at 95.1 million yen
  - Effect: 1) Environmental impact reduction by lowering chloroform emissions
  - 2) Cost saving: 45.07 million/year
  - Material cost saving: 2.66 million/year (Incineration cost of recovery system operation: 3.2 million/year)
2. **Cost saving and environmental impact reduction by changing waste water disposal method from incineration using the reactor for on the premises to activated sludge processing**
  - Effect: Waste disposal cost and environmental impact reduction
  - Cost saving: 35 million/year
  - Reduction of waste water incineration for the drug concerned
  - Reduction of incineration on the premises
3. **Cost saving and environmental impact reduction by recycling chloroform in the product**
  - Effect: Reduction of waste disposal cost and environmental impact, environmental risk avoidance
  - Cost saving: 45.91 million/year (due to lower labor cost, energy cost, etc.)

Overall effect: The total cost saving in phase one to three is expected to reach 58.63 million yen (phase 1: 0.49 m + phase 2: 13.32 m + phase 3: 46.91 m). The capital investment (96.1 million yen) will be recovered nearly in one year.

Consequently, we focused that the cost of burning waste liquid including chloroform during the synthesis process amounted to as much as 126 million yen a year, and so made a reform proposal on the waste disposal method.

Specifically, to reduce both environmental loads and the initial cost with reduction in social environmental cost in focus by collecting chloroform discharged into the air and recycling the collected chloroform as a first step, we installed a chloroform absorption and collection unit for improvement (invested amount of 66.1 million yen). As a second step, we cut down the initial cost and environmental loads by means of the

phasing-out of the burning of waste liquid from drugs. We changed the manufacturing method for separating chloroform such as condensation and cooling in addition to the investment in environmental equipment as implemented in the first step. As a result, the method of disposing waste liquid was changed from burning to an activated sludge process, thereby to reduce in the burning cost. Further, the abolishment of burning process in the whole plant in a third step brought about an economic benefit of 60 million yen a year (total economic benefit in the first to third steps) (the invested amount was recovered within about one year).



This is an actual example of the chloroform absorption and collection unit. While 95% of chloroform used in the Onoda plant has conventionally been collected and reused, this investment in equipment further reduced wastes of 25t (collection rate of 97 to 98%).

Concerning the current development of material flow cost accounting in our company, we completed systematization of material flow cost accounting in February 2004.

On the completion of systematization, we have extensively applied material flow cost accounting to all domestic plants (Onoda plant, Osaka plant) and all products in the Yoshiki Factory of Tanabe Seiyaku Co., Ltd. as an affiliate company and analyzed the loss.

In addition, to find the energy loss in more detail, we installed meters in the Onoda plant by applying material flow cost accounting and analyzed electronic data to make an efficient replacement of equipment.

Finally, as the result of introducing material flow cost accounting on trial, the method is proved to be an environmental management accounting method that is extremely effective for analyzing the loss. Moreover, it can be used effectively as a strategic environmental management accounting method for managers because the systemized material flow cost accounting could (1) realize the expansion of introduced region and continuous analysis; (2) improve exhaustibility and accuracy of data and the clarity of priorities; (3) promote the optimum allotment of managerial resources as an environmental corporate strategy and activities for sustainable environmental conservation; and (4) efficiently promote environmental management including the development of one-year plan, medium and long-term plan and long-term vision by clarifying the priorities of investment.

This concludes my presentation, "On Effective Application of Material Flow Cost Accounting in Strategic Environmental Management ". Thank you for your kind attention.

## Encouraging Implementation and Improvement of Environmental Management Accounting Tools

Takeshi Mizuguchi  
Takasaki City University of Economics

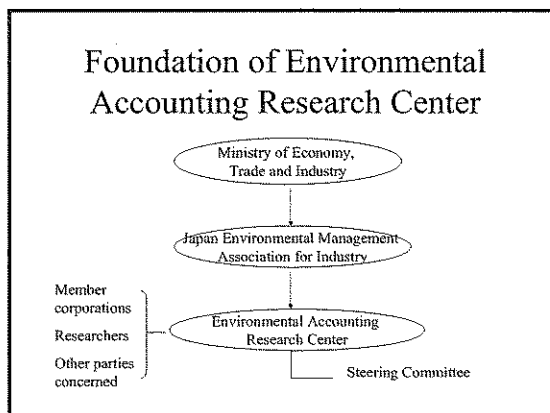
Today I would like to talk about three topics for the subsequent panel discussion. The first topic is the efforts by Environmental Accounting Research Center established by Ministry of Economy, Trade and Industry. The second topic is how environmental management accounting should be developed in the future. And the last topic is the relations with Environmental Accounting Guidelines suggested by Ministry of the Environment (MoE).

has not begun yet.

### Activities of Environmental Accounting Research Center

- Information gathering
- Development of methods
- Workshop
- Seminar
- Publication
- Others

[The efforts by Ministry of Economy, Trade and Industry]



In 1999, the Ministry of Economy, Trade and Industry (METI) started an investigation into the environmental management accounting by consigning it to Japanese Environmental Management Association of Industry (JEMAI). Based on its results, Environmental Accounting Research Center was established in 2003, with JEMAI being the Secretariat. For "member companies" stated in the lower left-hand corner of the slide, the recruitment

### Main environmental management accounting tools

- Environmentally conscious capital budgeting
- Environmentally conscious cost planning
- Environmental budget matrix (environmental quality cost accounting)
- Material flow cost accounting
- Life cycle costing
- Environmentally conscious performance evaluation

Environmental Accounting Research Center intends to develop and disseminate environmental management accounting methods. Presently, we are studying 6 methods that were made public in the workbook published by METI. We are developing case studies and manuals at this stage.

Now, I would like to present our achievements for 2003. The year 2003 is an inaugural year of Environmental Accounting Research Center, when we collected the results of case studies for each method. Taking material flow cost accounting for

**Progress in fiscal 2003**

- Actual examples  
Ex. Material flow cost accounting in 12 corporations, environmental budget matrix in 4 corporations, etc.
- Enlarging to the whole company from partial introduction
- Creation of software
- "An Introduction to Environmental Management Accounting: Theory and Practice" soon to be released

**From management accounting to environmental-"management accounting"**

- Expanding the existing management accounting methods from an environmental point of view
- Existing data is utilizable
- Achieving both environmental conservation and cost saving

example, we conducted case studies for total 12 companies including Tanabe Seiyaku, Co., Ltd. As for environmental budget matrix as well, 4 companies has introduced it on an experimental basis. As Tanabe Seiyaku mentioned earlier on, a characteristic result is that some companies have introduced material flow cost accounting company-wide although this accounting method is often adopted at 1 production line for 1 product on an experimental basis. In the case of material flow cost accounting, it takes a lot of man-hours to collect data. However, the company intending to improve data collecting method as a sense of common purpose showed the high effect of cost reduction. As for environmental budget matrix and environmentally conscious capital investment, we are presently making software and preparing for making it available for free download as soon as possible. Additionally, we are to release the guidebook titled "Guide to Environmental Management Accounting: Theory and Practice" soon, which will be an introduction to each method developed in this project.

**[Future development of environmental management accounting]**

I have presented a outline of the efforts by Environmental Accounting Research Center. Now, I would like to present my personal view about how environmental management

accounting should be developed in the future. Professor Kokubu classified environmental management accounting into 2 categories in his former presentation. My classification is similar to Professor Kokubu's classification but has slight difference. "Environmental [Management Accounting]" on this slide has the meaning as follows. . Environmental management accounting need not necessarily be started from zero. Rather, I think that many methods for environmental management accounting are often extended from a conventional management accounting. In this sense, this is just the management accounting paying attention to the environment, that is "Environmental [Management Accounting]." Since this type of method is to add environmental aspects to a conventional management accounting, there are many applicable methods that are easy to be introduced. In many methods, it is also possible to use existing data. If you carry out environmental management accounting by extending a conventional management accounting with the use of existing data, you can introduce this method easily. In this case, environmental conservation activities and cost reduction benefits may coexist to establish "win-win relation". Therefore, there should be benefits on business. I think that the method with higher business benefits like this can be introduced initially.

From environmental-"management accounting" to "environmental management"-accounting

- Voluntary and aggressive activities for environmental issues
- Environmental conservation is an integral part of CSR.
- Managing cost for environmental conservation
- Accounting for supporting effective promotion of environmental accounting → "environmental management"-accounting
- Contribution to environmental performance of products and corporate environmental quality

On the other hand, environmental management accounting is essentially not intended for just cost reduction. Particularly in Japan, more than 13,000 sites have acquired ISO 14001. More than 650 companies have published environmental reports. That is to say, before environmental management accounting is disseminated, voluntary and proactive efforts to environmental problems have already been well on the way. It is obvious that we should not continue to pursue the mass-production and mass-consumption-based economy of the 20th Century, so environmental efforts by companies are one of corporate social responsibilities (CSR). This idea has come to be recognized in Japan, and therefore voluntary and proactive efforts have been advanced. However, even if they are social responsibilities that companies should assume, they cannot disregard cost. Therefore it is necessary to manage cost in the proper way on the assumption that they tackle environmental problems. The accounting method like this is "[Environmental Management] Accounting" from the viewpoint that this accounting method pays attention to environmental management. The former type is "Environmental [Management Accounting]" developed by extending a conventional management accounting,

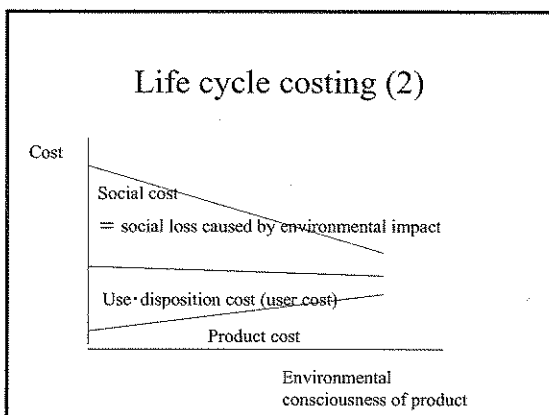
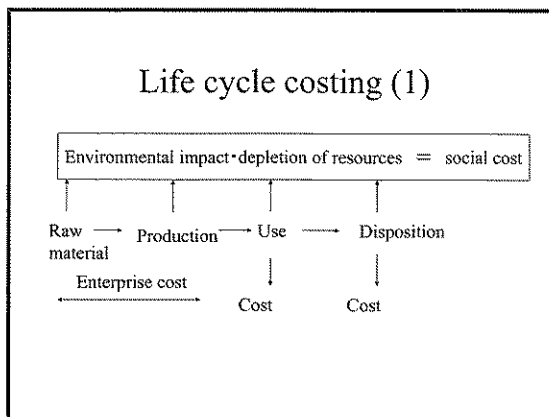
and the latter type is "[Environmental Management] Accounting" with the aim of environmental management. This latter type is my prospect of future environmental management accounting. Such type of EMA contributes to the improvement of environmental performance of the products and environmental quality of the company. More importantly these effects may make the company more competitive.

**Environmental budget matrix**

		Environmental conservation costs					
		Air pollution	Water pollution	Prevention of warming	Chemicals	Protection of ozone layer	Total budget
Internal environmental loss (monetary)	Repair cost of soil pollution						
	Energy loss						
	Material loss						
External environmental loss (physical)	Global warming						
	Air pollution						
	Wastes						

For example, we have environmental budget matrix method. In environmental budget matrix, longitudinal axis indicates internal cost and external cost associated with environmental loads, and horizontal axis indicates cost of environmental conservation activities. By paying for what environmental conservation, what environmental loads can be reduced to which extent? In other words, by analyzing causal connection of environmental conservation activities with reduction of internal and external cost, more efficient way of budgeting can be found.

As for life cycle costing of a product, as Professor Kokubu said, users pay for not only manufacturing stage but also using and disposal stage. This cost corresponds to the lower cost of the figure. At the same time, as indicated on the upper side, they give loads to the environment from using to disposal stage, and therefore they generate social cost.



Then if horizontal axis is environmental consideration to the products, the more consideration is paid to the environment, the higher cost may be necessary to manufacture the products. However, cost incurred when using and disposing of the products may lower and consequently social cost may lower too. That is to say, as getting closer to the right side of the figure, it is more possible to reduce the entire cost of society. If the manufacturers of such products receive higher reputation in the society, these manufacturers will have competitiveness. I think that life cycle costing acts as a tool to analyze the said mechanism. The purpose of these methods is not just cost reduction, but also more return than expenditure. As a matter of course, it is large enterprises that this logic is acceptable from a long-term perspective. How this logic can apply to small and medium-sized companies should be discussed separately.

**[The relations with Environmental Accounting Guidelines suggested by Ministry of Environment (MoE)]**

**Environmental accounting guideline presented by MoE**

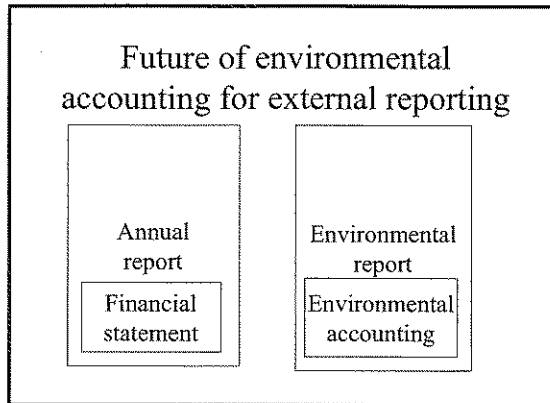
- Contribute to expanding environmental conservation activities and environmental accounting
- Less associated with methods for environmental management accounting in terms of data
- Required to become a tool capable of evaluating corporations more accurately

Environmental management accounting — Results of environmental conservation — Eternal report evaluation in the market

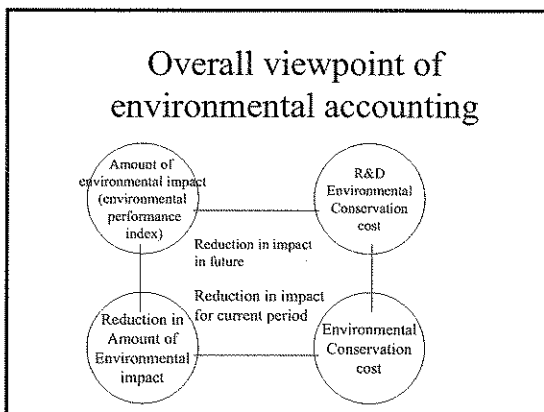
When I talk about environmental management accounting, the relation with MoE guideline becomes a subject of discussion, because environmental accounting in Japan originates in MoE guideline. Dr. Deborah Savage said earlier that Japan is unique in the point that more importance is given to external reports than internal management. I think that this is a result of successful environmental management because paying attention to external reports result that many companies have become interested in environmental issues. As long as environmental accounting is completed inside the company, individual short-term profit may be generated but other incentives are hard to be created. However, when accounting is reported externally, new incentives are given to the companies and therefore I think MoE guideline intended for external report contributed to the dissemination of environmental accounting.

Please note that MoE guideline and environmental management accounting I am presenting now has no linkage in data except for environmental budget matrix. Therefore they should be considered as separate materials at this moment. It is not that which material should be chosen, but MoE guideline and environmental management accounting are

both indispensable. MoE guideline should act as a method to evaluate more properly how each company tackle environmental issues. .



By being evaluated externally, internal environmental management accounting are also promoted in a circle. In this sense, the current MoE guideline is not enough at the moment. In the future, just as financial statement is a core of annual report, environmental accounting should be positioned as a core of environmental report. For example, an annual report is rather descriptive but a balance sheet and an income statement are available to analyze companies' track records. It is necessary that environmental accounting becomes available to evaluate companies.



Talking about environmental accounting, many people think of MoE guideline. On the other hand, environmental performance index is available for external report. Environmental performance index is often separated from

environmental accounting. However, I think that environmental accounting should include environmental performance index to be a better tool. The figure simplifies this idea. The current MoE guideline focuses on environmental conservation cost indicated in the right lower portion of the figure. Allocation of environmental conservation cost means that the enterpriser is tackling environmental issues. However, the effort cannot be evaluated properly just by cost, so we decided to trace the reduction of environmental load. It is fundamental for companies to grasp total environmental load and compare it with the reduction of environmental load. This is just the role that environmental performance index is expected to play as indicated in left upper portion of the figure. However the company with a large amount of environmental load is not necessarily a bad company. For example, in the case that more environmental conservation cost is allocated to R&D, this cost is intended to reduce environmental loads in the future. Therefore, it is necessary to analyze the relations between environmental conservation cost allocated to R&D and the amount of environmental loads at present. This will make it possible to analyze cost to reduce environmental loads in the future as well as cost to reduce environmental loads at present. By analyzing these factors in a comprehensive way, I think that more appropriate evaluation becomes possible. We expect that environmental accounting for external report will be developed in this direction.

#### [Conclusion]

Lastly I would like to add a word about the introduction of environmental management accounting to companies and the improvement

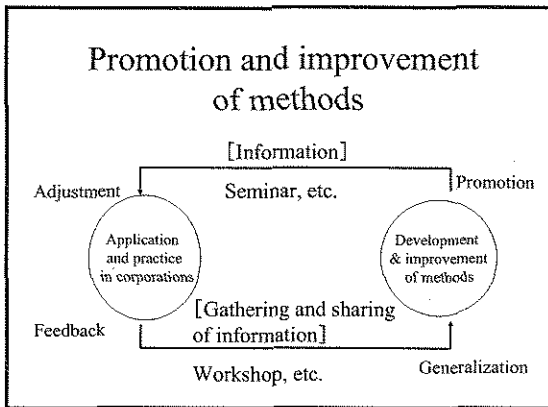


of methods.

There are no well-established methods of environmental management accounting that are applicable to any company. The environmental management accounting methods are not convenient magic wands, but we need to use them according to the current conditions of the companies. At the same time, applying the methods at actual sites of the companies will create new methods and/or improve methods. I think that advanced methods developed in this way should be returned to society.

Given this perspective, it is important that two roles of Environmental Accounting Research Center, provision of information and collection of information, work together. First, environmental accounting should be disseminated as provision of information. Next the accounting methods should be put into practice at actual sites. Based on lessons learnt from practice, the methods should be improved and reformed. In this way, dissemination, practice and development / improvement need to be promoted together. The role of Environmental Accounting Research Center is to control and manage this mechanism comprehensively. In other words, environmental management accounting cannot be developed by the Center only. We intend to develop the environmental management accounting together with many corporations.

Thank you for your kind attention.



## Panel Discussion

### “Frontier of Environmental Management Accounting”

#### *Coordinator:*

**Katsuhiko Kokubu**

(Project Leader, IGES Kansai Research Center/ Professor, Graduate School of Business Administration, Kobe University)

#### *Panelists:*

**Deborah E. Savage**

(Senior Scientist, Environmental Management Accounting Program, Tellus Institute/ Director of the Environmental Management Accounting Research and Information Center (EMARIC))

**Mark Stoughton**

(Senior Scientist, Business and Sustainability Group, Tellus Institute/  
Research Manager, Chemical Strategies Partnership/ Visiting Researcher of IGES Kansai Research Center)

**Takeshi Koga**

(Group President, Corporate Environmental Affairs Group, Fujitsu Limited)

**Yuji Kawano**

(Section Manager, Accounting Section, Finance and Accounting Division, Tanabe Seiyaku Co., Ltd.)

**Takeshi Mizuguchi**

(Assistant Professor of Takasaki City University of Economics/Certified Public Accountant)

#### **Kokubu**

Now, we will begin panel discussion. We'd like to discuss about one hour.

Today's main theme is expansion of environmental management accounting (EMA) and various methods for expanding it. Accordingly, based on the movements in Japan and United States, we have discussed problems; how to use these methods in an integrated manner and what systematic supports are needed to promote the methods.

This is the third symposium of the IGES' s 3-year project. Unfortunately we couldn't take much time to explain each method in detail. For the methods, we'd like you to read "Environmental Accounting in the Process of Updating" (The Energy Conservation Center) that we published last year, "Workbook on

Methods of Environmental Management Accounting" published by Ministry of Economy, Trade and Industry or "Introduction to Environmental Management Accounting" introduced by Prof. Mizuguchi, which will be published soon by Japan Environmental Management Association for Industry. You don't need to study environmental accounting thoroughly. Rather, when you find any point relating to problems that your companies currently encounter in today's symposium even if only slightly, you may try to introduce the related method. I really hope that this symposium provides an opportunity for the introduction.

Now we'll go into panel discussion. Among of 5 panelists, Dr. Stoughton, Mr. Koga and Mr. Kawano presented issues on

the application of specific environmental management accounting methods, and Dr. Savage and Prof. Mizuguchi reviewed the environmental management accounting methods from the broad viewpoint of US, whole world and Japan to provide analytical vision.

Firstly, as Dr. Stoughton, Mr. Koga and Mr. Kawano made presentations within a very limited amount of time, I think the audience probably wants to hear some more. So, to have a better understanding of contents of their presentations, I will ask a few questions for additional information.

Next, I will invite comments from Dr. Savage and Prof. Mizuguchi from a broader perspective about the trend of environmental accounting.

We have received questions from the floor. In the interest of time, we've received no questions for 3 presentations in Part II, but I hope to add some points during discussion.

First, I would like to ask a question to Dr. Stoughton. There are some basic questions from the floor such as "What are CP and P2". We should have explained these words when translating Power Point into Japanese. CP is an abbreviation of "Cleaner Production" and P2 does not mean "Phase 2" but "Pollution Prevention". Both words refer to activities and programs for preventing pollution in the manufacturing process. United Nations, in particular, takes the initiative in implementing the activities and programs by using the word "cleaner production", while US-EPA is implementing it under the "pollution prevention program". Both words generally refer to activities against pollution in the manufacturing process.

In this connection, you said, "when there are opportunities for CP or P2, environmental

management accounting can play a role". Please express your opinion as to whether methods such as material flow cost accounting and environmental management accounting related to material flow have been already recognized as being effective in CP and P2 projects in US or they have some possibilities, in association with Japanese cases described later.

#### **Stoughton**

This is a slightly difficult question. I think that most companies that undertake serious pollution prevention programs realize that being able to quantify the benefits and assess costs and benefits so they can make investment decisions is extremely important. That said, relatively few companies in the U.S. have adopted a systematic EMA system, as a prerequisite for engaging in systematic pollution prevention effort. Typically they have engaged only in ad-hoc efforts to quantify environmental costs and benefits. In my opinion, companies that do have an EMA system in place should be very well positioned to pursue an aggressive prevention based program and would in fact be much better positioned to consider supply chain management approaches of the type I described in my presentation. The U.S. is definitely not as advanced as I would like it to be. Dr. Savage may have something to add on this as well.

#### **Savage**

I would only add - I believe that companies in the United States that are doing something like materials flow cost accounting are not calling it materials flow cost accounting. But, for example, any of the companies doing the chemical management work are basically

doing material flow cost accounting - they are just not calling it that. So it has not been adopted in any formal way even though some companies are doing it.

#### **Stoughton**

So, for example, when we help a company assess the business case for chemical management services, we take them through a very limited material flow cost accounting exercise specifically targeted at chemical management.

#### **Kokubu**

As to this issue, we invited Dr. Robert Pojasek (Pojasek & Associates from Boston, US in the International Symposium on Environmental Accounting that held last year and discussed material flow analysis and material flow cost accounting. So, they are associated with cleaner production and pollution prevention. As Dr. Savage and Dr. Stoughton mentioned just now, accounting that makes a thorough analysis of material flow has internationally adopted in the manufacturing process. However, the means for calculating the cost varies extensively depending on methods as well as experts. Accordingly, I don't mention it today.

I am sorry to ask such a very difficult question of you. Please acknowledge that we have to include this point as it was asked from the floor.

Next, Mr. Koga, you told that you had introduced the activity called "green process" and achieved great results. I'd like you to ask the following questions; which department has taken a leading part of this activity? And how this activity has been implemented? I believe that this is company-wide activity rather than solely environmental department's

activity, and it is difficult for environment department to take the initiative in doing such a company-wide activity. But your company realized it and achieved excellent results. Please let us know this systematic activity some more.

#### **Koga**

I think it shares a common idea with what Dr. Savage and Dr. Stoughton mentioned. Manufacturing costs a great deal and therefore environmental activities cannot be initiated so easily. As Prof. Kokubu referred just now, to actually practice these activities, manufacturing department or design department rather than environment department must realize that environmental activities contribute to business success. Actually, in the beginning, we gave various supports, for example, by developing a guideline in environment department. We also offered advice on various methods that would lead to customer satisfaction. As I said today, in fact, we had difficulty in persuading manufacturing department to cut down on waste of materials. As Dr. Savage mentioned, for chemicals in particular, less the environmental impact, less the cost. Moreover, as the production line of semiconductors that I took as an example today is almost automated, personnel costs hardly generate. The change of button setting can securely reduce material costs. Though semiconductor may be a special field, the same applies to almost all processes.

Actually, the spread throughout the company including the group has not been made by Environment Department. Manufacturing Department can introduce the method of cutting costs effectively and efficiently in production lines while keeping conventional operations. Like the existing accounting, environmental accounting is on a quarter

basis. Further, Manufacturing Department clearly perceived how large the incentive of lowering environmental impact was. As Prof. Mizuguchi said earlier, our business offices are transmitting information on a substantial reduction in environmental impact to the customers through environmental reports and the like. In response to this, the customers increase order quantity of the semiconductor with less impact. In this way, we have established the relationship with the customers, and activities mainly in the production lines have become very active.

**Kokubu**

Thank you so much.

Next, I ask you a question, Mr. Kawano. I hear you introduced material flow cost accounting and achieved great results. You obtain information through material flow cost accounting, which is related to the problem that I rose at the outset of this discussion. Tanabe Seiyaku invests in plant and equipment for concrete activities. So, I suppose that satisfactory results cannot be produced unless material flow cost accounting and the method of determining investment in equipment are connected organically. In other words, I suppose that you achieved an effect by connecting the method of environmental management accounting in a multiple manner. Please explain the point in more detail.

**Kawano**

At the time, Environment Management Department focused on the reduction in environmental impact of chloroform as an important task and set its hopes on trial introduction of material flow cost accounting. As a result of the trial introduction, we could keep track of the waste disposal cost and

the lost amount of chloroform by process and clarify benefit/cost for improvement. Subsequently, to reduce the lost amount of chloroform, we devised a reform measure by investment in plant and equipment with a high feasibility in a short term and partial change in manufacturing method, and achieved reduction in the initial cost and environmental impact through the review of waste disposal.

In fact, we reported analysis results of material flow cost accounting calculated by Finance and Accounting Division to Environment Division and the plant, a reform measure was formulated in the plant, and benefit/cost according to pay back method was clarified. And then, through the final managerial decision of the company, we made an investment of 66 million yen in equipment.

Thus, the main point is that, in formulating a reform measure based on the found problems, when an investment is needed, decision of management can be promoted by clarifying benefit/cost.

**Kokubu**

Thank you very much.

I'd like to go on discussion, but we took no time to receive questions about presentations of Mr. Koga and Mr. Kawano. Now the floor is open for questions only to Mr. Koga and Mr. Kawano, if any. - - - As there are no questions, I'll go ahead.

Mr. Koga and Mr. Kawano talked specific corporate activities on EMA and Dr. Stoughton expressed his opinion on the effectiveness of environmental management accounting in supply chain management relating to chemicals.

Dr. Savage, concerning such movements of business, please give your opinion about business practice in Japan from an

international viewpoint and offer a suggestion about the course of the future, if any.

### **Savage**

First of all, I would like to say that I am really impressed by the level of commitment that Japanese government and industry have shown to EMA and related environmental accounting activities. In particular I was always very interested to learn about Japan's very unique focus on using EMA information for external reporting. I think that other countries need to learn from Japanese experience in using EMA for external reporting for two reasons. First of all, there's clearly a lot of interest from many, many different stakeholders on the environmental performance of industry and the main goal of reporting is to provide information to the stakeholders. But, in addition, as Prof. Mizuguchi mentioned earlier, there are many companies who may not do EMA for their own benefit. They may not for some reason believe that EMA can provide enough benefits - believe that maybe it's not worth doing - but if you require those companies or encourage those companies to do external reporting of the EMA information, it's a new motivation for them. And I think this is a very important point that parallels our experience in the United States with certain types of reporting, such as the Toxics Release Inventory, which I mentioned earlier. For this reason I believe that it is important for Japan to not only continue the very valuable work on Materials Flow Cost Accounting but also to include materials related costs in external reporting - I believe the guidelines from the Ministry of Environment currently do not include these types of costs. I believe that this would be very one strong recommendation on my part for future EMA work in Japan to

include materials related costs, not only for internal management decision making but also for external reporting. Because this will encourage more companies to actually do the accounting and make the improvements.

I would also like to recommend that, because Japan has focused mostly on voluntary environmental performance reporting to date, Japan consider extending work to include financial reporting and statistical accounting and reporting because there are many, many companies who will report to statistical agencies. Because it's required. It's a larger universe of companies than the number of companies who will do voluntary environmental reporting, so if you can increase to include other types of reporting, I think you will help make the adoption of EMA even more widespread than it is now.

### **Kokubu**

The important point of Dr. Savage's comments is that internal use of environmental accounting for Japanese companies is extremely important and has developed. On the other hand, the main feature of the Japanese companies is that they have utilized environmental accounting with a focus on external report. I think that Dr. Savage offered some following valuable suggestions. How the material cost should be disclosed in the external report? And, how environmental accounting data should be disclosed officially in terms of annual report or statistical information? For the future environmental accounting in Japan, there seems to be a significant opportunity for development in the relationship between external disclosure of information and internal management.

Initially I didn't intend to inquire Prof. Mizuguchi about this matter, but Prof.

Mizuguchi is a member of the committee for preparing Environmental Accounting Guidelines of Ministry of the Environment and also has a relation with Ministry of Economy, Trade and Industry. So, probably he has a lot of comments on environmental accounting that discloses the material cost in an environmental report, the relationship between environmental accounting and environmental management accounting and future directions that both will develop. We would like your opinion, Prof. Mizuguchi.

**Mizuguchi**

I really agree to Dr. Savage's opinion.

The Environmental Accounting Guidelines of Japanese Ministry of the Environment has the current system because it was originally based on the environmental conservation cost. After then, however, the study of environmental management accounting has progressed in Japan, confirming the importance of material-related information and material flow cost. I think that it must be reflected in the external report. One problem is that it doesn't correspond with the current guideline of Ministry of the Environment. Companies are required to consider much more factors when disclosing the material flow cost than when disclosing the environmental conservation cost. To make gradual transition, one possible method is to begin by measuring a reduction in material loss.

**Kokubu**

Thank you very much.

I'd like to invite comments from Mr. Koga and Mr. Kawano.

**Koga**

As stated just now, as the value of material

flow becomes higher, such effect cannot be obtained unless we go into technical capability as lifeline for companies and the like. That is, when we try to explain the effect specifically, we are obliged to disclose a detailed comparison with competitors and our know-how. Every competitor has the information on reduction in loss, which was mentioned by Prof. Kokubu. Therefore, I hope that, for example, when we disclose the information "Fujitsu has efficiently reduced much more chemicals in the manufacturing process than IBM", customers feel that "as Fujitsu works with hazardous material more earnestly than IBM, semiconductors made by Fujitsu seem to be safer". But, it's difficult to describe the details. Nevertheless, we want to get results. I think that we should explain good results of performance rather than keep them secret.

**Kawano**

Concerning the loss of raw materials, our company introduced systemized material flow cost accounting throughout the company to grasp the loss of raw materials automatically. We have already owned one-year data on the loss of raw materials up to the end of December 2003. Once the data is fine adjusted to confirm whether master setting is made correctly, the loss of raw materials is established. As Prof. Mizuguchi mentioned earlier, we will probably report this figure to the outside after winning the consensus of the company.

**Kokubu**

As to this matter, Dr. Savage and Dr. Stoughton, please offer some comments, if possible.

Dr. Savage told that the material cost should

be disclosed in an environmental report. Perhaps, the companies agree to the opinion as a whole, but some argue that the material cost is confidential information and so the disclosure is difficult in some aspects.

#### **Savage**

I do have a couple of comments. In the state of New Jersey in the United States, there was a similar issue. The state government passed a law to require that some big companies using a lot of chemicals do a type of EMA, including Materials Flow Assessment and also Cost Accounting. And then the companies were required to report the results, but the detailed report was given only to the government agency. A summary report with less detail was given to the public. So this was one way to partly protect some of the information which companies may have thought was confidential. And in addition, a part of the regulation said that if a company believed that one piece of information was very confidential, they could request that this information not be given to the public. But in the end, I think, only five or six companies even made this request.

#### **Kokubu**

The problem relating to trade secrets and classified material becomes so important. The same problem generates in the expansion to the supply chain as today's another theme. It is essential that the whole supply chain reduce environmental impact effectively in collaboration. For this reason, if the companies introduce material flow cost accounting, they must share the most important cost data somewhere. The chemical supply chain, to which Dr. Stoughton referred today, adopts the method overcoming the problem partially. But, in the chemical supply chain, chemicals

are not used from the upstream to the downstream in a flow, but used in a manufacturing process or a part of the flow. Therefore, by changing the contract system, the supply chain can reduce the cost while taking environment into consideration. For original raw materials or main components, it's so difficult.

In this connection, we have a very important question; "Although Supply Chain Environmental Management Supplier Technical Assistance Methodology (the term used in Dr. Stoughton's presentation) in Japan is considered to have been already carried out, for example, between an automobile manufacturer and an affiliated component manufacturer, I suspect that it brings mutual benefit. There is a possibility that benefit sharing is determined depending on their power relationship, and in the extreme case, only one side obtains a whole benefit." When implemented within a company, environmental management accounting cannot bring about a sufficient effect. To achieve the desired effect, it must be expanded to the supply chain. But, it doesn't always become beneficial to both parties. I think that this is the core of the problem. I'm sorry to ask such a difficult question, Dr. Stoughton, but, what do you think about this point?

#### **Stoughton**

Another difficult question. At least in the U.S. context, the reputation of large customers in, for example the automotive or electronic industries, is that they are not kind to their suppliers. Under the chemical management service (CMS) model, part of the barrier to introducing CMS is that the customer needs to view the supplier more as a strategic partner. We have seen over time that there is a risk that the customer's procurement department will



start thinking again in terms of unit pricing and relentless pressure to reduce unit cost. If this happens, the supplier is not a strategic partner, and the CMS model fails. That said, the chemical suppliers are in the business because they do feel they can make a profit. So in that sense, mutual benefit does exist regarding the supplier technical assistance model, I think that it's too early to make a determination. I would like to see a large customer firm think creatively about sharing benefits. In other words, the customer says to the supplier "I will help you. But we need to divide the benefits." Sharing benefits is critical, as I discussed, there are costs that the customer incurs when the suppliers make changes. So the question does raise an important issue: Creating mutual benefits is a change from business as usual. And it does require a more creative approach to structuring contracts. That's one of the most important barriers to address in this type of green supply chain management.

**Kokubu**

In this connection, there is a figure showing the relationship Fujitsu and their suppliers with a particular emphasis on LCA (Life Cycle Assessment) and LCC (Life Cycle Cost) stated at the end of Mr. Koga's presentation. Also in the activities by Fujitsu, in terms of the relationship with the supply chain, there should be various problems such as confidential information, one-sided benefit sharing and so on. Mr. Koga, how about those problems?

**Koga**

As mentioned earlier, many of our chemical suppliers are located in Asian region such as Taiwan, China and Hong-Kong. Because chemical management in these counties is quite poor, we are very concerned about it.

The win-win relationship with the supply chain in Japan is rather good. The suppliers in the above-mentioned countries hardly own such know-how and are considerably inferior to Japanese suppliers. To the suppliers, set makers like our company can have any number of programs for supporting management and analysis that Dr. Stoughton mentioned. To encourage the supplier under a contract, I think that the set maker will need to offer some incentive by purchase conditions. The set maker purchases materials from the supplier working with environmental improvement by priority at minimum purchase conditions. Our company has already achieved success. Perhaps other set makers are willing to do a deal with such supplier. If such condition is met, suppliers will make efforts.

In addition, given the environmental pollution in the above-mentioned Asian countries, the disclosure of results of supply chain management is very difficult. Accordingly, I think that information to be disclosed should be limited to the data on reduction in environmental impact in the whole supply chain, that is, the total reduction in the mutual partnership of vendors and our company. Disclosing the details of actual situation and improvements in each supplier causes serious damage to the supplier, and therefore that's impossible. Only the total reduction in mutual trade should be disclosed.

**Kokubu**

Thank you very much.

How about your company, Mr. Kawano? You probably have various types of developments in the supply chain.

**Kawano**

In terms of supply chain, our company

outsources a part of packaging process to its subsidiary, Tanabe Seiyaku Yoshiki Factory Co., Ltd.

As Tanabe Seiyaku Yoshiki Factory has introduced the same system as its parent company, Tanabe Seiyaku, the system of material flow cost accounting has been also introduced. As in the case of our company, in Yoshiki Factory, the waste disposal cost was clarified by the analysis of material flow cost accounting and it turned out that the waste disposal cost could be cut down.

Thus far, the cause and source of loss hasn't been tracked down with the investigation on the spot in quality control activities. But, as a result of the introduction of material flow cost accounting, it found that loss occurred in a certain process in terms of quantity and amount of money.

According to data analysis, the loss was due to format change for many types and small-lot production. The format change means an operation of changing manufacturing process that generates when different types of products are manufactured in the same line. The more the format change, the larger the product loss.

For this reason, Tanabe Seiyaku Yoshiki Factory has reviewed both of the waste disposal cost and reduction in waste materials. According to the analysis of the waste disposal cost, reduction of about 1 million yen a year is possible. I was surprised anew to find that the introduction of material flow cost accounting could produce good results so soon.

Reduction in initial cost and loss in the subsidiary has an effect on the whole group, leading to gain in profitability in the parent company. In the future, Tanabe Seiyaku will utilize the method of material flow cost accounting strategically and expand it to the green supply chain.

#### **Kokubu**

Thank you very much.

We have only about 10 minutes to go and so we can't present all questions one by one. However, if you have anything to ask about and you'd very much like to raise a question in the course of discussion, I will take the time some more. I hope that all of you will leave this symposium without feeling regret.

#### **Questioner**

My name is Hwa-Rong Shen. I am an assistant professor in Taiwan National Chiao-Tung University. For last five years, I have promoted the introduction and dissemination of environmental management accounting in Taiwan. I established EMAN-Taiwan and serves as the chairman. I have two questions. The first question is about the definition of effect of EMA. I'd like the representative of Fuji to describe how to measure the effect on the basis of environmental accounting system.

EMA is very important for companies, and in Japan, many companies have increasingly worked on EMA voluntarily. My second question is related to "voluntary". I am frequently asked from corporations about how to establish EMA system without any regulation and incentive in a country like Taiwan. Establishing a system requires investment of resources and additional personnel cost. How should we persuade management to introduce and promote EMA under the situation without any regulation and incentive? I would like an answer from Dr. Savage.

#### **Kokubu**

The questions each are directed to Mr. Koga of Fujitsu and Dr. Savage, respectively.

The first question is how environmental management accounting is defined and how the effect is defined and measured in Fujitsu. The first question is technical and the second question is a very profound one about the introduction of EMA. Let's begin from the first technical question. I'd like Mr. Koga of Fujitsu to answer the question.

**Koga**

Firstly, as to definition, environment ISO 14001 has also been implemented in each factory as the center of manufacturing in most business offices. Under the control, actual performance data, for example, how much wastes and energy was reduced by environmental activities, can be obtained. As in the case of Tanabe Seiyaku mentioned earlier, the data is basically collected in Management Department in a centralized fashion and transformed into cost price in tabular form to be compiled automatically.

It is very difficult to measure the effect, but of course, the effect in terms of energy and wastes can be easily recognized. The energy is replaced with electric power cost. Regardless of expenses of equipment investment, the effect of reduction in cost is achieved. The same applies to recycling. Cut down in waste disposal cost results in sales growth. Such figures are also calculated and compiled as data automatically in each Management Department. These two factors, energy and wastes are key factors.

And, most importantly, managers should understand that even if it's less cost-effective, risk is substantially reduced. For example, we have spent a lot of money on alleviating the fear of pollution. Once we can prove that such investments prevent accident, we present the cost-efficiency of the investments to the

manager with an authoritative. We argue that environmental cost can produce such a great effect. Generally, we show the cost and effect in this way. Of course, to ask people outside to understand, CFO makes it public in the yearly financial accounting report.

**Kokubu**

Thank you for your comment.

I'd like Dr. Savage to answer the second question. The point of the second question is as follows. In any countries in addition to Taiwan, when less powerful companies including medium and small companies try to introduce environmental management accounting, much cost and time are needed. Under such situation, how we should urge these companies to adopt EMA and implement EMA actually. I think that this problem is common to all countries. Especially for developing countries, this problem may be more serious. Dr. Savage, what do you think about this matter?

**Savage**

This is an important question in any country. How do you persuade a company, especially a small or medium size company to adopt EMA. One way to think about that strategically is to think very hard about who is the most convincing messenger. Because if I come from a non-profit group or you come from a university, maybe we're not very convincing. But if Mr. Koga comes from a customer company or even just as a professional colleague from another company, which has actually implemented EMA and has seen very significant benefits, he is perhaps a better messenger. In the Philippines for example, it was decided that the accountants would be the best messengers to promote

EMA. It may be different in different countries, in different cultures - who is the most convincing messenger. Beyond that issue of messenger, there is the issue of voluntary versus regulated, and I think that supply chain initiatives can fill the middle spot between voluntary and government regulation because maybe it's not required by the customer but if your customer is one of your most important business partners, you're going to listen to their message and you are much more likely to adopt something. So that has been my experience - that the messenger is almost as important and sometimes more important than the message itself if you want to persuade someone to adopt something.

#### **Kokubu**

Thank you very much.

Prof. Mizuguchi, what do you think about this problem?

#### **Mizuguchi**

The question is about how environmental management is promoted in medium and small companies, isn't it?

This is a very important issue also in Japan. As I said earlier, environmental accounting has achieved a certain level of success in Japan. However, the success centers on larger companies. In Japan, approaches to environmental accounting and environmental issues have been firstly initiated by large companies and then expanded to medium and small companies. Currently, medium and small companies may have a tough time to fulfill various requirements about environmental management from large companies. Under such situation, the method of supply chain management, which was described today, provides medium and small companies

with useful information, I think. Because it is the method by which SMEs establish a cooperative relationship with large companies in response to requirements from them. For SMEs, the method of forming a cooperative ties and sharing benefits with large companies is easy to be adopted. In this sense, the method of supply chain that Dr. Stoughton presented today is a frontier of environmental management accounting also for Japan. After all, I think that medium and small companies need to introduce beneficial incentives.

#### **Kokubu**

Thank you very much. This is a very important issue and when I talk about environmental management accounting in Asian region, I am asked this question every time. At that time, I always mention two things; what corporations must comply with and what is of benefit to corporations. To make corporations comply with what to comply with, regulation of laws and social infrastructure such as incentive system are essential. EMA is partially related to this and external disclosure is really connected directly with it. In addition, it is also important that corporations make a start on what is of advantage.

For example, concerning material flow cost accounting, the cases in Tanabe Seiyaku and Fujitsu were presented today. In one case, an information system is built by spending a great deal of initial cost or initial investment. In another case, there is a process to be improved definitely and accordingly a new investment is determined by calculating only the cost of the process. If this approach can reduce environmental impact and increase economic benefit, even developing countries or medium and small companies can adopt it. Therefore,

as said by Prof. Mizuguchi earlier, I think it important to make a start on what is of advantage and to improve social infrastructure as environmental conservation is socially essential.

**Savage**

I also believe that, with small and medium size enterprises, it's very important to make it easy, and this builds on what Prof. Kokubu has just said. One of the disadvantages of a very sophisticated Materials Flow Cost Accounting system is that it's not easy: it's complicated and it can be expensive. Large sophisticated companies can do this, but small and medium size enterprises - maybe they do not have the capacity, maybe they do not have the time, and they probably don't have the money. So that's why I think it is very important to take general approaches like Materials Flow Cost Accounting and create simplified versions that are easy to implement. You don't have to get every single number and you don't have to make every single number perfect. All you have to do is some rough estimates, I think, to prove to the company that there is a lot of value in doing the work.

**Kokubu**

Thank you very much.

There are still much to be discussed, but it overruns our schedule. We are scheduled to receive a bit of advice from each panelist at the end of this symposium, but being press for time, I'd like to hear from panelists who wish to make further remarks.

**Koga**

I forgot to mention in my presentation today, but I have one thing to be pointed out absolutely. The medium and small companies

with which we've made deals are merely working with environment for environment. However, turning our eyes to the world, there are increasing tendencies to improve environment in business activities among Asian and European countries in addition to Japan. Therefore, It is necessary that persons who bear little relation to environment including managers and engineers engage in the environmental activities in a top-down approach, and large companies join hands with medium and small companies. Without such cooperation, we cannot achieve a great success.

**Mizuguchi**

Someone pointed out that benefit might be divided inequitably in the supply chain management. I will speak briefly about this matter.

In the existing circumstances, there may be such cases. But this doesn't apply to many companies. The method of supply chain that presented today is indeed a frontier of environmental management accounting. So, I think it important to promote the relationship with benefit sharing rather than thinking about inequality of benefit.

**Stoughton**

I spoke earlier in the supply chain context about the need for creative contract mechanisms to share benefits. But it also requires integration of the environmental management accounting or the total cost approach into the financial accounting mechanisms in the firm. Why? Because sharing benefits within departments inside a company or with a supplier requires that the financial mechanisms exist in the accounting system of that company that allow you to make

real money transactions between departments that are justified on total cost principles. So to my mind, companies that derive full benefit from EMA will do it when they actually do integrate the EMA approach into the financial accounting. Dr. Savage has said that in a slightly different context but it is also true for the supply chain work.

### **Kokubu**

Thank you very much.

Though there is almost no time left, I'd like to offer a final comment to summarize the symposium.

Today's symposium is the last one in the three-year Business and the Environment Project at IGES Kansai Research Center. From April we will start a new project while associating with business, but in a sort, this symposium is defined the last one among symposiums focusing on environmental accounting.

Considering the flow of our three-year study, our goal is always to utilize environmental accounting in business management by some means or other. We initially assumed the environmental accounting focusing on external disclosure as recommended by the Ministry of the Environment. As Mr. Koga pointed out, one of the reasons why the environmental accounting was hard to be useful to business is that the relationship between the environmental accounting and business was unclear in many points. In this regard, environmental accounting has been quite developed.

As related to my first presentation, Japanese-typed environmental accounting developed to environmental management accounting by extending the scope of cost

in environmental accounting. As often stated earlier, there is a large disparity between boundary of companies and global environment, and apparently, this problem cannot be resolved within a single company. For all that, under the current economic world, it is impossible to introduce environmental management into all societies, all countries immediately, and for this reason, environmental management among companies is emphasized. As a key approach, green supply chain management has occurred in some specific ways, as talked by Dr. Stoughton.

However, as discussed here, cooperation or collaboration between competitors is much more difficult than expected. Our next challenge is to overcome this problem. Possible solutions include partnership, build-up of social cooperative system, supports of economic groups, efforts of companies themselves and so on. If I form a provisional conclusion at today's symposium, to develop environmental accounting in the future, it is necessary to extend its scope. At every extension, a new challenge generates, but we must overcome the problem and connect environmental accounting with mutual benefits and business to generate a driving force for overcoming the problem. But, there are cases where both cannot be connected with each other according to relative strength. In such cases, social support is probably needed.

Speaking abstractly, I finish up today's symposium by wishing for further development of the study and business practice.

Finally, I would like to express my sincere thanks to today's panelists. Thank you so much.

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