Proceedings of International Symposium
on Environmental Accounting 2003

Cutting Edge of Environmental Accounting for Corporate Management and Environmental Conservation

～Environmental Accounting in Japanese Corporate Management and Potentialities of Material Flow Cost Accounting～

Date & Time: January 31, 2003 (Friday) 10:30 - 17:00

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Ministry of the Environment of Japan, Hyogo Prefectural Government, Environmental Management Accounting Network - Asia Pacific (EMAN-AP), Japanese Institute of Certified Public Accountant (JICPA), Nihon Keizai Shimbun, Inc., Nikkei Ecology (Nikkei Business Publications, Inc.), The Osaka Chamber of Commerce and Industry, Asia-Pacific Network for Global Change Research (APN), International EMECS Center, Hyogo Environmental Advancement Association, the following eight organizations of the Advisory Board of IGES Kansai Research Center:
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Bernd Wagner

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Foundation of the Management Training Center, University of Augsburg in 1974. Member of its Board since then, Director since 2000. Professor for Management and Organization Development at University of Sierra Leone, West Africa in 1982-84. Professor for Technology Transfer for the EU in China in 1986. Foundation of the Institute for Management and the Environment, imu, 1992. Foundation of the German Environmental Bankers Association in 1995. Many environmental awards by the Federal German Industrial Association and the German Environmental Minister etc. Main topics of interest: Corporate Environmental Management including Environmental Management Systems and Auditing, Environmental Indicators and Controlling, Mass and Energy Balances, Environmental and Material Flow Cost Accounting etc.

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Developments of Material Flow Cost Accounting in Germany

Bernd Wagner
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Thank you very much for the invitation giving me a chance to present to you some of the ideas and experiences with Material Flow Cost Accounting (MFCA) in Germany. I will first go back to where MFCA comes from, back to its roots. Then I will present some ideas on present trends and developments - what we are currently doing in Germany - and finally we will have a brief look into the future. (Chart 1)

Chart 1

1. The Roots of MFCA

In some of these ideas I am presenting today, you will find similarities to developments in Japan. We, probably as well as you, started with environmental protection measures: the classical approach to environmental management. (Chart 2) This approach is technology driven and mainly compliance oriented. In the last few years we have emphasized environmental management systems like ISO14001 and the European scheme EMAS, which you are probably familiar with.

Environmental Management Systems

These systems emphasize organizational methods

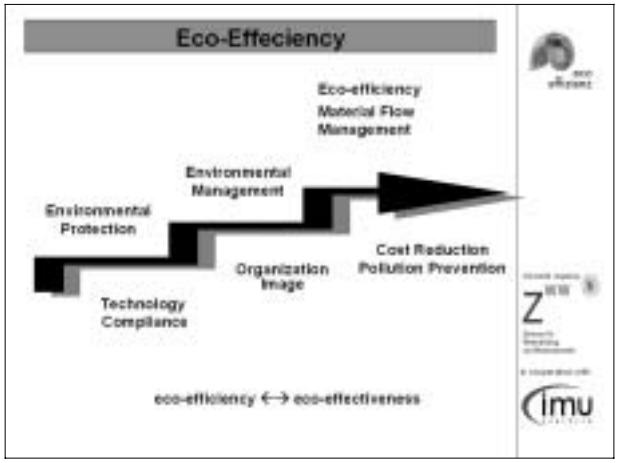


Chart 2

and approaches. They concentrate on improving the company's image, and they do this by reporting to the outside world. But recently, we have gone one step further with the concepts of eco-efficiency and material flow management. These concepts go beyond technology, compliance and organization, combining the objectives of cost reduction and pollution prevention. This is the main idea targeted with material flow management. (Chart 3) This international chart gives you an impression of the development of ISO14001. You might recognize on the very left side that Japanese companies are the worldwide leaders in the number of ISO14001 certifications. You will also find the European scheme EMAS in the upper right corner. EMAS meaning: "Environmental Management and Audit Scheme". The total number of EMAS participants is not as high as the number of ISO14001 certifications shown below. One will find the greatest number of EMAS certificates in Germany, but Germans are also strong in ISO 14001. So, if they are both added up, Germany comes closer to the Japanese level. Lately, we have observed the number of ISO

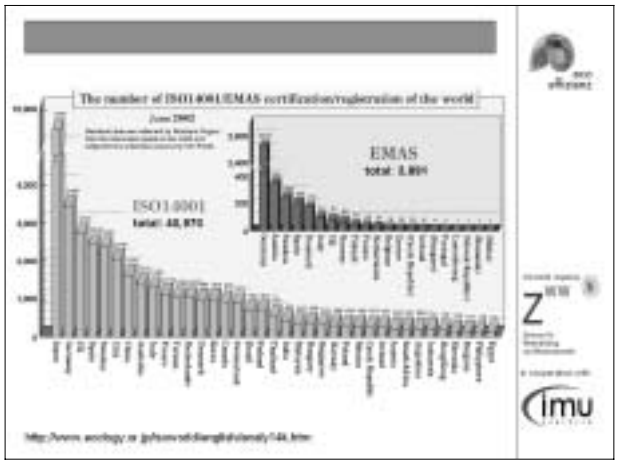


Chart 3

certifications increasing worldwide while the European standard remains at its present levels.

Environmental Costs

Now back to the topic of MFCA. When we start talking about "environmental costs", we have to make sure that we talk about the same notion. Many people use the same term "environmental costs" but many of them talk about different things. For example: talking about environmental costs, many people mean social costs, damage to the environment (Chart 4-1). Now in the business world, people talking about environmental costs, quite often mean end of the pipe costs for environmental protection, expenditures for environmental technology etc. (Chart 4-2). Others also include the costs for integrated environmental protection measures (Chart 4-3), not only end of the pipe costs. Others include costs of waste, some at the point of disposal, meaning disposal fees; others also include the handling, maybe even the purchasing prize of disposed material (Chart 4-4). When we look at flow cost accounting, we talk about all of these cost types (Chart 4-2,3,4,5). But we make sure to explain which one of the various types we mean. One has to make sure when talking about "environmental costs" to talk about the same subject. Within Material Flow Cost Accounting we consider the whole process from input to output and therefore all types of costs 2 to 5 (excluding social costs) may be calculated.

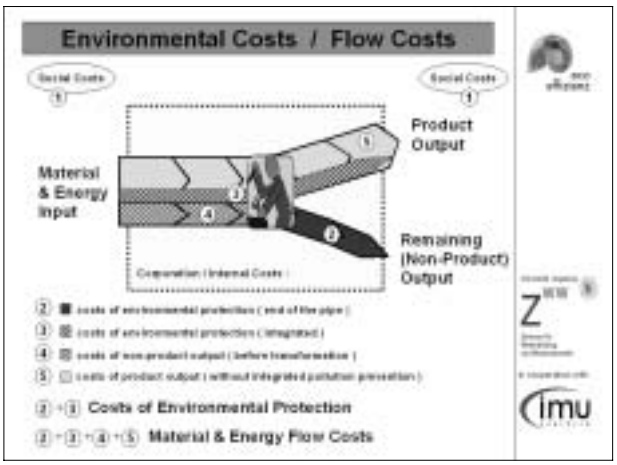


Chart 4

To make the importance of this point more clear: In Germany we have a law requiring companies to report on their "environmental costs". The law talks about "environmental cost accounting" but more precisely it means investments and expenditures for end of the pipe environmental protection technologies. The problem now is that different companies report on different types of cost, all relying on their individual definitions, and thus developing their own reporting systems. And we face another problem with this information; the expenditures for the environment can be very high. We have German chemical companies that invest several millions of Euro in waste treatment, water treatment, filtering emissions etc.. The higher the figure for these "environmental costs", the more likely the company management will say: "Well, this is too much money spent for environmental management. We have to cut down on this". So this turns against environmental protection. Counterproductively, it will lead to the reduction of environmental protection expenditures. Or management will say, "Germany is too expensive, we have to go somewhere else because the law is too strict."

If one wants to enforce environmental protection and motivate management to reduce environmental burdens one has to look at all types of environmental costs in the whole process, not only at the end pf the process.

Approaches to Environmental Accounting

Today, we find various approaches to achieve a higher level of transparency and control of environmentally relevant material flows in physical amounts and monetary values or costs. Some of them were already mentioned by Professor Kokubu. I will just name a few more. (Chart 5)

We find eco-balance, we talk about environmental

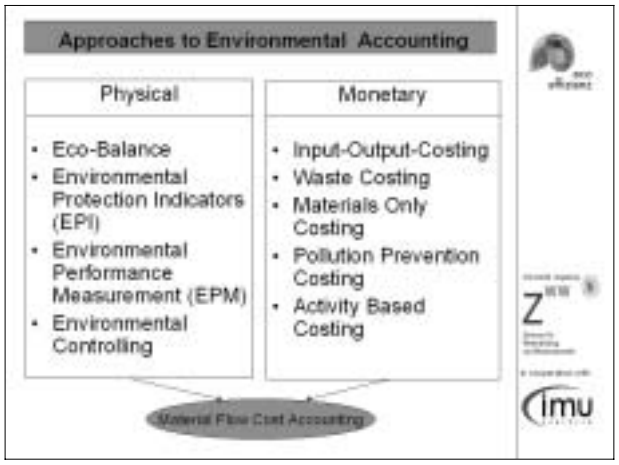


Chart 5

Chart 6

protection indicators (EPI), environmental performance measurement (EPM), environmental controlling and so forth. These terms will be familiar to most of you. They usually all show the same approach: They measure environmental matters, material flows, in physical terms, in kilograms or kilowatt /hours. Only lately have we tried to transfer this information also into monetary terms in order to meet the language and logic of the company's decision makers. This means today we are concerned about input-output-costing, waste costing, material-only-costing, approaches presently used in the United States, pollution prevention costing, which I mentioned before, or activity based costing. I will not go into any detail of these approaches. I just wanted to give a brief overview to the approaches and the vocabulary that is presently used in this field.

So, this was where the development to Material Flow Cost Accounting came from.

2. Present Trends and Developments

International Trends in Environmental Cost Accounting (ECA)

I now want to point out some recent international trends and developments of Environmental Cost Accounting in general (Chart 6) and its relationship to environmental management (Chart-7,8).

＊In Germany, we find a new standard, an industrial standard, called VDI 3800, asking for environmental cost accounting, standardizing terms and procedures. (Chart 6)

＊We find the above-mentioned law on corporate reporting of environmental costs. But this law quite often works counterproductively, as I mentioned before: Companies are able to show to the public that they have invested a lot of money in environmental protection, but it does not motivate them to do more for environmental purposes.

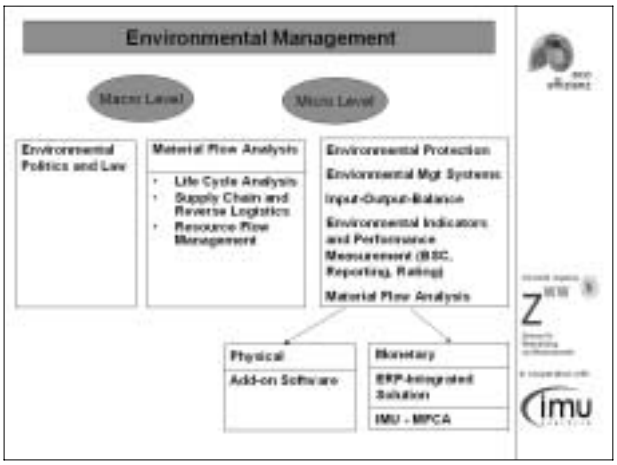
＊Then we have various programs by ministries and by academic associations and so forth.

＊Other approaches have been mentioned, there are quite a number of projects running in the United States. You will probably know more than I do about endeavors in Japan. And there are some global activities sponsored by international bodies that have been already mentioned, meaning also that the matter has been discussed worldwide.

Environmental Management and ECA

In general when we talk about environmental management, we must consider various levels. Chart 7 shows that in Germany you will find similar approaches to Environmental Management, like in Japan. We must distinguish between a macro level and a micro level. On the macro level, political programs and some laws concerning environmental management and protection are found. On the micro level, the company level, instruments and concepts are in practice that are familiar to Japanese companies too: technology oriented end of the pipe environmental protection measures, environmental management systems and environmental indicators. Recently, these instruments also cover the environmentally oriented use of the balance score card, of various new reporting procedures (e.g. via the company's website), lately going into corporate rating too, and finally into Material Flow

Analysis, Material Flow Accounting and Material Flow Management.



Char 7

Some of the recent instruments also might serve as links between the macro and the micro level. For example: Life Cycle Analysis, Supply Chain and Resource Flow Management usually start from a company's point of view but extend to a national or even global perspective.

Back to the micro level, where we find Material Flow Analysis: here again one might distinguish, as mentioned above, between physical and monetary approaches. We have a number of companies doing just the physical part of the material flow analysis (e.g. starting with an input-output balance), resulting in a classic environmental statement. But more and more companies now continue to accompany the physical analysis with the monetary one: translating physical terms, like amount of waste, in monetary terms, like costs or value of waste.

For the physical part, a number of add-on software offers are available, which I will mention a few slides later. For the monetary part, a number of projects are to be found that try to derive the necessary data from the existing information systems, not via add-on software that generally does not provide an automatic link to the existing data (ERP) systems.

In respect to environmental management procedures on a micro level, you are familiar with ISO14001 as well as we are. Looking closer at the ISO 14001 management system (Chart 8), one might distinguish between organizational aspects, aspects of technology and aspects of information that are covered through the ISO system. The information side of an environmental management system serves various purposes: Companies need some documentation of their environmental management system. They need reporting, internal reporting, external reporting, and they need tools for decision-making.

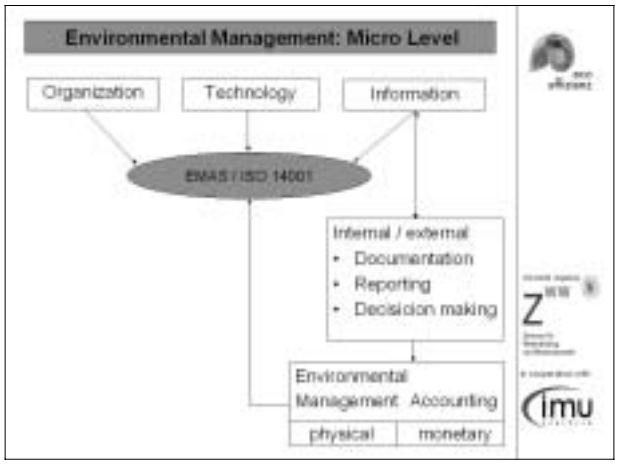


Chart 8

This is where the environmental accounting part comes in, distinguishing again between physical and monetary accounting, as prerequisite for decision making or reporting. Here, the relationship between environmental accounting on the one hand and environmental management systems, the ISO standards, on the other hand can be understood.

The number of add-on software we find in Germany today is quite plentiful (Chart 9). These are software tools that may be used for mapping and for tracing materials and material flows, but usually only on a

Chart 9

physical basis and outside the ERP system, outside of the regular information system of the company. Presently, they are not linked to the ERP system, so you have to feed them with data separately and often by hand. And there are no links yet to the standard accounting and controlling procedures in the company. Generally, these add-on tools therefore are used separately by the environmental officer. Their information is not prepared and not available for the decision-making processes of the line manager. This will not be a perspective of the long run.

The Beginning of Material Flow Cost Accounting (MFCA)

MFCA has its roots in "input-output balances" used within environmental management systems in order to gain environmental indicators for reporting purposes. Sometimes they are also called "mass balances" or corporate "eco-balances". The eco-balance goes into detailed analysis of the material or energy inputs and output. It all matches if the inputs are in "balance" with the outputs. The input-output analysis delivers ratios or indicators: Ratios of materials bought, compared to materials in the product or lost; percentages of various forms of energy (input) used, percentages of waste fractions (output) etc. The original indicators were only in physical units, like tons of waste per unit produced or kWh energy consumed per unit. It soon became obvious that, for the company's decision makers, it was necessary to translate the physical indicators into monetary units because company management was not so much interested in tons of waste, but in costs of waste, not so much in environmental waste or energy ratios, but in waste cost or energy cost ratios (Chart 10). So we had to translate the physical indicators into cost indicators, energy costs per units, raw material costs per units, waste cost per unit, per capita, per year etc. This seemed very simple, but as we looked at it closely it turned out to be much more complicated than we expected. To give an idea of how this worked in real life with working groups on site (Chart 11). When the working group started, we asked, "What are your waste costs?" The officer in charge left and couple of days later he showed up with a figure (Chart 11-1. run), "Well, we have this," he would say. The figure shows that this is quite a large company with 350,000 USD in waste costs. Looking at the company closer in a second run, we found that the first calculation was not complete and did not include all the information. There was, for example, a laboratory disposing waste too, but it was accounted for on a separate account. All together, in this second run, we found an additional 200,000 USD in disposal costs spread all over the company, not known to the officer in charge in the first run. During the next meeting of the working group, somebody argued: "This is not all the waste costs we have. We should consider transportation costs in order to get rid of the waste." In this case we found another 100,000 USD for waste transfer. Then somebody else suggested "Well, the wasted material also had been treated, separated, stored etc, the waste was handled, there was staff involved, this costs money, too", and we added personnel costs for the handling, the sorting etc. The staff had made

Chart 10

Chart 11

use of equipment such as forklifts, containers, space for storage was needed and so forth. We added depreciation and other positions like rents for rooms. And suddenly we had a completely different total sum for "waste costs". The company started with this sum up here (350,000 USD), and now was aware of 1,000,000 USD.

The next step then was obvious: the waste that was disposed of at the end of the pipe had been bought for a considerable amount of money at the beginning of the pipe. But nobody really knew the value of waste materials in terms of purchasing prices. Quite some research was necessary to get this information. Finally, we ended up with a material value of 1,500,000 USD. When company management, at the beginning of this process being aware of only 350,000 USD was only complaining about high disposal costs, at this point, looking at the total amount of 2, 500,000 USD, they decided on a new waste reduction program.

This was the example from a large pharmaceutical company. But we had the same experience with smaller companies. One just has to take off one zero at the end of the figures to get realistic figures for smaller companies.

This exercise, for us, was the start of Material Flow Cost Accounting: We started at the end of the pipe, and we traced the materials flow back to the beginning of the pipe, to materials purchasing. Today we follow materials flows in both directions. We distinguish between "material cost" for purchasing on the input side, the "system costs" for materials handling in the process, and "delivery" or "disposal costs" on the output side.

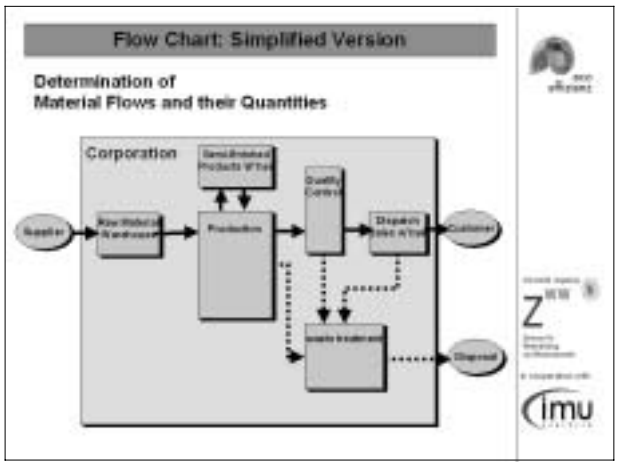


Chart 12

This was the start of Material Flow Cost Accounting, a simple idea, but challenging in the follow up.

Material Flow Cost Accounting Today

Today we trace the flow of materials with the help of flow charts (Chart 12: simplified version). And we are looking for the corresponding information in the accounting or ERP- system. Quite often, for example, we find waste flows not included in the accounting process.

Material flow charts for companies can depict quite a complicated network of materials flows (Chart 13).

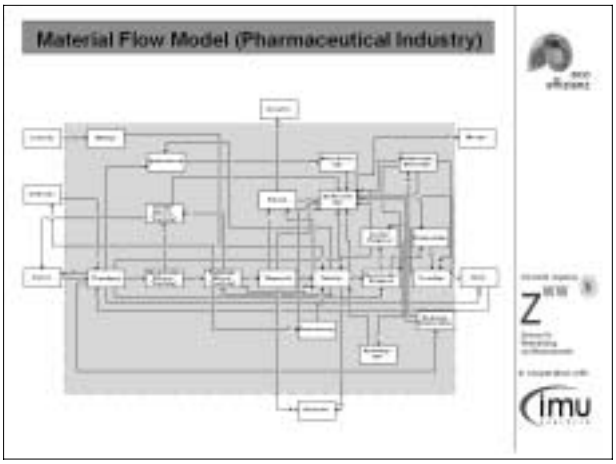


Chart 13

The boxes in the flow charts represent "quantity centers", equivalents to "cost centers", where the material is treated or stored. The arrows represent material flows. Clicking on the flow numbers brings up information on type and amount of material flowing and other additional available details. As mentioned before, along the flow of materials, three cost categories are distinguished (Chart 14): "material costs", "system

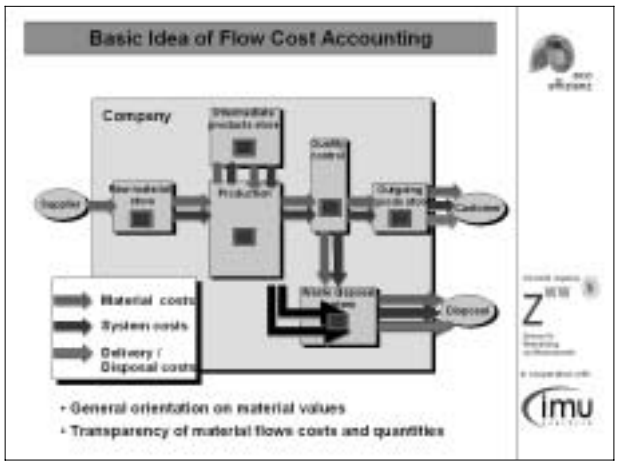


Chart 14

costs", including mainly personnel costs and depreciation, and, end of the pipe, the "delivery" and " disposal costs". Due to traditional cost accounting procedures (Chart 15) material costs are not allocated to

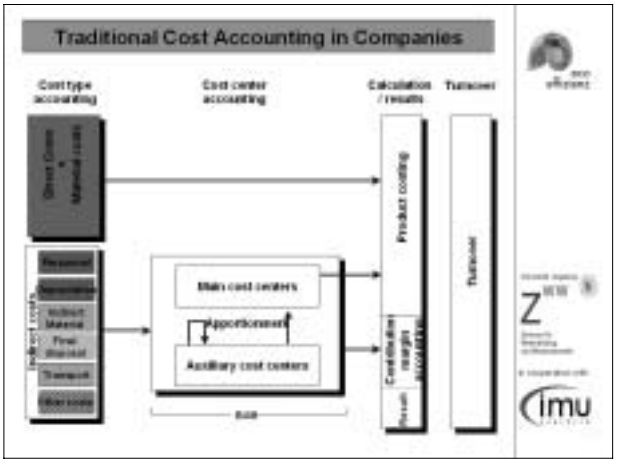


Chart 15

cost centers but posted directly to products. This means cost center managers have sufficient information on personnel costs, but insufficient information on costs and amount of materials handled. If managers are asked to reduce costs, which happens regularly, they are therefore bound to concentrate on reducing staff instead.

Aggregated results of the flow cost accounting process can be shown in flow cost matrices (Chart 16). The

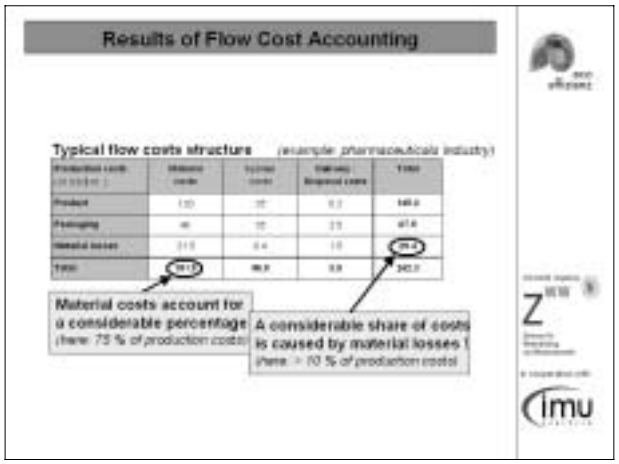


Chart 16

matrix shows the amount of material costs going into the product, cost of packaging material and costs of material losses. The matrix teaches us two lessons. First, it shows that quite often material costs are considerably higher when compared to system (mainly personnel) costs. Second, material losses are usually considerably higher than regular accounting systems calculate. The matrix again suggests it might be much more rewarding to look for cost saving potential on the material side, than on the personnel side.

In the next step, therefore it is necessary to trace down along the material flow the sources of the material losses. This example of pharmaceutical company (Chart17) lists some of the main causes or reasons for material losses. Here again, one might start to concentrate on the higher numbers, deriving measures for improvement or Kaizen where there are better opportunities for improvement.

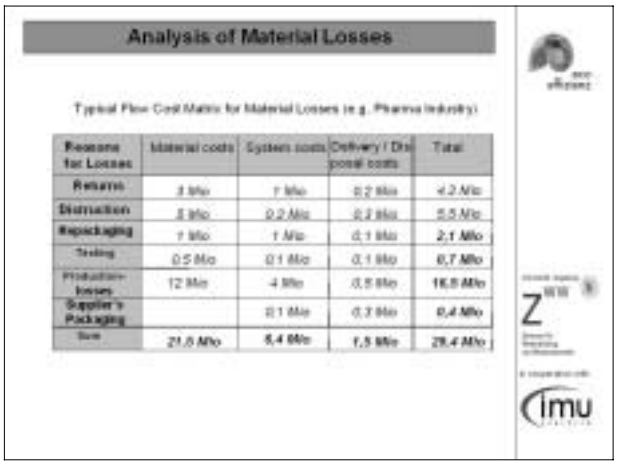


Chart 17

Here is some general statistical evidence for the above flow cost matrix we found in the German Statistical Yearbook (Chart 18). On average, in the German production industries, and this might be similar in Japan, material costs amount to 54 percent of the overall costs, personnel costs make up for only 18 percent and 28

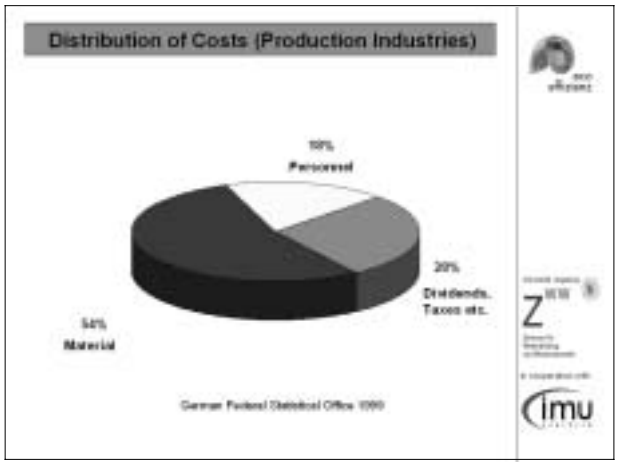


Chart 18

percent for the rest. In spite of this ratio the main part of the energy and consideration of cost accounting systems go into personnel cost accounting, resulting in the demission of staff.

For the largest block of costs, representing the highest potential for saving, the material costs, we had to realize that transparency is lacking. Companies know about material costs in the product, but the production process itself, the flow of materials, is quite often a black box in terms of material value in process, on stock etc.

This lack of transparency on the other hand offers new fields for improvement and Kaizen. It offers new chances for cost savings. The next chart, Chart 19 shows the example of another pharmaceutical company, where, looking closely at the flow of materials and the reasons for material losses, we were able to spot a number of actual cost saving measures.

The general experiences from MFCA pilot projects in the last few years are: (Chart 20)

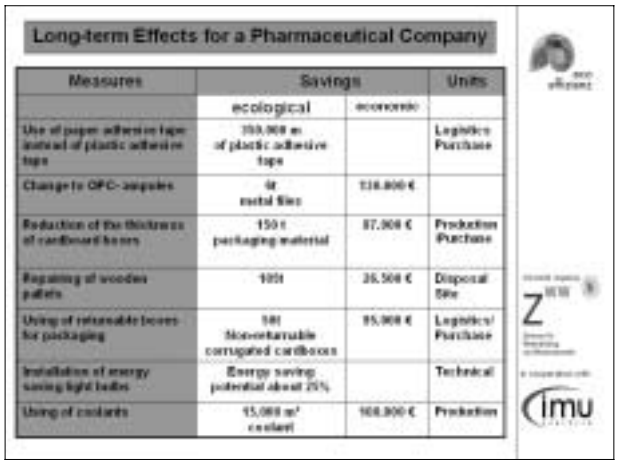


Chart 19

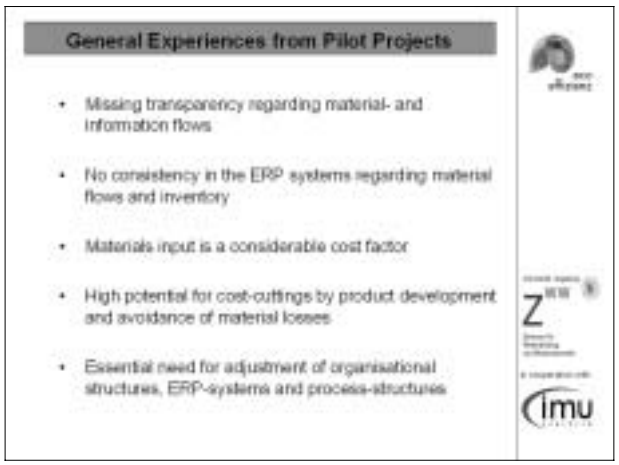


Chart 20

∗We found in companies a missing transparency regarding material flows information. We hardly ever found exact cost information on the material flow throughout the company. But without transparency, without exact information, companies are not able to organize and control material flows or production processes efficiently. If companies do not have exact information on the costs of material losses there is little incentive to reduce these losses.

∗We also found that companies' information systems, the ERP systems, like SAP, do not provide much information on material flows and, if at all, often had wrong or inconsistent information. As long as we do not have good information here, we cannot be very efficient in the material flow.

∗Material input in many companies was an underestimated cost factor.

∗If this is the case, it simultaneously offers considerable cost cutting potential.

∗In order to increase efficiency of material use, improvements might be necessary in various fields : by restructuring the organization, by remodeling the ERP system or by reengineering process structures.

If we consider the improvement of material efficiency as a relief to the environment it might be interesting to note that this relief is achieved through the reorganization of functional structures, remodeling of information systems and reengineering of production processes, not through typical environmental management programs like cleaning, filtering or sorting out of material. And the earlier within the flow of materials these measures are introduced, e.g. through purchasing or R&D, the more promising they are.

3. The Future

Where are we headed with MFCA? Presently, we are running a research project in Germany with 12 companies involved, including companies like Fujitsu-Siemens, Ciba-Geigy and others (s. www.eco-effizienz.de).

Reducing Functional Separatism: Material Flows as a common core of communication

In these and other companies we find people speaking

various languages, so they do not talk to each other or do not understand each other. For example, we meet management with an economic focus (Chart 21),

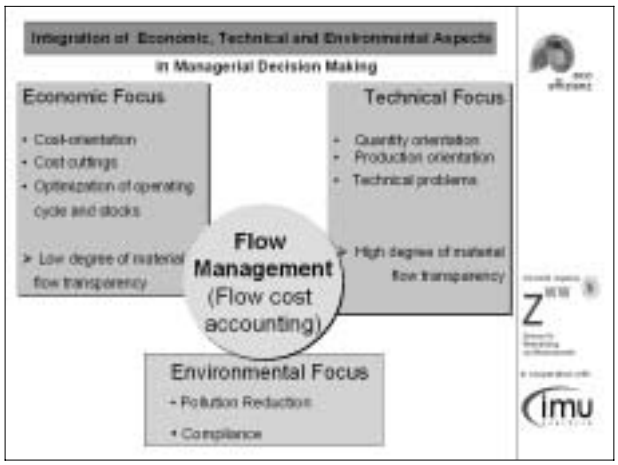


Chart 21

speaking a monetary language or we find the production or construction people speaking a technical language, thinking in the logic of the technical functioning of the product or the production process. Or there are people from the environmental department thinking in terms of pollution reduction or legal compliance. They all use their own language and follow their own proper logic. As they usually work and live in separate parts of the company they do not communicate with each other.

Administrative management knows a lot about accounting and marketing, but they do not understand the intricacies of the technical production processes including the flow of materials. The technical people have a high degree of material flow transparency, but in physical terms, not in monetary terms. They do not have good cost information. They have to reach quantitative and qualitative production goals and resolve technical problems. The people from the environmental department again try to motivate employees to comply with ISO standards, but have little information on costs or on technical interdependencies.

The task of the future is to bring these people together and make them talk to and understand each other. Flow charts, visualizing the flows of materials throughout the entire company, are communication tools to this purpose. People from various departments come together and start to talk about the same thing, the flow of materials, linking various departments. Interdependencies of departments are visualized. People at the end of the flow have a chance to talk to those at the beginning. The flow is their common topic. Flow charts are the tools of communication. Flow management is an integrative measure.

MFCA at the Click of a Mouse

A second future task: In all environmental accounting projects, in Japan or elsewhere, for statistical or MFCA purposes, data, at present, is collected by hand from various sources. This will not be possible in the long run. We will need information on material flows automatically out of the existing information systems, out of the ERP systems. What is needed is an ERP-integrated solution (Chart 22). The future will be a data warehouse including a huge amount of information. Through data mining, information for various purposes might be retrieved, for example, for various kinds of material reports: balanced scorecard, flow cost accounting, production report, procurement report and reports for EH & S, modular information.

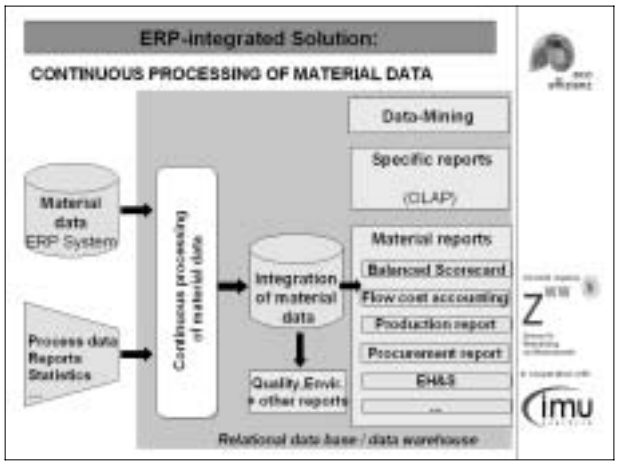


Chart 22

These reports are mainly for internal information and decision-making. But they might as well be used for external reporting, for environmental reports and other purposes. There is an enormous basis of information already stored in the present ERP-systems. But the information is not easily available. It is hidden somewhere in the black box of the ERP-system. If presently we are able to retrieve some MFCA-relevant information, it quite often is still of poor quality or even wrong or badly aggregated.

In the future, there is no way around a more

precise data based information on material flows, on their physical amounts and values. And this information must be easily and automatically accessible. If a company wants to be efficient in the use of its material, it must have exact information on its material, its flows and its stocks. The companies with better information will have a competitive advantage and there will be a natural selection. But there is still some work to be done until we are able to obtain the necessary information at the click of a mouse. The ERP-systems today are, in principle, able to provide the information, but they are customized with different objectives.

I would be happy if we could do some of this upcoming work together, in order to make material flows more efficient, and by this reduce costs and environmental damage.