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Environmental Management Accounting for Better Eco-Efficiency

- Close Look at Material Flow Cost Accounting -

Introducing Material Flow Cost Accounting for Environmental Management Accounting System

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The Kansai Research Center of the Institute for Global Environmental Strategies (IGES) carried out a Material Flow Cost Accounting (MFCA) trial project in the 2002 fiscal year. This symposium intends to make a presentation of the results of that project and discuss MFCA from a global perspective under the title of Session 2, "Environmental Management Accounting for Better Eco-Efficiency - Close Look at Material Flow Cost Accounting-". Prof. B. Wagner from the University of Augsburg, Germany and Prof. R. B. Pojasek from Harvard University, the United States of America, will present their experiences as well as techniques on MFCA, which is globally studied and employed. Researchers from the USA, Germany and Japan (including corporate participants) will have opportunities to exchange their views with each other on their findings. Thus the symposium offers valuable opportunities for academic interaction as well as further international exchanges.

Allow me to outline the relationship between MFCA¹⁾ and the two professors. Prof. Wagner, the founder of the Institut fuer Management und Umwelt (IMU), invented the MFCA that is used in Japan. Prof. Pojasek developed the "Systems Approach", a major tool used for "An Organizational Guide to Pollution Prevention, EPA/625/R-1/003, August 2001" issued by the U.S. Environmental Protection Agency. His Systems Approach is similar to Prof. Wagner's approach in that it also emphasizes material flow in the production process for its improvement through the application of process mapping.

The three countries studying MFCA have one thing in common: we conduct research by applying MFCA to corporate activities in each country, as represented by Nippon Paint Co., Ltd. and Shionogi & Co., Ltd., who will present the results of their trial project. These projects have been conducted with collaboration between the business organizations and researchers (the research organization). This is unique and socially valuable in that business and research people are working on the same projects from the same perspective and on the same stance.

Now let me explain the point of view from which we will discuss MFCA. Japanese companies often use the term "environmental management", though they do not always present a clear definition of it. This is because they are not sure what they should do. They translate the term in any way they like; whatever they do, they can call it "environmental management". Therefore, before starting the discussion, allow me to define "environmental management" as the management that will maximize corporate profit while reducing environmental impact. Environmental management accounting is essential in the environmental management in order to reduce environmental impact in concrete terms and at the same time improve corporate profit. Environmental management accounting should be recognized as a tool to attain this goal. It is important to support management decision-making in terms of the environmental management by using this tool.

I would like to point out one important thing. The day before this symposium, a closed workshop was

1) Prof. Pojasek's Systems Approach is not quite same as MFCA, but in this symposium his approach is recognized as a sort of MFCA.

held where we exchanged our views with Profs. Wagner and Pojasek. We discussed how to translate the Japanese term "kankyo keiei" into English. If it is translated as "environmental management", it may be understood in English as being limited to the-end-of the pipe environmental management - for example, the environmental management of waste treatment. This is not what "kankyo keiei" means in Japanese. It was proposed that "corporate environmental management" or "sustainable management" would be a more appropriate translation.

In this way we are going forward while forming a common understanding and language. Unlike the definition of environmental management, the subjects of this symposium, that is, Material Flow or Material Flow Cost Accounting is universally recognized. The international community is interested in material flow management. Based on material flow management, a wide range of environmental management accounting information is offered and a variety of environmental management accounting tools has been developed in some countries. Among a number of tools, MFCA developed by IMU, founded by Prof. Wagner and the Systems Approach proposed by Prof. Pojasek are the most effective and practical tools.

Material flow management, the origin of the two approaches, emphasizes mass balance in the process of a company. Generally we focus on mass balance consisting of input and output to and from a company, when we review environmental impact. According to Profs. Wagner and Pojasek, we should look into the entire process, not the-end-of-the-pipe, to identify and get rid of the causes of environmental burden. More precisely speaking, mass balance is not necessarily applied to the process; however, both their theories focus on the analysis of process. Another element they have in common is that they analyze materials within a company. Most of the materials in the company are defined as raw materials or calculated as raw material costs in management accounting, particularly in cost accounting. In this sense, the biggest difference between MFCA and cost accounting is that while the former reflects the data of every physical material, the latter reflects the data of "most of the materials".

In material flow management, material physical data in terms of environmental information is integrated with cost information (economic information) and evaluated based on the physical data. Thus MFCA offers a new set of information - different from conventional cost accounting - relevant for decision-making. Profs. Pojasek and Wagner as well as the two Japanese companies will explain this new type of information and perspective in their presentation about their case studies. Specifically, Prof. Wagner will talk about MFCA developed by IMU in Germany. Prof. Pojasek will illustrate his Systems Approach using case studies in North America. The Japanese companies will explain the MFCA trial projects conducted in collaboration with IGES.

The IMU's MFCA can be described as the origin for MFCA applied in Japan. The term "origin" means that the MFCA applied in Japan is not a copy of the IMU's MFCA. We learned the basic concept of the German MFCA and modified it to the Japanese way. Therefore, the IMU's MFCA and the Japanese MFCA are not identical. The original MFCA was transformed to the Japanese MFCA in the process of application.

Systems Approach proposed by Prof. Pojasek is a little different in its approach. His tool also monitors the material and operation flow in the production process and the company, but as the name indicates, it uses several kinds of software to systematically archive it; it uses MS-Visio to make a process map and list the data on a database with MS-Excel or MS-Word. A folder is made at each point in the process : the folder is designated as an archive of the data for that point: the data and documents are systematically made into database for the whole process. As this demo software works on MS-Windows, it offers very illustrative and comprehensible data as well as a broad overview of the entire process. According to Prof. Pojasek, a flow chart similar to the one used by MFCA can be easily produced by inputting the data step by step on MS-Visio.

Although their approaches are a little different, the IMU's MFCA and Prof. Pojasek's Systems Approach are similar in that both of them intend to find the

waste of materials for the improvement of the production process. In spite of their differences, both produce similar maps and the attached data is also expected to have little difference. Even if some variation exists in the results, it could come from the different approaches that were employed to attain the same goal, which intends to elicit material flow in the process. It may be possible that the two approaches are not mutually exclusive: they may even be complementary. This is because quantitative data is physically constant even if it is affected by the measurement range or level. Although they employ different cost evaluation methods (differences originating in different definitions and procedures), it seems that the Systems Approach does not rule out other cost evaluation methods and thus it can include MFCA's cost evaluation method as well.

Now the development of MFCA in Japan is shown briefly. A committee, whose activities were limited to three years, was established in 1999 to develop environmental management accounting tools as one of the Millennium Projects commissioned by the Ministry of Economy, Trade and Industry (METI).²⁾ A total of five working groups were set up under the committee: one of them was for the research of MFCA (chairman: Prof. Nakajima). As far as I know this was the first project introducing MFCA to business entities.

IGES Kansai Research Center in cooperation with Nippon Paint Co., Ltd. and Shionogi & Co., Ltd. conducted the second such project in fiscal 2002. Each case study will be presented in the following section. We can see some differences in these two projects. The METI's project seems to place more emphasis on contribution to the improvement of profit or reduction of costs than the reduction of environmental impact, though the goal of MFCA was set to both improve profit and reduce environmental impact. On the other hand, IGES aimed to reevaluate the benefit of MFCA as an environmental management accounting tool with an emphasis on cutting back on environmental impact and a validation of that effect.

As a result of the IGES project, it has been reconfirmed that MFCA is capable of analyzing the current status of a company just like a CT (computed tomography) scanner. With MFCA, we can observe the inside of a company and examine its health. As Prof. Wagner says, MFCA provides a company with a mirror to look at itself.

Whether it is likened to a CT scanner or mirror, the implication is the same. Let me expand the professor's analogy. A mirror reflects your appearance or how you appear to someone else, offering you a strong motive to change yourself. However, compared with a CT scanner, it gives you less information. A CT scanner offers you cross-section images of the insides of your body. Even if you look healthy, the scanner can show what is wrong with you internally. The scanner, however, cannot automatically identify the abnormality. It is a doctor (management) that decides what is normal and what is abnormal. MFCA is a useful tool for people and organizations to justify change. Prof. Wagner shares with us the experiences and potentiality of changing companies.

The process can be improved and changed by using a mirror and CT scanner. Therefore new communication opportunities will arise among corporate staff in analyzing the process. MFCA contributes not only to the reduction of costs and environmental burden but also the creation of a new corporate culture that emphasizes communication. Then we can easily imagine the necessity to introduce MFCA to the supply chain and the magnitude of the effect gained from it.

In the course of developing MFCA in Japan, the triangle consisting of theory building, methodology development and corporate-level validation has been established. Theory interacting with methodology is applied to business activities. The results are fed back to the theory and methodology for further development of MFCA. I propose that we look at the presentations by the two professors and Japanese companies from this aspect: we will learn specific results and values for MFCA, which has been successfully used as a

2) The Ministry of Economy, Trade and Industry established and commissioned to the Japan Environmental Management Association for Industry a three-year project under the theme of "Research on Environmental Business Development and Promotion: Establishment of Environmental Management Accounting Tools", which was completed at the end of March 2002. The Ministry made public the results in its own name in the Workbook of Environmental Management Accounting (2002) in Japanese.

business tool for environmental management accounting.

This symposium may motivate some companies to use MFCA. Business management should have a global or an international perspective beyond the company itself. Environmental issues call for international/global attention. Through international communication like this symposium, we, as a member of the global community, are able to further explore environmental management as sustainable management.

The reality in Japan's business community is that the environment is treated as a special addition to business management. Some environmentally conscious companies use the term "environmental management as sustainable management" and address environmental issues by reanalyzing and restructuring their businesses and identifying a variety of issues from a new point of view. However, the environment is still treated as something special in their system. It has now become necessary to build up the (environmental) management

framework where environmental activities are included as a normal management factor rather than something special.

Let me cite what one environmentally advanced company said: currently the environmental department is an independent unit in the company, but when we have achieved the goal of our environmental management, that environmental unit would be no longer necessary. This does not mean that the company will lose interest in the environment. It means environmental efforts will simply be blended in with management factors.

The enhancement of profit and reduction of the impact on the environment may be difficult to combine, but that compatibility is demanded today. It is very important to manage business with an environmental management accounting tool such as MFCA in order to achieve these ends. It is very meaningful and creative to share and discuss the experiences of Japan, Germany and the USA.

Developments of Material Flow Cost Accounting in Germany

Bernd Wagner

University of Augsburg, Germany

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

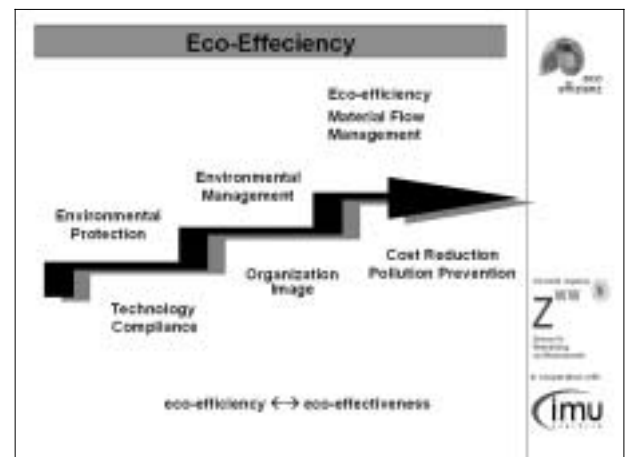


Chart 2

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

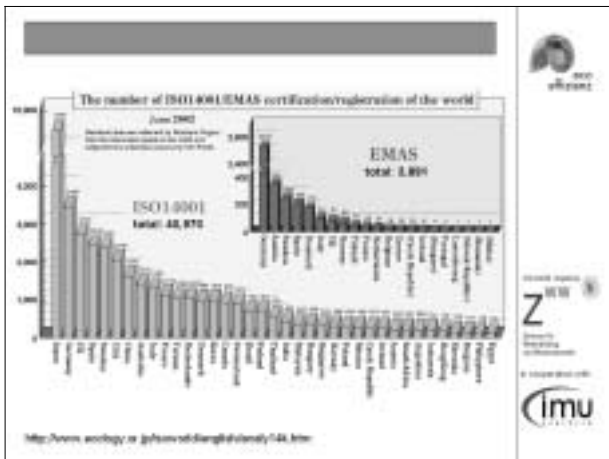


Chart 3

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

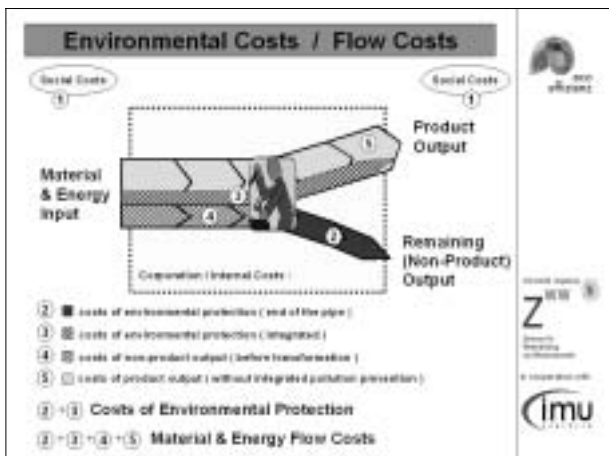


Chart 4

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.

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 of 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

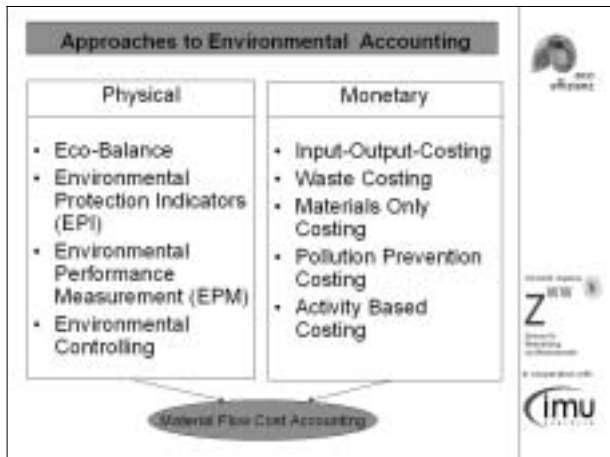


Chart 5



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

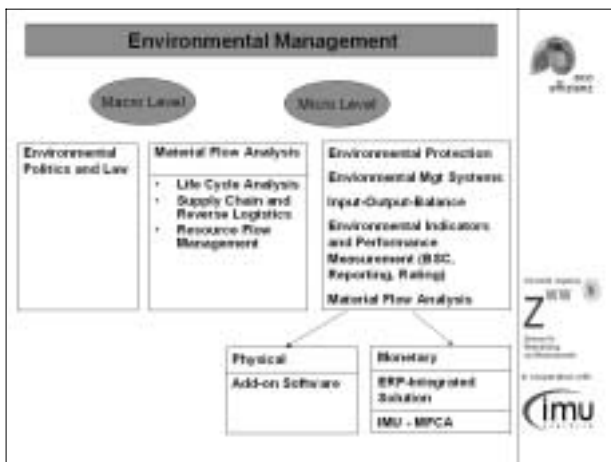
often works counterproductively, as I mentioned before: Companies are able to show to the public that they have invested a lot of money in environmental protection, but it does not motivate them to do more for environmental purposes.

- * 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.

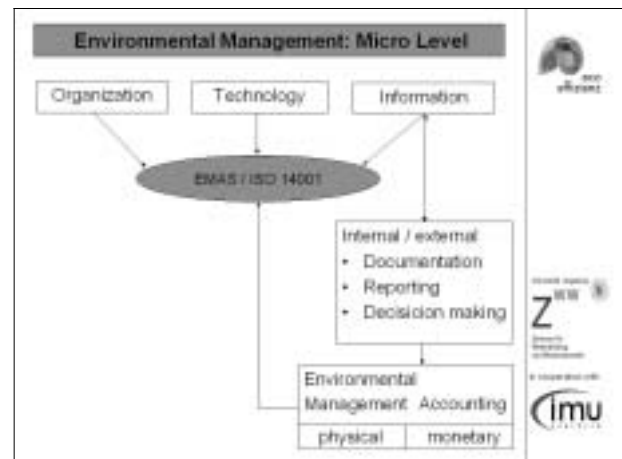


Chart 8

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

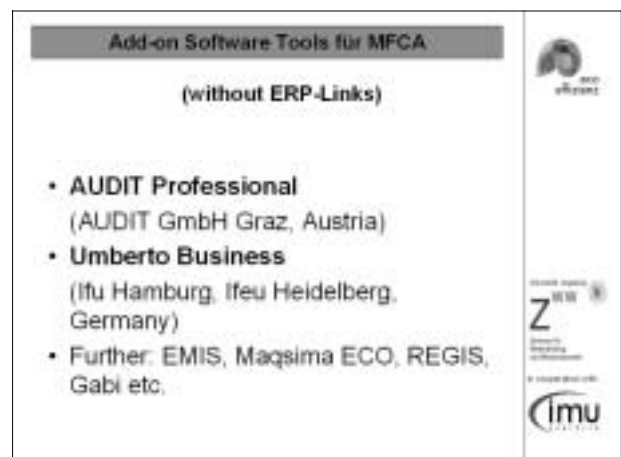


Chart 9

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 Cost Ratios	
- Energy Costs / Unit	
- Raw Material Costs / Unit	
- Auxiliary Material Costs / Unit	
- Waste Costs / Unit	

Chart 10

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

Total Waste Costing	
Disposal Fees (1. run)	US \$ 350,000.-
Disposal Fees (2. run)	US \$ 200,000.-
Transportation Costs	US \$ 100,000.-
Personnel Costs	US \$ 150,000.-
Machines / Equipment (Depreciation)	US \$ 150,000.-
Miscellaneous (rents, etc.)	US \$ 50,000.-
	US \$ 1,000,000.-
Material / Purchasing Costs	US \$ 1,500,000.-
Waste Flow Costs (in total)	US \$ 2,500,000.-

Chart 11

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

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.

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).

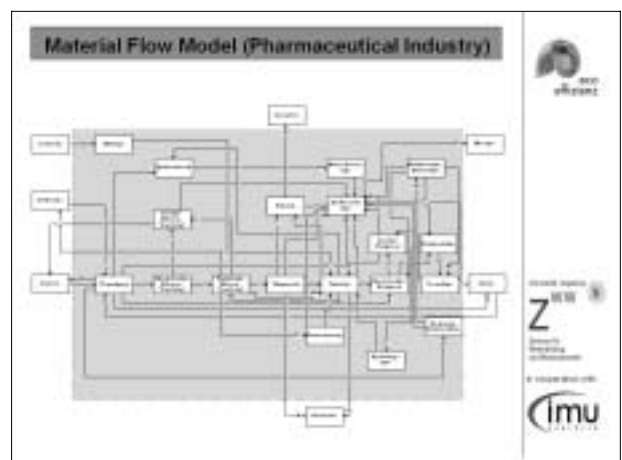


Chart 13

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

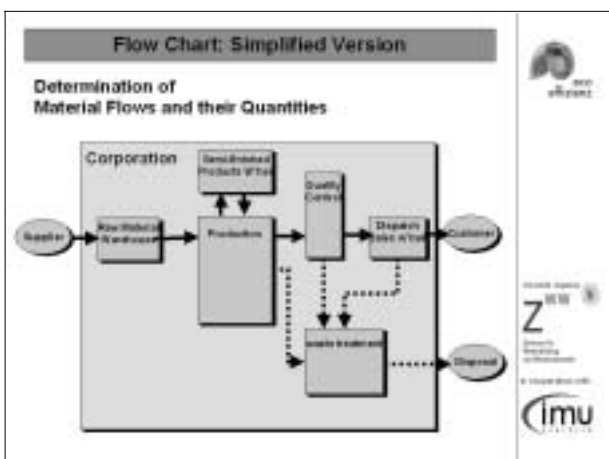


Chart 12

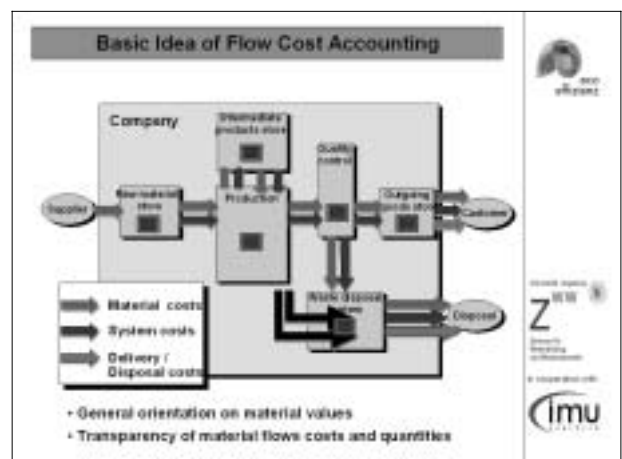


Chart 14

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

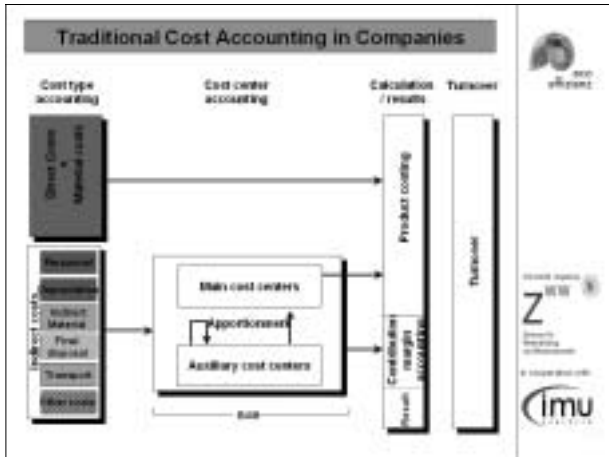


Chart 15

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

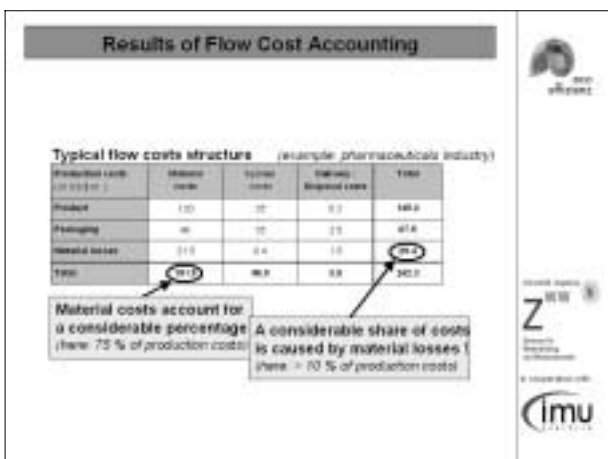


Chart 16

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 (Chart 17) 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.

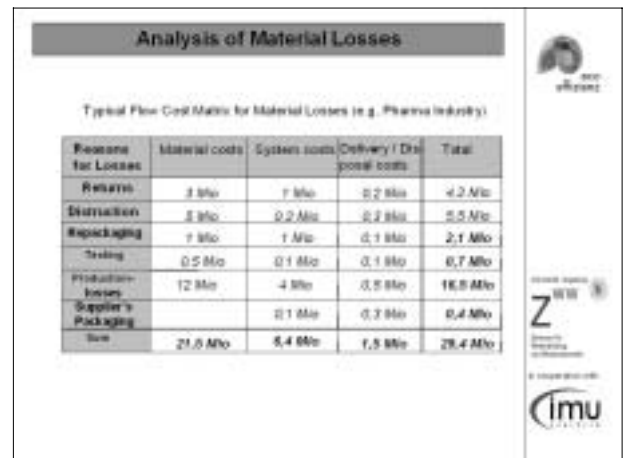


Chart 17

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

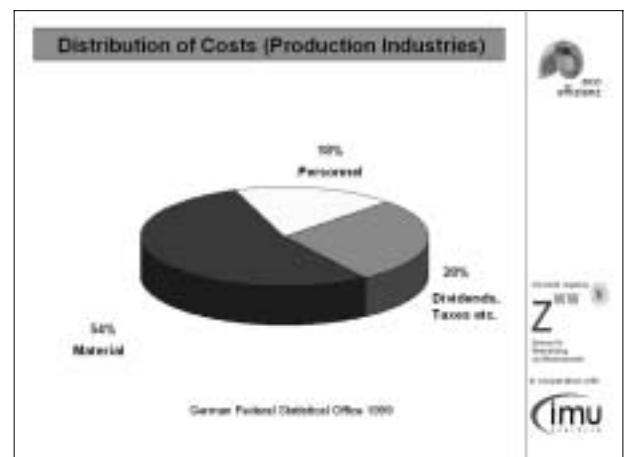


Chart 18

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)

Long-term Effects for a Pharmaceutical Company			
Measures	Savings		Units
	ecological	economic	
Use of paper adhesive tape instead of plastic adhesive tape	359,969 m ² of plastic adhesive tape		Logistics/Purchase
Change to OPC-inkjet	49 metal files	118,800 €	
Reduction of the thickness of cardboard boxes	150 t packaging material	87,900 €	Production/Purchase
Regaining of wooden pallets	100t	26,500 €	Disposal Site
Using of reusable boxes for packaging	58t Nonreturnable corrugated cartons	95,900 €	Logistics/Purchase
Installation of energy saving light bulbs	Energy saving potential about 25%		Technical
Using of coolants	45,000 m ³ coolant	168,900 €	Production

Chart 19

General Experiences from Pilot Projects	
+	Missing transparency regarding material- and information flows
+	No consistency in the ERP systems regarding material flows and inventory
+	Materials input is a considerable cost factor
+	High potential for cost-cuttings by product development and avoidance of material losses
+	Essential need for adjustment of organisational structures, ERP-systems and process-structures

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),

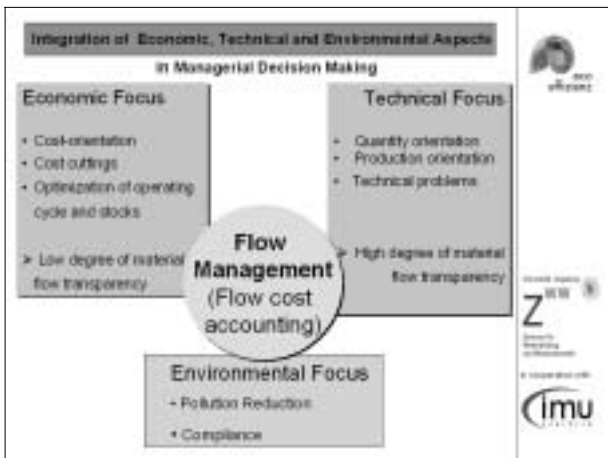


Chart 21

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.

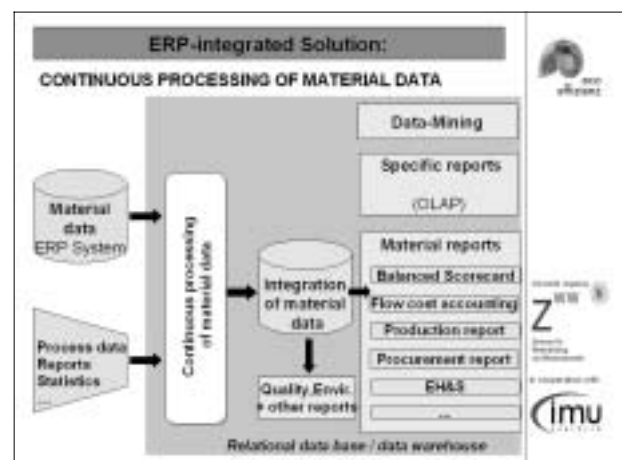


Chart 22

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.

Using Process Maps and Other Tools to Improve the Use of Material Flow Cost Accounting : The North American Experience

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Introduction

I am honored to have been invited to this international gathering to introduce you to the Systems Approach to process improvement. This approach should be useful to help the material flow cost accounting methodology become more consistent and visual. The Systems Approach will also allow you to implement material flow cost accounting in harmony with your kaizen efforts to conserve the use of resources and to eliminate wastes.

The Systems Approach has enjoyed widespread use in the United States and elsewhere in the Americas. It is featured in the US Environmental Protection Agency's publication, "An Organizational Guide to Pollution Prevention." Each participant in this conference has been provided with a CD version of a demonstration of this methodology. An updated version of this demonstration can be found on the Internet at http://courses.dce.harvard.edu/~envree105/DEMO_START.swf.

Material flow cost accounting has made much progress in Japan with the efforts of IGES and the companies that the Institute is working with. I have been very interested in the kaizen methods that have been presented by Nippon Paint and Shionogi Company. The Systems Approach can provide six important roles as other companies seek to follow their example:

1. All process maps will be consistent and visually compelling;
2. All resource flows will be visually linked to the process maps using "object linking" techniques;
3. Opportunities for improving the process will be

4. Kaizen activities will be systematically facilitated using the Systems Approach tools and formal employee action plans;
5. Material flow cost accounting will be used to quantify the results; and
6. A unique performance measure will be used to track and trend the process improvement effort and compare it to other improvement efforts.

The Systems Approach can serve as an effective means to facilitate the entire process improvement effort.

Material Flow Cost Accounting Model

The material flow cost accounting model (Chart 1) has evolved from material flow analysis (i.e., input/output models) and environmental cost accounting. Significant advancements have been made by IMU in Augsburg, Germany to help make this methodology useful to industry. IGES has been developing this model here in Japan - adapting it, as necessary, to

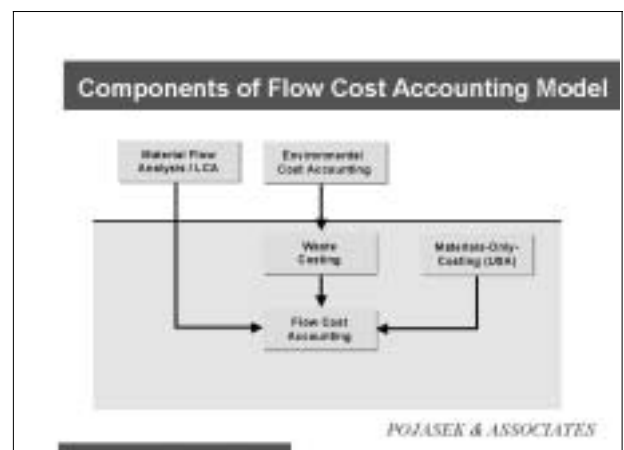


Chart 1

fit the culture and industrial variations that differ from the model's application in Europe.

Material flow cost accounting (Chart 2) tracks materials from suppliers into the incoming stores. After production, the throughput materials pass through packaging and outgoing stores before being sent to the customers. You will note that material losses from these steps are accounted for in an "environmental technology" area.

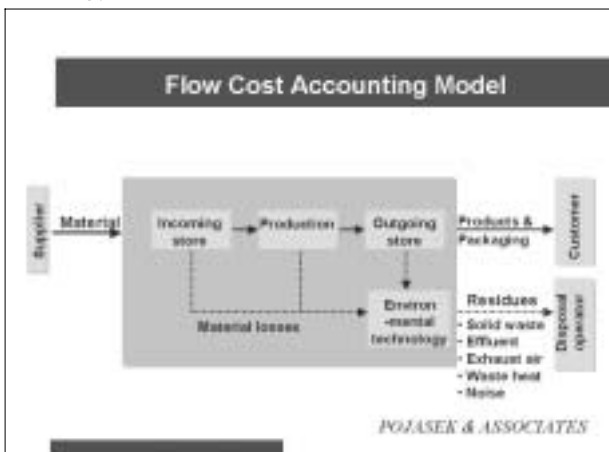


Chart 2

A simplified model (Chart 3) of the materials flow cost accounting model is represented by the "top level" of a hierarchical process map. The discharges, emissions, noise, odor and wastes from the process work steps are accounted for in the form of "supporting processes" that are linked to the main process by means of a resource accounting sheet. This linking will be described later in this presentation.

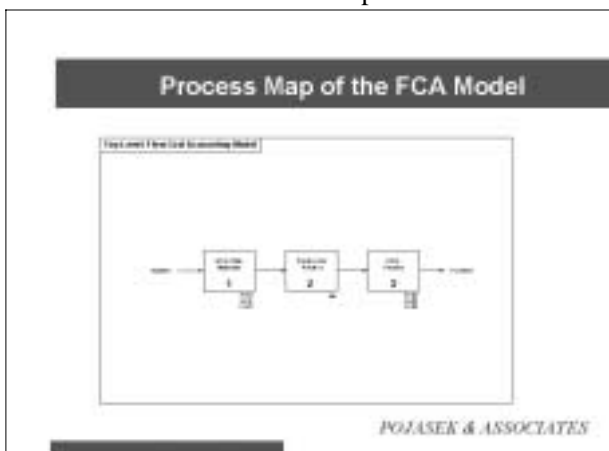


Chart 3

Please note the simplicity of this model. Everything is on one line with a consistent flow from left to

right. There are links to the various accounting sheets under the first and third work steps. The "PM" under the production step indicates that there is more process mapping detail linked to this work step.

Process flow diagrams (Chart 4) have been used by the materials flow cost accounting teams to track materials through the production process. These diagrams are often complex. This complexity makes it difficult to explain the materials flow cost accounting to management and other interested parties. There is a need to have a simplified process mapping technique and a logic for mapping that enables the various applications to be compared on a consistent basis.

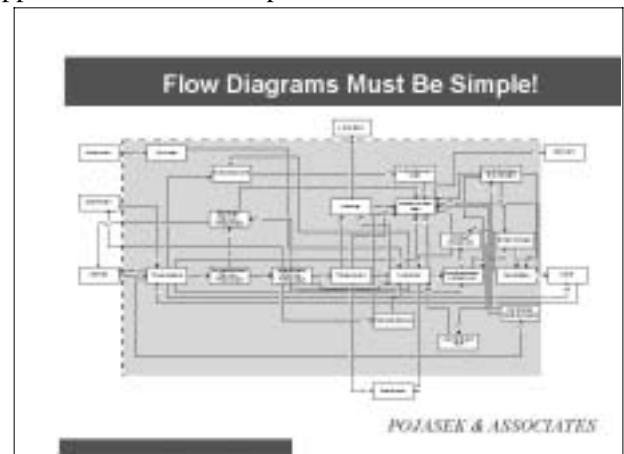


Chart 4

Systems Approach Process Mapping Tool

The Systems Approach characterizes the process using a hierarchical process mapping technique. Each level in the process map is restricted to three to six work steps. This rule allows the process map to be useful to the material flow cost accounting team while being understandable to everyone else with an interest in this methodology. Flow charts, process flow diagrams, piping & instrumentation diagrams, and value stream maps can all be converted to hierarchical process maps.

Process maps can be computerized with software that enables the user to only show the process sequence that is being considered. If we go back to Chart 3 and click on the PM, the second level of the process map will appear on the computer screen (Chart 5).

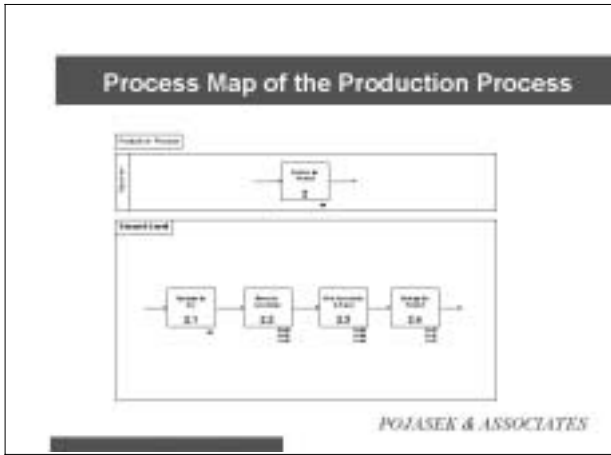


Chart 5

You should note that each work step has two numbers in the work step boxes. This tells you that you are in the second hierarchical level. Please notice that this segment of the process map at the third level under work step 2.1. Work steps 2.2 through 2.4 cannot be described in more detail at a lower level. They have accounting sheets associated with them as you will note.

Now if you click on the PM under work step 2.1, the third level process map (Chart 6) will be visible on the computer screen. Please notice that there are three numbers visible in each of the work step boxes.

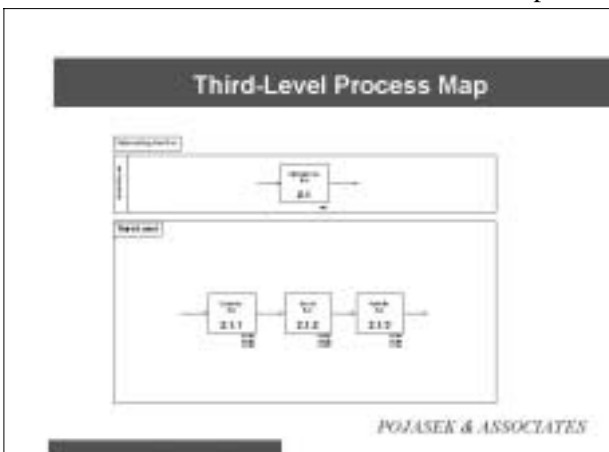


Chart 6

All manufacturing and service processes can be presented using this hierarchical process mapping technique. Books of process maps can be prepared to show different processes in the same company. Process maps can be used to link the supplier processes with the company processes. This is useful for supply chain management programs. Process maps can be

used to link the company processes with customer processes. This linkage can facilitate product stewardship activities and product take-back activities. Every aspect of a product's life cycle can be linked using this process mapping technique. By using these process mapping techniques, it should be easier to integrate material flow cost accounting throughout this product life cycle.

Resources, Activities and Supporting Processes

Let's take a closer look at work step 2.1.3 - "Paint the Box." (Chart 7). You will notice that the description of the work step involves a verb-noun combination of words. This shows that "work" is being done here. There are three items below the work step: RA#4, AA#4, and CA#4. Let's take a look at how information is linked to the process maps. If you were to click on "RA#4," the process map would leave the computer screen and a resource accounting (RA) sheet (Chart 8) would appear. This resource accounting sheet is divided into three sections.

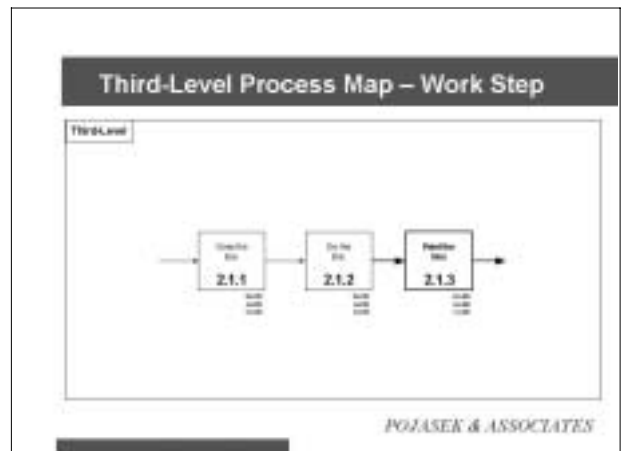


Chart 7

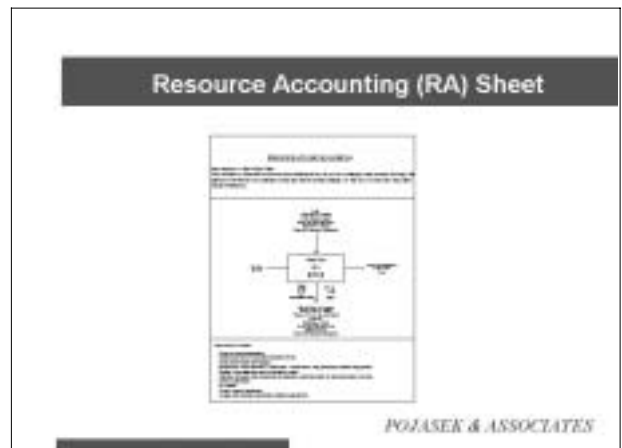


Chart 8

In the top section (Chart 9), there is a description of the work that is taking place in this work step. This description often comes from the Standard Operating Procedure (SOP). The company's ISO 9000 program is one place where you can look for this description in an electronic format.

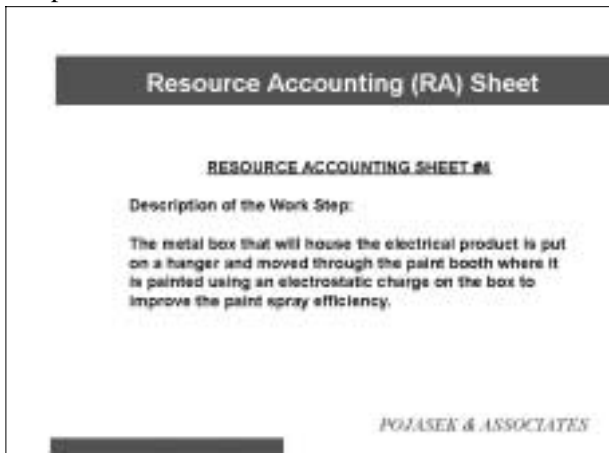


Chart 9

will provide many strategic leveraging points for the material flow cost accounting methodology.

In the lower part of the resource accounting sheet (Chart 11), a listing is provided of all the supporting processes that are necessary in order for the work step to take place. You should notice two things here:

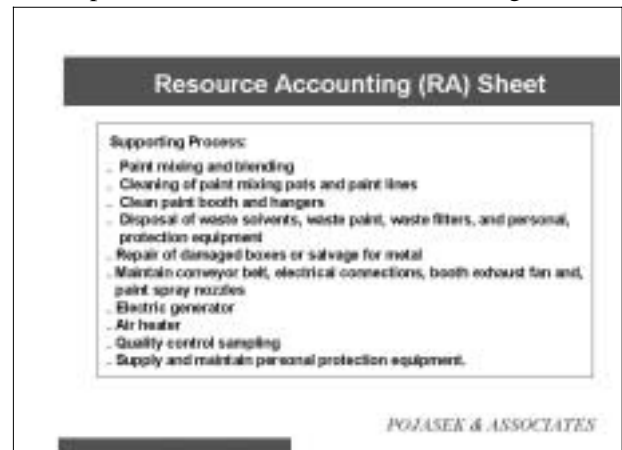


Chart 11

In the center of the resource accounting sheet (Chart 10), there is a 360-degree look at the work taking place. On the left is the work step that takes place before this work step. On the right is the following work step. Above the work step are all the resources (i.e., energy, water and materials) that are required in this work step. Below the work step are all the resources that are lost (i.e., wastes) as a result of the work step. This provides a visual means of accounting for the resources used and lost at each work step at the lowest level in the hierarchical process map. The user can create a "glossary" for these resources so they can be tracked to any work step where they might be used or lost in the entire process. This linkage

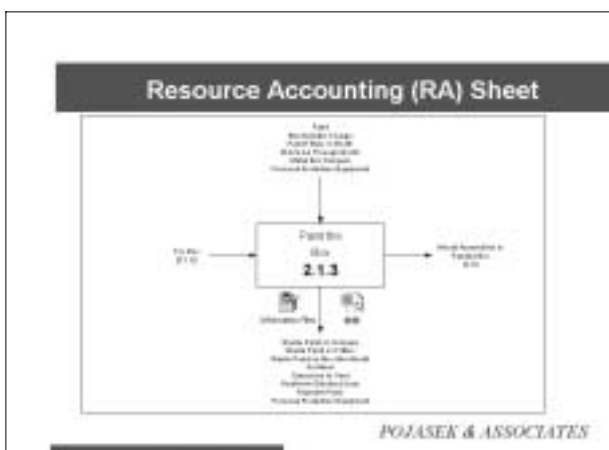


Chart 10

1. All discharges, emissions, noise, odor, and waste are controlled or handled by supporting processes; and
2. All these supporting processes use and lose resources.

It is possible to determine the resource use and loss from these supporting processes and determine the costs associated with this resource flow. In this manner, the resource flow cost analysis can be extended to the entire "system" through the process depicted in the hierarchical process maps.

While the use and loss of resources are costing the company money, there is also much money spent to have people manage these resources. To account for the time people are spending in this regard, we have created an activity accounting (AA) sheet (Chart 12). You can view a larger version of this sheet on the CD demonstration of the Systems Approach.

It is very similar to the resource accounting sheet, except in two ways. Above the work step box, all the activities are listed that are needed to manage the work step. Below the work step box, all the activities that manage the losses (i.e., discharges, emissions, noise, odor, and wastes) are listed. Below the box

activities are consistent with the material cost flow accounting model's "environmental technology" box.

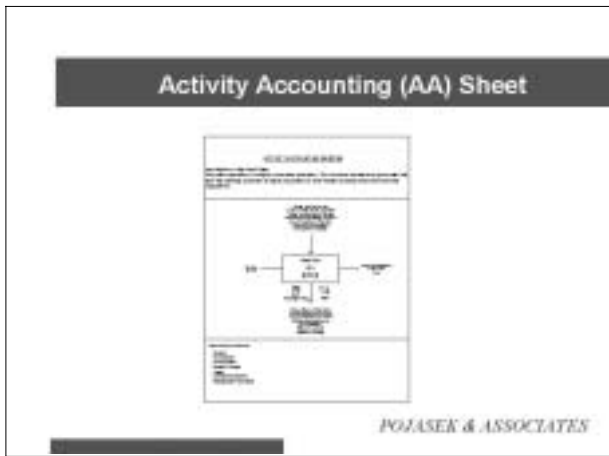


Chart 12

Cost Accounting

IMU (Germany) and IGES (Japan) have been perfecting means to use the facility's enterprise resources planning (ERP) system to automate the generation of costs for the material flow cost accounting service. By combining that knowledge with the Systems Approach, companies will have a more visual means to link resource flow accounting with cost accounting. The users of the combined system can use a more visual framework to "see" where the cost impacts are in the process and to leverage this knowledge to reduce costs in other similar work steps and supporting processes.

Costs are assigned to both the resource and activity accounting sheets (Chart 13). These costs can be combined and displayed as a cost accounting (CA) sheet. The resources are typically linked to the

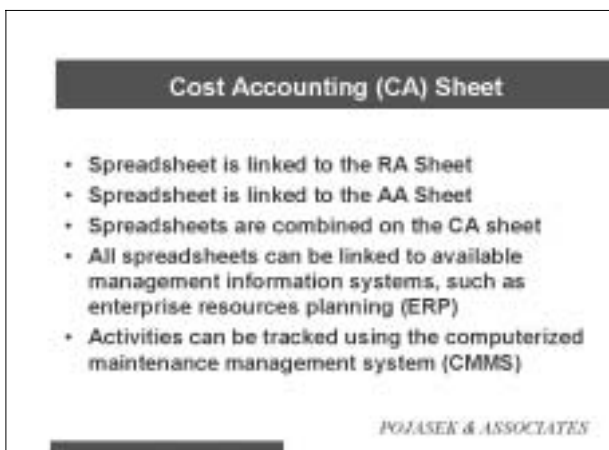


Chart 13

materials resources planning (MRP) component of the ERP or a stand-alone MRP information module. We have used the computerized maintenance management system (CMMS) module to track the activity based costs of managing activities associated with process improvement activities. The CMMS is often embedded in the ERP or can exist as a stand-alone module.

It is very important to automate the cost accounting activities. Experience has shown that process improvement efforts often fail because this information is not properly maintained and used to justify the efforts. Material flow cost accounting efforts have made significant strides in allowing process improvement teams to have this very valuable information to plan, implement and report on the kaizen efforts.

Conclusions

There are many reasons to consider the integration of material flow cost accounting with the Systems Approach (Chart 14):

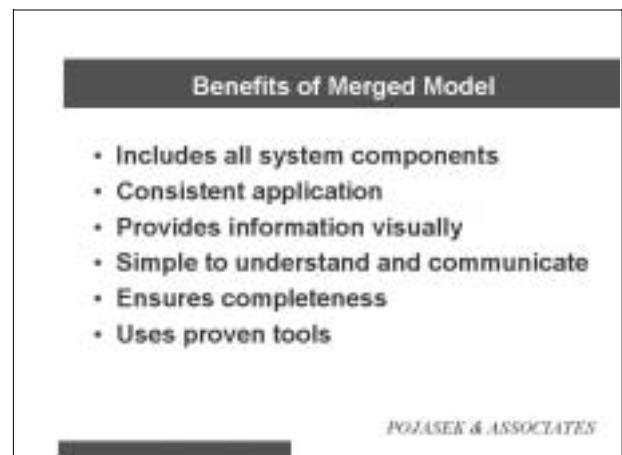


Chart 14

System. It is important to apply the material flow cost accounting in all aspects of the systems found in most manufacturing companies. In this way, important linkages and other leverage points can be identified to help improve the effectiveness of the methodology.

Consistency. Application of material flow cost accounting can be enhanced if everyone involved can "see" how it is affecting them. The Systems Approach methods provide this visuality.

Communication. All of the items help material flow

cost accounting implementers to communicate their work to people at all levels in the firm. As they begin to penetrate the supply chain, this enhanced communication using the Systems Approach will allow the divergent interests to be focused on the value creation that is desired.

Completeness. It is important not to leave out supporting processes and their use and loss of resources. The Systems Approach links all activities and work in the company back to specific work steps in the main process(es).

Proven Tools. All the quality tools in the Systems Approach have been proven in applications around the world. The youngest tool in the approach was published in 1943. The use of the Systems Approach provides a solid platform for implementing material flow cost accounting in any company.

In a workshop hosted by IGES (Chart 15) the day before this conference, we presented a paper that addresses the manner in which the Systems Approach can help to facilitate the kaizen process improvement effort and link them back to continuous improvements using the material flow cost accounting model. This paper has focused on the front end of the application. The CD presents an interesting metric that can score the *performance* of the facilities that use an integrated suite of these methods. I hope that this meeting will provide the seeds that will grow as we all work together to integrate these value creation methodologies. I would be pleased to correspond (Chart 16) with anyone

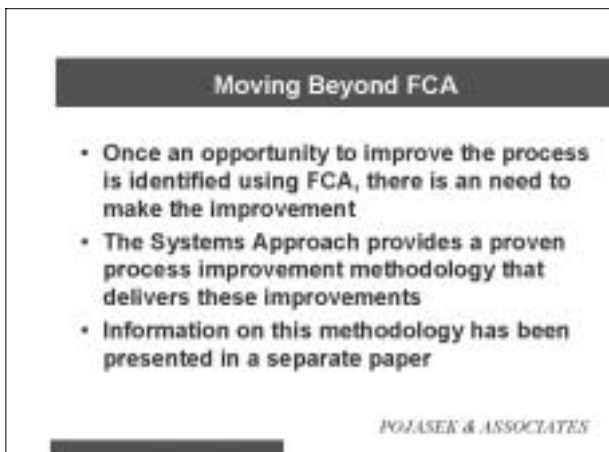
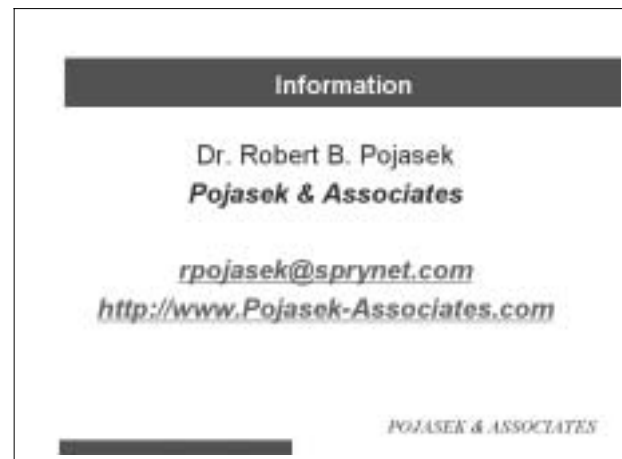


Chart 15



☒16

seeking more information on the Systems Approach. I have appreciated this opportunity to present these ideas with each of you and look forward to hearing more about the elements of this integrated approach.