

CLEANER PRODUCTION - PREVENTING POLLUTION AT SOURCE

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As the title of this symposium emphasizes, today the focus will be more upon improvements, rather than repeating how bad things are, or are becoming. The focus must be instead on signs of improvement, the evidence of shifting attitudes and changing procedures. But before that, as part American Indian myself, I would like to use the words an earlier American-Indian, a Canadian American Indian, used 300 years ago; "Only when the last tree has died, the last river has been poisoned and the last fish has been caught, will we realize ... that we cannot eat money. And if you try, it isn't very nutritious." That is an important point. People often say, "Oh yes, but it's going to cost so much money..." The real question is; "What are the costs in human health, ecosystems health, bios, overall?" Another Canadian, a recently appointed UNEP leader, said in her introductory speech; "My inspiration is to cause constructive damage to the status quo". I intend to say things which I hope will shake up the status quo too.

Flowers should be the real symbol for today. One flower can live sometimes in water, sometimes in soil and sometimes in air, exposed to all elements; another anchors its roots deeply in the soil, but each day follows the sun, gathering energy very openly. I hope that we can gather energy very openly today.

Looking at human activities today, it is quite clear that humanity is trashing the earth. Our ability to manipulate our environment has far outstripped our ability to understand the effects of that manipulation. The impact of society's actions is far greater than its understanding of the ecosystem. For example, twenty years ago CFCs looked like beautiful, safe substances; now the ozone layer problem has appeared. Another example of a very real indicator of ecosystem damage is the decrease in the frog population in Melbourne, Australia, as the human population increases.

Albert Einstein said thirty years ago: "If mankind is to survive, we shall require a substantially new manner of thinking". The causes of the problems should be sought. They should be mini-mized at source, through different product and process design, corporate values, and sets of government policies, to ensure that this paradigm-shift takes place. This symposium is primarily directed at this new way of thinking. In this respect, often quoted by our World Commissioner on our common future: "We have a mandate to change our focus, so we can help ensure that future generations have the ability to provide for their needs as we do for ours."

The challenge today, is how to put hands and feet to the concept of sustainability. How to go beyond "Yes we must", and convert it into action? A common goal is asked for. What are these goals? They should include environmental-risk reduction, as well as economic efficiency improvement. The question is how to find a way to decrease the effects, economically and efficiently, of water pollution, bay pollution, and air pollution, (which is quite a problem in Athens). How can we go beyond this, environmentally and economically efficiently?

Some Steps in the Direction of Sustainability

Governmental shifts	Academic shifts
Corporate shifts	Non-governmental shifts
Labor shifts	Media shifts
Agricultural shifts	Religious organizational shifts
Consumer shifts	Conclusions

It is increasingly clear that there need to be some real attitudinal and procedural changes. Certainly there is such a need in government, and some governments are start-ing to think about the environment more holistically. Some companies are now setting very good examples, but 99 % of companies are still not very far advanced.

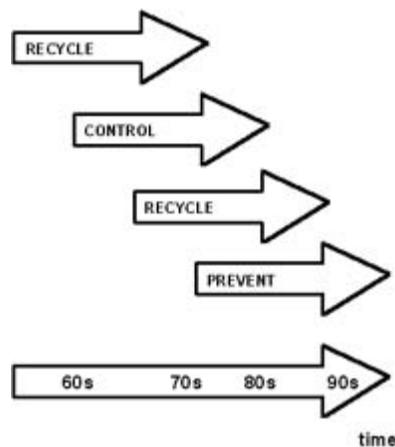


Figure 1: Historical Development of Waste Control Techniques

Labor, agriculture and so on should begin to be part of the solution, instead of the problem. Looking more holistically at how different parts, socially, can play a role means not looking at "Humans apart from nature" but looking at "Humans as a part of nature". It is hoped that ways can be found to re-integrate the human, in a real sense, into the total bios. Government policies and corporate practices show that the answer so far has mainly been dumping; into the air, water and landfills. For some time it was thought that waste could be controlled by burning it, sending it away to the DDR or Bulgaria, Romania or Nigeria, etc. This mistake was very quickly realized. Then the main goal became recycling. Now, however, the realization is coming that prevention is the right approach.

Phases of Environmental Protection

- Dilution is the Solution to Pollution
- Pollution Control is the Solution to Pollution
- Pollution Prevention is the Solution to Pollution
- Not producing is the Solution to Pollution ...

Before economists object, it should be emphasized that selective non-production of certain materials is meant by this, such as not producing PVC etc.

Environmental Protection Hierarchy

- By Design
- Source Reduction
- Internal Recycling
- Open Loop Recycling
- Command and Control

Products must be designed which are much more bio-sensitive to needs. The target center must be reached, rather than, as in the past, just an approximation to the target itself. There is a saying in English, and possibly also in Greek; "An ounce of prevention is worth more than a pound of cure." One company, the Minnesota Mining & Manufacturing Corporation, 3M, put that, in 1975, in the approach named "Pollution Prevention Pays". By this is meant: "We take the pollutants plus the know-how we have, and transform them into potential resources, and profits."

The approach was to eliminate waste at source; not to build a better treatment facility, but to identify the source by asking whether it is a management, maintenance, or equipment problem. The approach involved not just engineers, environmental health and safety managers etc., but all employees. The guideline was: find the problem, look for the source. The company first redesigned the products, then the processes, then changed the equipment, and finally looked for a productive use for former waste material. In a very short time they found hundreds of thousands of ways to improve, using fewer resources, less energy and producing less waste. They saved hundreds of millions of dollars compared to what the pollution control approach would have cost to reach the same bio-limits.

There are Swedish, Dutch, Polish, Danish, British, Irish, Greek and Spanish European projects. In 1987, in a Swedish demonstration project, the question was; "Can Swedish companies take these concepts of holistic approaches and put them into practice?" The first reaction was: "No! We are already the best, years ahead." But when the project was implemented and suggestions from the bottom were taken seriously, hundreds of ideas for improvement were found, and millions of Krone saved, creating real environmental improvements to air, water and so

on.

In 1988 the PRISMA Project was begun in the Netherlands. Ten companies were selected, five from Rotterdam, and five from Amsterdam. Could opportunities for improvement be found? Since then, several other demonstration projects in several European countries and throughout the world, have been initiated and carried out.

The most important conclusions drawn from the experience of the PRISMA project can be summarised as follows:

- Pre-assessment yielded 200 prevention options:
 - 30% good housekeeping
 - 30% input material changes
 - 30% technology changes
 - 10% product changes
- No single firm had a good overview of its waste-streams
- Many facts were known, but they were not interrelated

After the Dutch PRISMA Project, the goal is to get this kind of approach implemented in 500,000 companies over the next 2 years. PRISMA companies found about 200 ways to improve; 30% of them were about good housekeeping, better maintenance, better training, better management, 30% were about changing raw materials, and some improvements were technical and process changes.

In these companies managers and operational personnel relearned their processes. Referring to our personal experience of having worked with four thousand companies, none of the management persons had a good overview of company's waste-streams. They had estimates, "guesstimates", but they always underquantified what the processes really costed. These companies had quality, health and safety, and environmental, offices, but many of them did not cooperate effectively. Since they did not integrate their efforts, they made counterproductive decisions.

As the project went along, enthusiasm increased, as both managers and employee groups began to realize that they could not manage what they could not monitor well. In many cases they had not known what to monitor, so they had not been managing very well. "Better monitoring is better management". That is the key factor to think about, when looking at more efficient ways to improve production, or, as government officials or educators, to promote this philosophy, as well as the procedures and technologies associated with it. That means better and newer monitoring methods, better process optimization, better and newer technologies, and always, better substitutes.

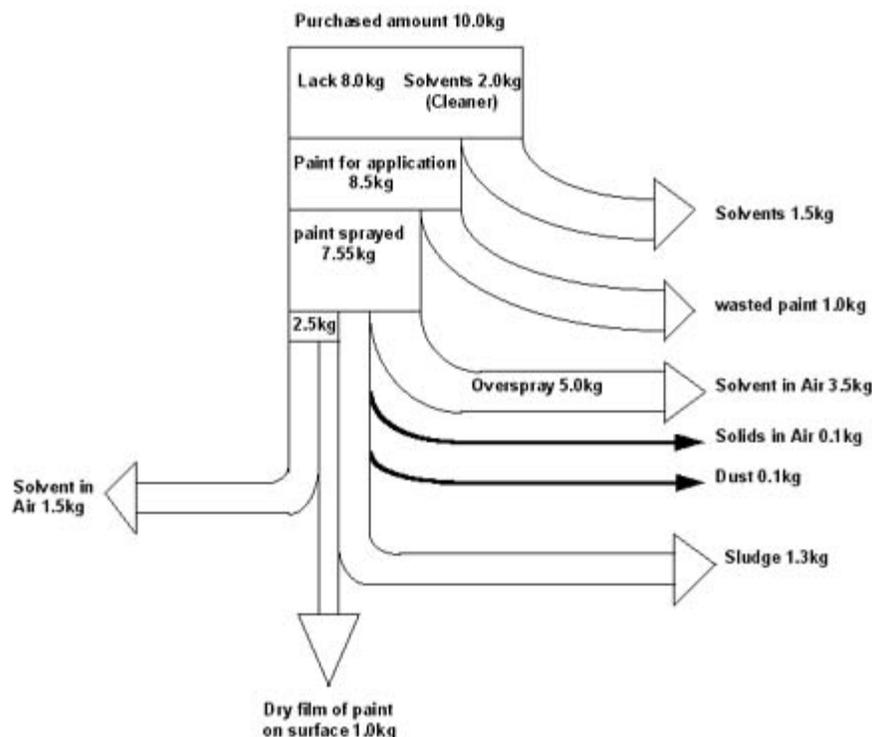


Figure 2: Mass flow diagram of conventional paints and solvents used with low effective application techniques. Situation is not acceptable for environmental and economic reasons

An Austrian example can be used, to illustrate the "before" and "after" phase. Figure 2 concerns an Austrian firm, considered the best in

Austria, that repaired automobiles and then re-sprayed them. When the project was started, they used ten kilos of paint to get one kilo of paint on an automobile. The other nine entered the environment, including the workers' breathing space. They were ignorant of what was being wasted, and they had no incentives to look for ways of improvement.

When the extent of the waste was realized, which was both a cost, and a risk to the environment, a narrower line was accomplished, with better product quality. They used 1.7 kgs of paint to get one kg on the car.

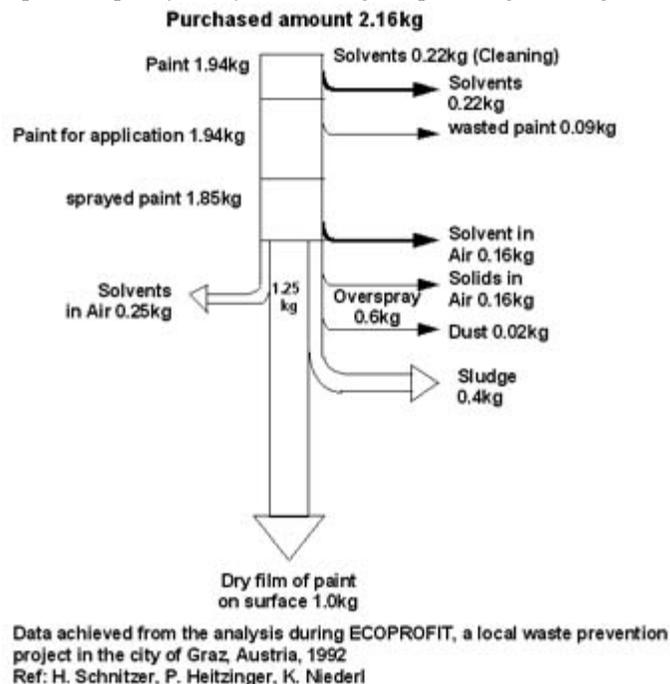


Figure 3: Mass flow diagram of paint and solvents used in the improved painting process of a car repair shop

This report is of interest, as one of the first projects to be started by a city, its mayor and council, and supported not only by them, but by the environmental ministry, universities and companies. It was essentially a bottom-up kind of project. Now dozens more such city and regional projects are being created all over Austria. The same is happening in many other countries.

In an example from Norway the question was: "What can we do about it?" In this case the costs will be compared for the pulp and paper company, of dilution, pollution control, and prevention techniques, as approaches to obtain better environmental quality. If they had used the dilution of pollution approach, it would have cost them in this case a hundred million Krone to build a pipe 23 kilometers long, and 1.5 meters in diameter, in order to dump the waste into a fjord. Local government said that this was what the company should do, since the counsellors wanted to be able to fish in the river and could not, if it were polluted. The company disagreed. Oslo decided that pollution control was obviously the best solution. The company hired a consultant who offered to build a controlling plant, and a treatment plant, to cost 32 million to build, and 8 million to operate every year. So ongoing cost was involved. In practice, the effluent would have been improved by about 75%, and the river would have become healthier, but not very much.

The employees of the company were given two days to look at prevention oriented approaches. Finally they suggested more than 500 ways to improve their own company. They had simply never been asked for their views before. That change in management mentality unleashed a great surge in creativity. As a result the company incorporated many of these improvements, not at the cost of a hundred million, but at a cost of ten million Krone. It must be remembered that the other solutions would not have improved product quality or productivity and would not have reduced cost. They would have continued to be an open-ended cost.

It must be emphasized that these changes, which arose primarily from the shop-floor, saved five million Krone in chemicals per year, ten in energy per year, and eight million more in paper production instead of discarded wastepaper. This is illustrative of the power of the more prevention-oriented approach, and this is not happening only in the big companies in the north; it is in fact happening in Athens. An example is a leather-making company, the Hellenic Leather Center which worked jointly with the Netherlands, and dramatically reduced their chromium losses, saving the chromium for the next batch. What needs to be reiterated is that these prevention-oriented approaches are not only feasible in multinationals like 3M, or big companies in Norway, Sweden or Holland, but in practice, they are also feasible, and have been put into practice here in Greece.

Another example, in the United Kingdom, is the Coca Cola Bottling Company, considered among the best in the bottling chain of Coca Cola. After the same kind of work was done with their 500 employees they saved, in the first year, the equivalent of about 700 million Drachmas.

It is clear that some new kinds of partnerships and approaches, are becoming important. These symposia are to be welcomed as opportunities to move forward on these. Where should the new commitment be? At least a part of it is to move from a reactive to a creative mode. Expanded partnerships may include co-operation between Business and:

- Government
- Labor
- Academia
- Customers
- NGOs
- Native Cultures

Ten Blocks to Creativity

Working with people is a little difficult, partly because some people put up barriers, because of fear. Most of the blocks to creativity have fear as their starting point; fear of making a change, that customers will not be satisfied, that perhaps something will not work, or of being seen as foolish. Each of these has been well documented in the field of industrial and governmental endeavor. The following are ten blocks to creativity caused by the fear of:

- making mistakes
- being seen as fool
- being criticized
- being misused
- being alone (a person with an idea is automatically a minority of one)
- disturbing tradition and making changes
- being associated with taboos
- losing the security of habit
- losing the group's love
- being truly an individual

Another reaction is "mañana"; the "tomorrow" syndrome: "Yes we will do it, but tomorrow. Today we have got a great deal of production pressure, so we will do it tomorrow."

In conclusion, to highlight some of the lessons from such demonstration projects concerning, first of all, company leadership: company employees have no clear vision of their present condition and the kind of competition to face. Secondly, they lack a vision for the future, a setting of goals and specific steps to achieve them.

If it is not known what the present company's condition is and where future goals are intended to lead, then it is very difficult to know how to get there. This is no overstatement of the way some companies work. Many are definitely envisioning and documenting much more clearly where they are. What is needed, therefore, is a clear image of what a company is, where it wants to go, and after that, how to get there. It is important to place this vision in the center and then to develop the kind of infrastructure, in terms of changes in technology, attitude, education and motivation, needed to achieve this goal.

It has been realized that an integrative approach is necessary, in which there are important behavioral, structural and technical strategies, in order to reach improved performance.

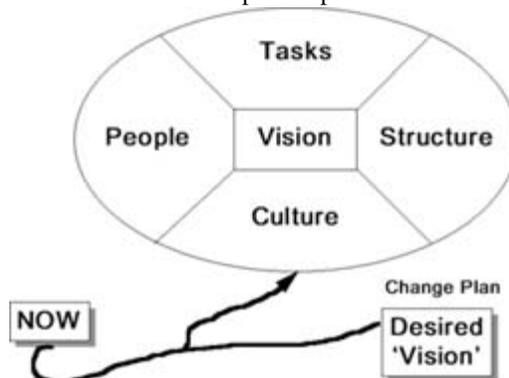


Figure 4: The Change Plan and the Organization



Figure 5: Organizational Change

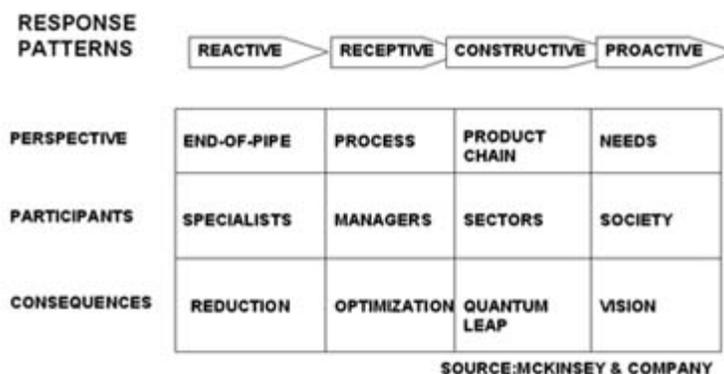


Figure 6: Environmental Protection Approach

In conclusion, let us look at environmental protection approaches from the government-tal and the corporate point of view, as well as from the point of view of what educators must provide for their students and older students already working in industry. Focusing primarily on a reactive approach which leads al-most al-ways to an end-of-pipe perspective, where specialists are held responsible, may achieve a reduction of the impact on the environment. However, the best ap-proach is to become more receptive at these levels and look at the entire process, to see how to minimize problems in all areas of the process. It will be realized that, increasingly, managers at all levels need to be involved, not just specialists; and this may create an optimization of both process and production.

But even that is not quite enough. There is a need to move increasingly to the constructive mode, to look at the entire product chain and all the raw material suppliers associated with it. Companies often find that problems with chromium, cad-mium, or nickel, etc., come as con-taminants from suppliers. The whole sector must be looked at. This means a quantum leap, not just polishing the edges a little bit, but make a real improvement.

The latter leads to the submission that companies will reach the goal of sustain-able societies which are more bio-sensitive, if they make that final jump by being increasingly pro-active, increasingly anticipative, and putting priority to what are the real needs of this society they must fulfill with their products. Therefore there must be a vision. With that vision, perhaps such goals as the Chemical Manufacturers' Association's Responsible Care can be achieved.

Professor **Donald Huisingh** is currently Professor of Environmental Sciences at Erasmus University in Rotterdam. He has led and directed interdisciplinary research teams and fact-finding task forces in his effort to implement preventative approaches to environmental quality improvement. Dedicated to the development of integrated approaches for the solution of societal problems, Professor Huisingh has collaborated with industrialists, political leaders, academians and students alike in coordinating educational and research mechanisms capable of accomplishing such holistic, system-wide approaches. A recipient of numerous grants and awards, he is the author of more than 90 publications, most recently on hazardous waste reduction and pollution prevention. Professor Huisingh is currently also assisting the United Nations Environmental Office in the Development of a Global Information Network on Concepts, Policies and Technologies on Low and Non-Waste Technologies.