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PROVISION OF A TECHNO-ECONOMIC STUDY ON DIFFERENT OPTIONS OF HOSPITAL WASTE MANAGEMENT IN THE *SZENT IMRE* HOSPITAL, BUDAPEST, HUNGARY

Final Report — Technical Report No. 8

Prepared For Government of Hungary
by the United Nations Industrial Development Organization

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*This document has not been edited.

EXECUTIVE SUMMARY

This final report of a series of eight Technical Reports, concerning the provision of a techno-economic study on different options of hospital waste management in Hungary, summarizes the findings to date.

Technical Report No. 1 provides a Waste Management Master Plan; this part of the overall study was undertaken in May 1998, simultaneously with Technical Report No. 2 — Szent Imre Hospital Waste Audit Report.

Technical Report No. 3 provides an overall economic appraisal and includes two technical options which are applicable to the Szent Imre Hospital and have potential application to any hospital in the Central and Eastern European Region. These options embody management of clinical waste and its disposal by incineration or microwave disinfection including cost savings for non-clinical waste.

Technical Report No. 4 is the Notes handed out at the Training Sessions held 7–11 September 1998 at the Szent Imre Hospital and which was attended by 30 hospital waste management personnel; two representatives from Hungarian Ministries of Environment, and Economy; and three from industry.

Technical Report No. 5 is the handout drafted for participants to a proposed International Workshop to be organized later in the program, and which should nurture the initiation of a networking scheme for healthcare and hospital waste throughout the Region.

Technical Report No. 6 is a series of 15 Appendices, which provide supporting material for, the other Technical Reports in this series, and includes notes of the visits made in May 1998 (Appendix A) and of the Study Tour, August 1998 (appendix L).

Technical Report No. 7 includes reports on visits to five other Hungarian hospitals and two incinerators visited in September 1998; together with meetings with the National Institute of Hygiene and the British Embassy.

The overriding **Recommendations** indicated in this series of Technical Reports are to improve segregation of waste including the recycling of non-hazardous wastes; reduction to the practical operational and safety minimum of clinical/infectious wastes disposed of in 'yellow' bags; appointment of hospital waste managers, who meet regularly; supported by active waste management committees.

The **recommendations** for the purchase of five silver recovery units for x-ray film processing units at the Szent Imre hospital should enable the hospital to save ~15% of its total waste management expenditure.

All aspects of the hazards associated with the handling of clinical/infectious waste including segregation, storage, transport and final treatment needs careful management both from the economics involved through to occupational health and not least environmental sustainability.

Considerable emphasis is placed on the treatment of waste both clinical/infectious and non-hazardous and the consultants are firmly of the view that large scale regional incinerators incorporating combined heat and power are the favored option for the Region. Emphasis is given to a microwave disinfection device which has the capability of being used as a mobile unit.

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ABBREVIATIONS

ADR	European Agreement Concerning the International Carriage of Dangerous Goods by Road
BOD	Biological oxygen demand
BPEO	Best practical environmental option
BSO	Backstopping Officer (For this project — Dr. Zoltán Czisér, UNIDO, Vienna)
CEC	Commission of the European Communities
CD-ROM	Compact disc — read-only-memory
CEE	Central and Eastern European (Region)
CHP	Combined heat and power
CMO	Chief Medical Officer
COD	Chemical oxygen demand
COSHH	Control of Substances Hazardous to Health
CPL	Classification packaging and labeling
DC	Development cooperation
DFID	Department for International Development
DOSE	Dictionary of Substances and their Effects
DSA	Daily Subsistence Allowance
EBRD	European Bank of Reconstruction and Development
EC	European Commission; or European Community
EMAS	Environmental management and audit scheme
EMS	Environmental management system
EINECS	European Inventory of Existing Chemical Substances
EU	European Union
FIFO	First-in-first-out
GBq	*Giga Becquerel*
GLP	Good laboratory practice
GMP	Good manufacturing practice
GOST	State Standard of USSR (Gosudarstvennyi Standard USSR), Izdatelstvo Standartov Novopresnenski Per.3 D-557, Moscow
HMSO	Her Majesty's Stationery Office
IAEA	International Atomic Energy Agency, Vienna
IBC	International Business Communities Limited
IDSP	Industrial Development Support Programme
IFCS	International Forum on Chemical Safety
ILO	International Labour Office
IMS	Integrated management system
IOMC	Inter-organizational Programme for the Sound Management of Chemicals
IPC	Integrated pollution control
IPCS	International Programme on Chemical Safety

IPPC	Integrated pollution prevention and control
IRPTC	International Register of Potentially Toxic Chemicals
ISG-3	Internet Forum on Chemical Safety
ISO	International Standards Organization
JIT	Just in time
MAK	Maximale arbeitsplatz konzentration
MEL	Maximum exposure limit
MBI	Market based instruments
MSDS	Material safety data sheet
NGO	Non-government organization
OECD	Organization for Economic Cooperation and Development
PCB	Polychlorinated biphenyl
PCCDs	Polychlorinated dibenzo dioxins
PCDFs	Polychlorinated dibenzo furans
PEC	Predicted environmental concentration
PET	Polyethylene terephthalate
PHARE	Polish-Hungarian Assistance for Reconstruction and Economy
PNEC	Predicted no effect concentration
POP	Persistent organic pollutant
PRTR	Pollutant Release and Transfer Register
PVC	Polyvinyl chloride
SI	Statutory Instrument
STW	Sewage treatment works
TC	Technical cooperation
TCDDs	Tetrachlorodibenzodioxins
TQM	Total quality management
UK	United Kingdom of Great Britain and Northern Ireland
UN	United Nations
UNCED	United Nations Conference on Environment and Development
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization
UNITAR	United Nations Institute for Training and Research
WHO	World Health Organization

I. RECOMMENDATIONS

The overall **Recommendations** from this series of eight Technical Reports include:

A. Segregation of Waste

i. 'Yellow' bag waste. The quantity of clinical/infectious waste should be segregated to be maintained at a minimum, in line with all aspects of safety.

Ii. Non-hazardous waste should be further segregated so that glass, metals, paper and plastics may be recycled. It is appreciated fully that this might entail support from Ministries of Industry and Trade/Economy to ensure that legislation and economic incentives are provided to both recycling industries are established, and to all concerned.

B. Treatment of Waste

i. Incineration. A number of alternative methods were considered. Incineration on a regional basis was considered as the preferred option. However, it is emphasized strongly that such large incinerator units must include combined heat and power.

ii. Pyrolysis Batch (and comparative small ~2–10 tonne/day) units with high temperature after burners were considered. The unit studied was found to be attractive, but suffered from the disadvantage of not being suitable for cytotoxic and certain other hazard pharmaceutical chemical waste.

iii. Microwave disinfection. The unit examined is very attractive but again suffers from the disadvantage of not being suitable for hazardous chemicals. If considered, the disinfected waste should then be used as a fuel source in power generation. Additionally, this unit can be constructed as a mobile unit.

iv. The above are outlined in detail in Technical Report No. 3 — Techno-economic Options, Section VII, Option 1. Notwithstanding, the consultants would point out, that in comparison with a number of countries in the Region, Hungary currently has a good capacity for incineration.

C. Hospital Management

i. Hospital waste management officers. Each hospital in the Region should appoint such a manager — in many cases the hospital engineer would appear to be a suitable choice.

ii. Hospital waste committee. A waste committee, to which the Waste Manager should be secretary, should be appointed, under the chairmanship of one of the hospital's principal directors and include representatives from all departmental and at all relevant levels and ideally an international and independent consultant (at least initially).

iii. Unit Cost Control. This should be implemented for all departments, so that each Head of Department is aware of the costs involved in the disposal or the waste generated in each Department. See Technical Report No. 1 — Waste Management Master Plan, Section XII; and Technical Report No. 3 — Techno-economic Options, Section IX, J.

iv. Code of Best Practice. This should be compiled for the handling of hospital waste and issued to all hospital Waste Management Officers and other interested parties for consultation.

v. Capital commitments. These should be the responsibility of the relevant Ministry(ies).

vi. Running costs. These should be the responsibility of individual hospitals.

vii. Hospital Waste Management Officers should meet on a regular basis to discuss common problems and best practice.

D. Training

This is a vital part of good hospital waste management, which is a team effort requiring total commitment, from the hospital general manager through **all** departments including janitorial and portage staff.

It is vital that training is maintained as a an on-going activity. Technical Report No. 4 provides core training material.

E. The Future

i. Accreditation. A number of the hospitals in the Region may wish, in the medium term, to consider accreditation under the ISO 14000 series and the Eco-Management and Audit Scheme (EMAS).

ii. Forum. A waste management forum should be initiated in the Region to promote training, discussion and new techniques/technologies. This should be in the form of holding international discussion meetings and publication of a newsletter in hard copy (initially) and on the Internet.

iii. The Szent Imre Hospital should become the focal point for all future activities.

F. Special Activities

i. Mercury spillages from broken thermometers, etc. Consideration should be given to the replacement of mercury thermometers with electronic devices. See Technical Report No. 3 — Techno-economic Options, Option 2, F.

ii. Silver recovery from x-ray and other photographic processes, this should be considered as a source of income. See Technical Report No. 3 — Techno-economic Options, Option No. 2, E. The acquisition of five silver recovery units at the Szent Imre hospital should incur savings of ~15% of the hospital's total waste expenditure.

iii. Sewage treatment. The very simple (and inadequate) primary sewage treatment at the plant receiving the Szent Imre Hospital sewage contributes to inferior potable water quality, downstream of such discharges. Governments need to give very serious consideration to enhancement of sewage treatment to a minimum of secondary treatment.

G. Summarized Recommendation

i. All hospitals need to establish accounting procedures to document costs they are incurring in managing medical waste.

ii. All hospitals should assess their existing medical waste generation and establish a waste minimization program.

iii. All hospitals should evaluate their existing medical waste collection and transport systems, and establish formal acceptable collection and transport procedures.

iv. Those who collect and transport the medical waste should ensure that it is measured adequately, and the results recorded.

v. The hospital must provide protective equipment and training in its use for those involved in the handling of medical waste.

vi. Hospitals must work together with environmental inspectorate and landfill managers to establish a formal slag disposal plan.

vii. Hospitals must work together with environmental inspectors and wastewater treatment plant operators to establish formal, acceptable liquid waste disposal procedures, including simple risk assessments using PEC/PNEC ratios.

viii. In the short term, hospitals should take measures to increase segregation of waste and to make good use of existing approved incinerators (in Hungary).

II. EXPLANATORY NOTES

No. 1. Waste Management – Master Plan
No. 2. Szent Imre Hospital — Waste Audit
No. 3. Techno-economic Options
No. 4 Training In-House Hospital Management — St. Imre Hospital, 7—11 September 1998
No. 5. International Workshop — Handout
No. 6. Appendices
No. 7. Visits to Other Hungarian Hospitals and Incinerators

- The word *dispose* has been used throughout, whereas the preferred word within the European Commission is now *discard*; and

- The word ***Region*** means Central and Eastern Europe; whereas ***region*** means an area around a town, e.g. 50 km around Budapest.

III. INTRODUCTION

A. Brief History

This UNIDO initiated project commenced in 1996, following the Technical Reports *Technical Assistance to Szent Imre Hospital, Budapest, Hungary, TF/HUN/94/F90/ 11-51 & 52, 17 January 1997.*

The salient **Recommendations** included: That an audit of waste arising and a management survey of the hospital be undertaken — this was accomplish as Technical Reports Nos. 1 and 2 of the current series of Technical Reports, viz. *Waste Management Master Plan* and *Waste Audit Report,* respectively in May 1998. Those consultants further **Recommended** that other Hospitals in Hungary are inspected and this was accomplished. See Technical Report No. 7 — *Hungarian Hospitals Audits: September 1998.*

They also proposed the appointment of a hospital waste manager and committee, these proposals have yet to be implemented.

A sampling program and analysis of the effluent streams and potable water supplies to the Szent Imre Hospital should be undertaken — a detailed survey was undertaken in 1997, and reported in *Project TF/HUN/94/F90 — Hospital Waste Management Waste Water Analysis in the Szent Imre Hospital, Budapest, Hungary.* Subsequently (August/September 1998), it was noted that that the results of the organic analyses were flawed, as the samples had been taken through tubing sterilized with formaldehyde and sealed in bottles with natural cork stoppers. Subsequent analyses undertaken by the Hungarian National Public Health Center indicated total trihalomethanes were an average (six results) of 8.3 µg/l, and hence within EC guidelines.

The staff at the Szent Imre hospital should continue with worthy efforts to minimize waste discharging of a hazardous nature to sewer — this was found to have been achieved in May 1998.

The earlier Reports emphasized that waste treatment should be only considered as a last resort when all other avenues for waste minimization, re-use and recycling have been explored. This is a core activity in the current study.

The overriding **Recommendation** by the UNIDO Project Manager was that a Techno-economic study should be undertaken and this forms the Technical Report No. 3 with its two economic based options, which are applicable equally to all hospitals in the Region.

The outcome of the bacteriological and chemical analyses indicated that in general terms the hospital effluent was similar to domestic sewage, except for enhanced mercury levels. The

consequences arising therefrom and remedial measures are detailed in the current study. See also Technical Reports 1, 2, 3, and 6.

As much of the potable water supplies in Hungary and other towns in the Region are abstracted from lowland rivers suffering from wholly inadequate sewage treatment, this is a matter for urgent attention to install appropriate sewage treatment facilities.

B. The Current Study

This commenced in May 1998 with a Waste Management Audit at the Szent Imre hospital and the development of a Waste Management Master Plan. See Technical Reports 1 and 2, respectively.

This was followed in June–August 1998 with the development of a Techno-economic options' study, which included a general economic background and two options applicable to the Szent Imre Hospital and in principle to all hospitals in the Region. See Technical Report No. 3.

A two-week study tour in August 1998 to the United Kingdom was undertaken by Mr. Elemér Fehér, Szent Imre Hospital Environmental Protection Manager; Dr. Amanda Horváth, Deputy Director, Hungarian National Public Health Center; and Dr. Béla Ralovich, Senior Special Counselor, Ministry of Health, Budapest. They visited six hospitals, the British Department of Trade & Industry, Hungarian Embassy, The Royal Society of Chemistry, The British Medical Association, a sewage treatment works, waste disposal/treatment facilities, including four incinerators and a microwave disinfection facility, and had meetings with equipment suppliers and consultants.

In September 1998, training sessions were held at the Szent Imre Hospital and were attended by participants from 30 hospitals, two Hungarian Ministry representatives, and three industrialists.

Visits were undertaken at five Hungarian hospitals, two incinerators, and meeting held at the National Institute of Hygiene and the British Embassy. See Technical Report No. 7.

The study includes a detailed handout (see Technical Report No. 5) for an International Workshop to be organized by UNIDO later in the program, within the Region.

C. Summarized Activities

i. The Szent Imre Hospital

Most of the activities and discussions has been concerned with the Szent Imre Hospital in Budapest.

The Waste Audit (see Technical Report No. 2) was performed at the Szent Imre hospital in May 1998 and led to the major recommendation of installing a Waste Management System. This involved the appointment of a Waste Management Officer, whose job description is detailed in Technical Reports Nos. 3 and 5, and the initiation of a waste committee composed of members from throughout the hospital structure. It is proposed

that this committee would discuss the most appropriate means of dealing with all types of waste generated at the hospital. Additionally, the Waste Management System would require a review of relevant existing regulation/legislation, production of written procedures from all waste related activities, the establishment of targets, objectives, staff training and for a management system. This committee should review progress regularly and update target objectives and procedures as appropriate.

To reduce costs, it will be essential that there is a clear program for segregation, initially between clinical and municipal waste and later, when an infrastructure for subdivision of municipal waste has been established, detailed recycling activities can be undertaken profitably.

ii). Other Hungarian Hospitals

Only a limited number of other Hungarian Hospitals were visited. However, from observations and discussions held it is deduced that if a Code of Best Practice can be compiled and agreed, and with adequate Central funding for its establishment for all Hungarian healthcare establishments, then it should be possible for Hungary to comply with current and foreseen EC legislation.

Incineration is recommended as the safest and most reliable means of treatment of hospital waste. At present there is sufficient incineration capacity, with reserve capacity, within Hungary to meet current and anticipated needs. Therefore, the current requirement is to establish that there are procedures available to handle the control of waste produced at hospitals. These include collection, labeling, storage, transport, incineration and final disposal of ash. It is anticipated that all these will be contained in the code of best Practice. Additionally, very strict and pragmatic guidelines must produced to effectively control and restrict any atmospheric emissions or possibility of water pollution from the existing incineration facilities.

Different incineration facilities and other disposal methods for the disposal of hospital waste have been considered, including:

- Individual Hospital incinerators. These have been used in Hungary and as elsewhere rejected on the grounds of a number of poorly-controlled incinerators that were unable to meet the increasingly strict national and international health, safety, and environmental standards.

- Local/regional incinerators. This is where the waste from a larger number of hospitals is transported to one site, either at another hospital or a dedicated site. In both cases, specialists operate the incinerator. This meant that there is a small number of well-controlled incinerators and this is the current position in Hungary.

- Mobile incinerators. Whereas mobile incinerators are very useful for the treatment of waste on a 'one-off' basis or in difficult situations (i.e. following disasters, decontaminated of polluted sites), they have been found to be impractical when there is a requirement for repeated use amongst a number of sites on a regular basis. There is often the case of different priorities between sites; transport between sites is

necessary, set up at the new sit is required for material subject to microbial activity such as clinical waste and additional storage capacity is required.

Alternative methods for treatment of clinical/infectious waste have been considered. See Technical Reports No. 3 — Techno-economic Options, Option 1, i.e. pyrolysis and microwave incineration, the latter could be considered in the form of a mobile self contained unit for more remote areas.

As with the waste produced at the Szent Imre hospital there is a requirement for good separation of clinical/infectious waste from general garbage. To reiterate, as with the Szent Imre hospital , there is the problem the even with improved separation of municipal waste, there are insufficient recycling facilities/organizations within in Hungary to provide the impetus for segregation. This will require assistance from the relevant ministries, especially the Ministry of Economy with input from UNIDO.

The foregoing is one of the topics that will require to be discussed by the hospital Waste Management Officers, officials from the Ministries and from organizations that might be willing to establish the requisite facilities to thus enhance environmental sustainability.

iii). The Regional Situation.

Currently, the consultants did not have an opportunity to have discussions with other than hospitals in the Region. It is the intention that UNIDO will organize an International Workshop within the Region (or at UNIDO) later in the program at which time these matters can be debated. See also Technical Report No. 5 — International Workshop — Handout.

Subject to the foregoing proposals and when implemented, Hungary will, with confidence, be in a position to advise, using the Szent Imre Hospital as a model for the whole Region. It will be essential for:

- Implementation of a definition Code of Best Practice;
- Waste Management Officers to have met and discussed Best Practice and any outstanding problems;
- Relevant disposal routes to be fully available;
- Alternatives to be discussed as indicated in this current study and to be offered to others; and,
- Recycling to be discussed and possible joint ventures originated to obviate the expense of duplicating facilities throughout the Region.

IV. Environmental Protection Regime

A key area is the environmental protection regime, with its growing understanding that many forms of pollution and resource depletion growing from modern economics do not respect national borders and can be tackled effectively only at an inter- or supranational level.

International trade and environmental protection are evolving rapidly. Since in a number of respects they are different, then sometimes there is a clash.

During the negotiations around OECD's proposed Multilateral Agreement on Investment, there have been difficulties, partly because of the negotiators' failure to incorporate the environmental dimension fully at the commencement. The pace of this debate is accelerating, leading to the following questions:

- How does environmental regulations interact with current and developing patterns of investment and trade?
- How can environmentally sustainable development be promoted in an increasing globalized economy?
- What role can the private sector be expected to play in promoting environmental sustainability; and where is there a need for public regulation and action?
- How can the international regimes for trade liberalization and environmental protection be reconciled? and,
- How can environmental objectives be integrated into international agreements?

V. ACHIEVEMENTS

A. United Kingdom Success

The following are core achievements which have been found in the United Kingdom:

i. A full-time waste manager has been appointed who understands what to do;

ii. Since the introduction of rigid containers, needle stick injuries have reduce to zero;

iii. All staff, and we mean **all** staff, know how to avoid the generation of all unnecessary waste and what to do with the waste they produce;

iv. The hospital waste managers, and the competent authorities, follow the collection contractors to see where they take the waste;

v. With improved segregation, the content of yellow bags are halved and hence costs are reduced;

vi. Clinical waste management really works and is a team effort;

vii. Inclusion of annual reviews/assessments in fiscal reports to the government also improve chances for much needed central governmental financial support for healthcare waste management of facilities and document that this is a significant and necessary expense.

B. Highlight Experiences

i. The most cost-effective waste management technique is minimization, which includes re-use.

ii. Hospital waste is not only a technical problem, but is influenced strongly by cultural, social and economic circumstances.

iii. The best sustainable solution will come from those directly involved in local waste management.

iv. A well thought through waste policy, legislative framework, and plans for achieving local implementation are essential.

v. Change will be gradual, but it is inevitable and should be encouraged only against a background of what can be technically and financially sustained in the future.

C. Silver Recovery from X-ray Photographic Units at the Szent Imre Hospital

The Szent Imre hospital operates five major film processing units and some smaller units. Overall, ~400 m^2 of x-ray film per week are exposed and developed, which incurs disposal of ~2500 liters of developer and ~3500 liters of fixer solution as hazardous waste.

In 1997, the hospital incurred a waste disposal charge for these of HUF ~120,000 (US $ ~600), and whilst some silver was recovered, no income was received.

The following should be considered:

- X-ray film normally contains 8–10 g of silver per m^2; 50–80% of this silver is removed during processing; or 3–5 g silver per m^2; thus, for 400 m^2 per week, 1.6–3.5 kg of silver is solubilized per week;
- The current price of silver is US $ ~160 per kg;
- Therefore, it should be possible to recover US $ 260–550 weekly, or US $ 12,000–28,000 (HUF 2.5–5.5 million) per annum.

The simplest unit to achieve silver recovery to <1 mg/l is US $ ~65000. Running costs are low (~200 watts of electricity). It is proposed to install on the five larger film units, and solution from the smaller units transferred to these units for silver recovery, there would be an initial investment of US $ ~33,000 (HUF ~7 million) requirement.

Furthermore, the 20–50% silver remaining on the film might be recovered from the film when its storage period (usually five years) has been reached. Thus, it should be possible to recover a further US $ 3000–13,000 (HUF ~0.6–2.5 million) per annum, less any recovery charges per annum by removal of the silver from end-of-date processed film.

The purchase of the five silver recovery units, by UNIDO on behalf of the Szent Imre hospital, will mean that the hospital should be able to save HUF ~2.5 million per year, thus representing a substantial proportion of the hospital's waste management and disposal costs.

This represents one of the positive outcomes derived from this project.

VI. OVERALL CONCLUSIONS

When considering the treatment of hazardous healthcare waste, safety must never be compromised.

Within the current study it was only possible to visit a limited number of other Hungarian hospitals. However, from the observations made and discussions held, providing that a Code of Best Practice can be compiled and progress through a professional consultative process which, when agreed can then be implemented, together with the necessary central financial support. It should be possible for Hungarian hospitals to comply with all current and foreseen EC legislation (see Technical Report No. 6 — Appendix B).

It is important, especially for those countries seeking early Membership of the European Union, that governments enact regulations which are enforceable and pragmatic. For EU Member States, the approximation of legislation in the field of the environment is not a luxury — it is a necessity which is justified for both ecological and economic reasons. To be effective, this will entail the development of Environmental Agencies with trained personnel who can both produce guidance to all waste generators, waste treatment facilitators and indeed the public on the most pragmatic means of enforcing environmental legislation, without entailing excessive costs to waste generators. This will ensure environmental sustainability for future generations.

A sustainable waste management strategy should consist of three major components:

- Reduce the amount of waste produced;
- Make best use of the waste that is produced; and,
- Choose management practices which minimize risks of pollution and harm to health.

It is essential that the management of both hazardous and non-hazardous waste be optimized.

The following waste management hierarchy is proposed:

Avoidance
Reduction
Re-use
Recycling
Recovery
Treatment
Disposal

This ranked approach indicates the possible options for managing hazardous waste. It may be of use to healthcare operations when envisaging the various possibilities available; to local authorities as a basis for communication and justification of their activities and to the general public for a thorough understanding of hazards, risks and benefits of the solutions envisaged. Very clearly, a whole range of actions are possible, from not producing a particular form of waste, to ensuring its final safe disposal/treatment.

The above ranked approach is the basis for a successful management and most likely to minimize controversy with both professional and the public.

Governments and Municipalities will need to liaise closely with industry who share their views for the future.

In prescribing potential policy interventions, consideration will need to be given to the following choices:

- The degree of threat: should a country direct action to those areas where the threat is the greatest and/or immediate; or,

- The likelihood of success; how should the probability of success be factored into the analysis?

Other considerations include:

- It should be remembered that it is not so much the cost of waste disposal; but the value of the waste!

- Good hospital management will lead to good business opportunities, involving in turn socially responsible business, continuous environmental performance improvement, value-driven corporations and sustainable development.

- Healthcare waste management is not only a technical problem, but is strongly influenced by cultural, social and economic circumstances.

- It would be ironic if waste generated from the healthcare industry was found to the cause of disease and ill-health!

- Inter-governmental processes largely through the support of UNIDO and IOMC has given environmental and developmental issues a central (pivotal) focus, working increasingly with other interested and affected parties, including environmental groups, scientists and the public.

- In international environmental decision-making, the key elements of the past decade of intergovernmental work have been those with equity and democracy; a recognition of a need to build increasingly on advances already made in other intergovernmental areas; to broaden participation in environmental decision-making to include non-governmental actors; and to make progress for the means and terms of entry into such agreements from developing countries.

- Changes will need to be gradual but is inevitable and should be encouraged, but only again a background of what can be technically and financially sustained in the future.

At first sight, any improvement of conditions for the disposal of healthcare waste entails higher direct costs to the producer. However, in fact, it would be incorrect to believe that poor management costs nothing; very often expenditure is not properly entered in the budget and is difficult to assess.

Costs include:

- Collection;
- Transport;
- Processing and disposal costs; and,
- Management costs.

If financial pressures are increased too much, producers may refuse to keep to the disposal strategy, or they may be forced to abandon medical projects aimed at providing the population with greater access to medical care. Medical authorities, governments and local authorities must try to check these developments.

Various measures are possible:

- Encouraging waste generators to sort their waste so as to reduce the amount of waste requiring disposal as hazardous waste;

- Undertaking a progressive introduction of environmental standards, to enable both waste generators and those disposing of waste to plan and comply with legislation will lead to a healthy environment;

- Adapting the capacity of installations progressively in order to limit unit disposal costs;

- Stimulating group action by the various producers for the purchase of receptacles and the conclusion of collective contracts with private collection and processing firms; and,

- Reducing management costs by eliminating unnecessary administrative stages and staff surpluses.

The indirect benefits of good healthcare waste management cannot be over emphasized. Lower environmental pollution and improved hygiene in hospitals reduce the public health problems and the consequential economic losses for industry and agriculture. Simultaneously, increased professionalism in waste management activities brings out the best in staff and boosts the population's confidence in the confidence in those involved.

One of the most outstanding outcome of this project is the provision (by UNIDO) of five silver recovery units for the x-ray film processing units at the Szent Imre hospital. The recovery and subsequent sale of the crude recovered silver should enable the hospital to reduce its overall waste disposal and management costs by ~15% per annum.

Resource conservation and waste minimization are the most effective means of reducing expenditure. Manufacturers and purchasing departments can play a significant role in cost reduction by minimizing packaging and providing consumables in optimal sizes and quantities. Bulk and/or regional purchasing can achieve economies of scale, but must be carefully implemented.

Healthcare managers should never regard environmental management as separate 'bolt-on' after thoughts, or a luxury. It is an essential and integral component of sound business and indeed a requirement for investment, and hence is very closely linked with core corporate values.

This series of Technical Reports on hospital waste management will provide the basic requirements for hospital managers and governments throughout the Central and Eastern European Region to fuel their 'engines' to develop the power required to ensure that all healthcare waste is treated effectively in an environmentally sustainable manner.

Einstein: *Make science as simple as possible — but not too simple!*