Environmental Data Management Strategy

Technical report

Strengthening the Capacity of the Ministry for Environment and Physical Planning
An EU funded project managed by the European Agency for Reconstruction

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Technical Report:

Data Management Strategy

Project result 16

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Authors:
Andreas Jasch, International Data Management Expert
Andrea Kulakov, Local Data Management Expert

Members of the Core Group 6 - Environmental Monitoring and Data Management
Jernej Stritih, International Task Leader of Component 2
Svetlana Gjorgjeva (MEPP), Local Task Leader of Component 2
Zlatko Samardziev, Deputy Team leader
Biljana Mileva, Communication/ Data Management junior expert
Zoran Lozanovski, IT Expert
Maja Gramatikova, Ministry of Environment and Physical Planning
Katerina Nikolovska, Ministry of Environment and Physical Planning
Maja Georgieva, Ministry of Environment and Physical Planning
Marionka Vilarova, Ministry of Environment and Physical Planning
Slavco Nocev, AD Alkaloid – Pharmaceutical, Chemical and Cosmetic Industry
Liljana Todorova – Talevska, Air expert from Hydrometerological Administration

Advisor:
Zoran Velickov, Local Senior Monitoring Expert

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Team leader:	**Bernard Raninger (10.06.2002 – 20.09.2003)** **Heinrich Anders (20.09.2003 – 08.07.2004)**	Project Director:	**Heinrich Anders**

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List of Abbreviations

AQ	Air Quality
BALWOIS	Water Observation and Information System for the Balkan Countries
CARDS	Community Assistance for Reconstruction, Development and Stabilisation
CEE	Central and Eastern Europe
CHPI	City Health Protection Institute
CIRCA	Communication and Information Resource Centre Administrator
CITES	Convention on International Trade of Endangered Species
COP	Country Operational Programme
CORINE	Coordination of Information on the Environment
CSV	Comma Separated Values
DB	Data Base
DBMS	Data Base Management System
EAR	European Agency for Reconstruction
EC	European Community
EEA	European Environment Agency
EIONET	Environmental Information and Observation Network
EIS	Environmental Information System
EMEP	European Monitoring and Evaluation Programme
ERDAS®	GIS Software
GEF	Global Environment Facility
GIS	Geographical Information System
GOPA	Gesellschaft für Organisation, Plannung und Ausbildung
HBI	Hydro Biological Institute
HMA	Hydro-Meteorological Administration
INFOTERRA	The global information exchange network of the UNEP
IPPC	Integrated Pollution Prevention and Control (EC Legislation)
ISO	International Standards Organisation
ISP	Internet Service Provider
ITTAG	Information Technology and Telematic Advisory Group
IV&V	Independent Validation & Verification
JICA	Japan International Cooperation Agency
LAN	Local Area Network
MAC	Maximum Allowed Concentration
MAFWE	Ministry of Agriculture, Forestry and Water Economy

MapInfo®	GIS Software
MED-HYCOS	Mediterranean Hydrological Cycle Observing System
MEIC	Macedonian Environmental Information Centre
MOEPP (or MEPP)	Ministry of Environment and Physical Planning
NEAP	National Environmental Action Plan
NEIS	National Environmental Information System
NFP	National Focal Point
NFP-MK	National Focal Point - Macedonia
NGO	Non Governmental Organisation
ODBMS	Object-oriented database management system
OS	Operating System
PC	Personal Computer
PCE	Public Communal Enterprises
PHARE	Technical Assistance Program for EU Accession countries
PRO	Public Relations Office (of the MEIC)
RDBMS	Relational database management system
REC	Regional Environmental Centre for CEE
REReP	Regional Environmental Reconstruction Programme for South Eastern Europe
RHPI	Republic Health Protection Institute
RIMSIS	River Monitoring System
SEE	Southeast Europe
SoER	State of Environment Report
SQL	Structured Query Language
TFMM	Task Force on Measurement and Modelling
WAN	Wide Area Network
WHO	World Health Organization
WMO	World Meteorological Organization

Chapter 1 Executive Summary

Background

For more than a quarter of a century, EU environmental policy has developed so rapidly that there are now over 100 major pieces of legislation in place, encompassing the entire spectrum of environmental issues from global climate change and stratospheric ozone depletion to the protection of local biodiversity. These Community laws now set the framework for the environmental policies of all 15 current Member States, are followed by the three countries of the European Economic Area who are also EEA Members, and will soon be applied in 13 Candidate Countries as the Community enlarges.

The complexity and continuing flood of environmental legislation in many countries, combined with the increased level of public involvement in environmental issues, environmental liabilities and customer pressure have led to the development of new instruments aimed at the thorough integration of environmental monitoring strategies in national policies.

To assess whether Community environment policies are working, data and information is collected by Member States and reported and analysed at EU level. At the national level, many agencies are now seeking to effect the following kinds of improvements:

- Reducing the time and effort involved in issuing permits and licenses, determining compliance, and pursuing enforcement actions against violators
- Developing multi-media permits
- Responding more quickly to requests for information from the public and regulated industry
- Streamlining data collection efforts by the agency and the regulated community
- Improving cross-program analysis and reporting capabilities

The present situation is summarized in the SWOT analysis table below.

Strengths	Weaknesses
The Ministry of Environment and Physical Planning is a “young”, dynamic ministry. Due to its staff and well-developed practices of internal and external informal communication, the MEPP is flexible compared to other government institutions. The MEPP enjoys the public image of being a positive force in the country. The MEPP has a good international reputation and receives significant international political and financial support. The following guiding principles represent	As with many large public and private organizations, the MEPP’s information systems have evolved over the past years to meet specific requirements. Most of these systems have been created through the donations of different donors. This has led to a proliferation of data systems. As a result, environmental data is difficult to share, costly to assemble, and hard to assess in terms of integrity and accuracy. At the same time, there is an increasing need to share information externally with domestic institutions, international environmental organizations, and the

the vision for the MEPP's data management program: ▪ Data are viewed as a resource with which to make informed decisions. ▪ Data are available in a timely, easily accessible, and understandable format to all users who need it. ▪ Data are managed throughout its life-cycle from creation to disposition at a data-warehouse. ▪ Core data are standardized for increased interoperability and increased accuracy. ▪ Data sharing between stakeholders and the MEIC is conducted in accordance with a standardized methodology. ▪ The MEIC provides help to the stakeholders for the development of future Data Management Systems.	public. The development of the EIS from its current state to the desired goal of sustainable development is faced with the following challenges and difficulties: • Lack of a shared EIS vision for Macedonia • Lack of co-operation between Sub-EIS units • Lack of co-ordination at donor and government levels • The existing 'communication culture' in public administration being unfavourable to the sharing of information, which presents one of the main obstacles for any EIS development • Perfectionism in systems implementation • Lack of standards • Lack of a mandated co-ordination body • Low sustainability
Opportunities	**Threats**
Several external activities, initiatives and processes may enhance the development of the EIS, such as: • Increased need for environmental information due to conventions, public awareness, and EIA policy • Decentralization of decision-making • Environmental legislation reform • Growing availability of training institutions • Donors willing to support activities • Existing experience and capacities, e.g. the GIS network • Growing awareness of EI at political levels • Increasing cooperation between institutions • State of the environment reporting process The revolution brought about by the World Wide Web and other new technologies is opening up access to a burgeoning amount of information. Never before has it been so easy to access information or to make information available.	The first priority will be to obtain **data** in time and in validated form. The EIS will offer a user-friendly solution, but only if access is available to the correct data! Without data—or with wrong or insufficient data—we may as well forget the whole EIS.

Proposed Strategy

The Environmental Data Strategy provides a step-by-step plan for the implementation of a standardized architecture for software and data structures that can accommodate data from multiple regulatory programs—such as air pollution control, water pollution control, soil and noise control and hazardous waste management—and that can provide integrated (i.e. cross-program) access to data. In parallel with the technical roadmap that guides the implementation of the necessary EIS modules, the Environmental Data Strategy addresses the human factor challenge of how to avoid frictions between the involved parties and build cooperation while at the same time motivating the users. The users will require special training in parallel with the hardware and software installation, but they must also be motivated and informed about the benefits of using the EIS in their daily work. In the end, the Ministry of Environment and Physical Planning (MEPP) will adopt a data management approach that promotes efficient, well-integrated data management within each environmental program area and also facilitates cross-program data viewing and multi-program retrievals.

This Data Management Strategy of the Ministry of Environment and Physical Planning (MEPP) of Republic of Macedonia provides the guiding principles and framework for implementing a national environmental data management program. Future environment protection depends upon modernized and highly unified data services to maintain reliable, secure, and efficient information-sharing in the face of the expected growth in demand for such services. Effective data management is at the core of these services in support of the MEPP's mission.

The MEPP should implement an integrated data management program. This data management program needs to be narrowly focused on the areas with the greatest potential benefits for the Ministry. The process should be evolutionary, with an emphasis on collaboration—wherever this makes sense—and standardization of core data elements, better communication along the information chain and discrete projects that address the areas of greatest need. The Macedonian Environmental Information Centre (MEIC) within the Ministry will be the focal point for data management activities. The stakeholders will work with the competent personnel at the MEIC and with the Administrator for Information Services at MEIC to implement this Data Management Strategy and the subsequent program.

The primary goal of the MEPP's data management program is to provide reliable information available quickly. The achievement of this primary goal requires the following specific goals:

- The establishment of an Environmental Information System (EIS) managed by the MEIC
- An increase in data sharing
- The improvement of data availability in terms of timeliness, access, and quality.
- The promotion of collaboration on data management activities
- The provision of maximum benefit with existing data infrastructure.

The entire strategy involves the following components:

1. Information system development
2. Definition of data provided to MEIC

3. Principal database design
4. Data reporting
5. Building awareness and cooperation with all involved parties
6. Using moderated teambuilding workshops to enhance efficiency
7. Establishment of a steering committee between the Ministries and other involved parties
8. Establishment of taskforces for special needs
9. Starting awareness raising actions with donors, universities, industry
10. Asking public for sponsorships for monitor stations
11. Presentation of awards for students for the best EIS poster and subsequent placement of the 10 best posters on the MEPP homepage
12. Identification of staff requirements
13. Training programs, including a study tour for administrators to the EPA
14. Maintenance and future development costs

The following points were presented as constituting being key success factors in the development of a Macedonian EIS:

- Common purpose
- Open information sharing & exchange culture
- Common EIS vision & strategy
- Co-ordination body
- Political support at the highest level
- Definition of standards
- Harmonization of classification schemes
- Cost recovery and sufficient budget allocation
- Data availability

By its very nature, the term *'environmental'* encompasses a wide variety of information from many diverse disciplines. There is information on flora (plants), fauna (animals), soils, climate, topography (the shape and form of the earth's surface), World Heritage Areas, water quality, rivers, lakes, pollution, vegetation cover, census, population, socio-economic data, the state of the environment, endangered species, climate change, environmental monitoring, land degradation, and so on.

This information takes many forms, for example:

- maps
- reports and documents
- data files
- themes and layers in a Geographic Information System (GIS)
- satellite imagery and other remotely sensed data
- records in a Relational Database Management System
- images (including photographs)
- bibliographies
- sequences of images as animations
- links to related World Wide Web documents

Below we list the priority issues which have been identified in order to take full advantage of identified opportunities.

Issue	Description
Winning and motivating people	From the technical point of view, the implementation of an EIS does not present a great problem. The budget will be the limiting factor in the design of the roadmap as to which hardware and software will or will not be added, but **winning and motivating people** to cooperate with the MEPP will be the primary task. It will be necessary to deliver appropriate training courses to the different users and this can be done by domestic companies.
Establish a steering committee	From international experience, it is recommended that a **steering committee** be established which will be shared by the MEPP to enhance cooperation between the relevant Ministries and other organizations involved. The CIRCA server can be used for this and other purposes.
Establish a small task force	It would be a good idea to work with a small **task force** to develop and introduce procedures to collect the data in electronic format and in time.
Establish a teambuilding process	Within MEPP, **moderated teambuilding processes** could help to integrate the GIS department without too much friction.
Organize workshops	A set **of workshops with all country-wide users** and stakeholders must be conducted to raise awareness. The EIS needs as much support as possible and this can be mobilised through lectures at the university and meetings with the chamber of commerce. This can be done by the MEPP staff. The EIS will also be an opportunity for domestic industry, but this must first be promoted and explained to representatives from industry.
Meet international donors	A **meeting with all international donors** under the umbrella of the MEPP, together with a press conference, should be organized after the testing phase of the databank software.
Include students	An **award** for students for the best EIS poster should be considered in close cooperation with industry and, perhaps, the banking sector.
Use sponsorships	**Sponsorship** should be sought wherever possible.

Chapter 2 Introduction

2.1 WORKING GROUP 6 IN THE GENERAL CONTEXT OF THE PROJECT

The European Union (EU) has funded an 18-month project entitled 'Strengthening the Capacity of the Ministry of Environment and Physical Planning'. The goals of the project are: to adapt Macedonian environmental legislation to the Acquis Communautaire (the existing body of EU legislation); to raise environmental awareness; to improve communication; to develop environmental monitoring and data management; and to provide environmental training programmes.

The objectives of the project have been:

- To improve the quality of current environmental legislation and draft other subordinate acts which will supplement the Act on Environment, thereby supporting the Ministry's efforts to adapt its current legislation to the Acquis Communautaire
- To establish an adequate permit and enforcement structure
- To improve the level of functioning and efficiency of the MEPP and thus enhance the MEPP's overall performance
- To strengthen the Ministry's position vis-à-vis other Ministries
- To improve communication between stakeholders in the field of environmental management
- To reinforce institutions responsible for environmental-awareness raising
- To streamline the MEPP's tasks in the field of environmental monitoring

In order to achieve these objectives, the project has been organised in three components:

Component 1 has encompassed the approximation of legislation in four areas: horizontal legislation; water resources management, including wastewater issues; waste management, including hazardous waste management; and nature conservation. Accordingly, responsibility for work on these four areas has been assigned to four interdisciplinary and inter-ministerial Working Groups (WGs). The work of the four WGs has been allocated as follows:

WG1 'environmental horizontal legislation', including subgroup WG1/2 'the master plan on phasing out leaded petrol'
WG2 'water framework legislation'
WG3 'waste and hazardous waste legislation'
WG4 'nature conservation'

Component 2 has encompassed environmental awareness raising; improvement of environmental communication; environmental monitoring; and data management.

WG5 'awareness raising strategies and environmental communication'
WG6 'environmental monitoring and data management'

Component 3 has encompassed a variety of training and training-related activities arising from project components 1 and 2, and formal training interventions.

In the course of the project, the three components have produced the following results:

Overall	
Result 0:	The Project is managed, coordinated and implemented by the Project Management Office in Skopje
Component 1	
Result 1:	Draft framework Law on Environmental Protection produced, incorporating the general rules on EIA, SEA, IPPC. Access to public information made available
Result 2:	Draft regulations on EIA/SEA made available
Result 3:	Draft regulations on IPPC made available
Result 4:	Draft regulations on access to environmental information and public participation in decision-making made available
Result 5:	Recommendations for compliance with sectoral legislation made available
Result 6:	Draft framework law on spatial planning made available
Result 7:	Draft framework law for water management made available
Result 8:	Draft framework law for waste management made available
Result 9:	Draft regulations for hazardous waste management made available
Result 10:	Draft framework law on nature protection made available
Result 11:	Master Plan for phasing out leaded petrol made available
Component 2	
Result 12:	Short-term and Medium-term Environmental Awareness Strategy developed (2003-2006)
Result 13:	Short-term strategies for improvement of public awareness implemented in 2003
Result 14:	Horizontal and Vertical Environmental Communication Strategy developed
Result 15:	Environmental Monitoring Strategy developed
Result 16:	Environmental Data Management Strategy developed
Component 3	
Result 17:	Training Programmes designed and implemented

This report constitutes Result 16: Environmental Data Management Strategy. This report has been produced in the framework of Working Group 6.

2.2 SCOPE OF WORK OF WORKING GROUP 6

The task assigned to Working group 6, under Component 2 of the project, was that of developing a draft environmental monitoring and data management strategy. In the course of the project, it was further agreed that support to the institutional development of MEPP should be provided through the tendering of advice on the organizational restructuring of MEPP and on meeting the needs of human resources. This support was provided in close coordination with Component 1.

Working Group 6 was tasked to produce the following two project results:

Result 15: Environmental Monitoring Strategy is developed

Result 16: Environmental Data Management Strategy is developed

These two results have been realised through the following activities: the adoption of the Environmental Monitoring Strategy and the Environmental Data Management Strategy (this report); an Assessment of Current Monitoring Systems and an Assessment of Current Data Management Systems; a Gap and Deficiency Analysis of Environmental Monitoring and Data Management Systems; and several supporting studies and documents related to the environmental monitoring and data management activities. By adopting this approach, environmental monitoring and data management have already been improved during the lifetime of the Project through cross-component activities involving representatives from a wide range of stakeholders from each Working Group. Moreover, this approach has benefited the development and finalisation of formal strategies formulated in the later stages of the project; thus taking into account the hands-on experience gained through activities already implemented.

2.3 WG MEMBERSHIP AND RULES OF PROCEDURE

The Working Groups were established as the main working methods of the project in order to ensure broad stakeholder participation and dialogue. Such broad participation and dialogue was seen as essential in ensuring that the development of a legal draft and strategies would correspond to the particular circumstances prevailing in Macedonia and that the results would later be implemented. Each Working Group consisted of a *core* group and a larger *advisory* group.

The objective assigned to the core group was that of performing the Project activities on a continuous basis in accordance with the Work Plan, i.e. the assembly of materials, the review of drafts, etc.

The composition of the core group has included staff members of the MEPP and representatives—as required—from other governmental institutions. The core group has also included senior and junior experts, recruited both internationally and locally.

The objective assigned to the larger, advisory group within each Working Group was that of providing commentary and advice pertaining to the work of the core group.

The composition of the advisory group has included staff of the MEPP and other governmental institutions as well as representatives from non-governmental institutions and organisations. The Working Group members were nominated by the Project Management, the MEPP and other Ministries concerned, as well as by governmental institutions or other organizations. They were appointed with the

official approval of the MEPP. The list of the members of the larger Working Group 6 is presented in Annex 3.

No remuneration has been given to members of Working Group 6 on the basis that these members served the Working Group in the capacity of official representatives of the respective institutions from which they were drawn. The reimbursement of travel expenses for those members travelling from outside of the city of Skopje has been granted by the Project, however, in cases where the institutions from which such members were drawn proved unable to bear the travel costs.

In accordance with the Rules of Procedure as presented in Annex 2, the core group has held meetings on a weekly basis, while meetings of the larger Working Group have been held per milestone of the project.

The composition of the secretariat of the Working Group has consisted of senior and junior technical experts employed by the Project. It has been the task of the secretariat to organize meetings of the core group and the larger Working Group: preparing agenda, producing minutes of meetings and ensuring communication within and between the core group and the advisory group. The secretariat has also been charged with responsibility for keeping the records and documentation of the Working Group. Minutes of all meetings have been drafted, finalised, and made available to the group members.

The Working Group has been assisted by international experts in accordance with their respective Terms of Reference and in line with the Project Work Plan and Schedules. International experts have provided advice based on their knowledge and experience of relevant communication, monitoring and data management techniques in EU member states and other accession candidate countries.

The language of everyday communication of the Working Group has been Macedonian, with translation provided in English for the international experts. Important documents that were not originally produced in English have been translated into Macedonian to the extent that translation resources have allowed. Working documents reflecting the progress of the core groups have been made available to the members of the larger group. The core group has presented a report on the progress of the project in each meeting with the larger group.

2.4 METHODOLOGY AND PROCESS

The development of the Environmental Data Management Strategy has followed the general methodological approach of the Project in seeking the involvement of stakeholders. By this means, it is intended that these stakeholders will assume ownership of the strategy after the Project has been completed and that they will ensure the implementation of the Project results. This approach reflected the following two main objectives, adopted in order to secure the quality of results:

- That the strategy should respond to the needs of the stakeholders based on up-to-date information about the situation in the environmental sector in the country
- That the implementation of the strategy should be made possible through genuine stakeholder commitments and input

To achieve these objectives, the development process of the Environmental Data Management Strategy involved regular consultation inside and outside the core

group and direct communication with stakeholders inside and outside the MEPP. Domestic and international experts supported this process by drafting the interim and result documents and by facilitating dialogue among the various participants in the process.

The Environmental Data Management Strategy is closely linked with the Environmental Monitoring Strategy. The two strategies are mutually supportive and mutually dependent and will thus require simultaneous implementation. Certain elements are referred to in both documents and this is illustrative of the close links between the two strategies

The preparation of the two Strategies was led by Dr. Wolfgang Krinner, International Monitoring and Data Management Expert, from the beginning of the project to April 2003. Mr. Krinner was then replaced by Andreas Jasch, International Data Management Expert, who worked between September and December 2003. An overview of the process of development of the Data Management Strategy and of the methods employed in this process is provided in Table 1.

A detailed list of all meetings and workshops held in the course of the project is presented in Annex 3.

Table 1. Process of Development of the Environmental Monitoring Strategy and the Environmental Data Management Strategy

Time	Main Activities	Methods employed
June – September 2002	Project inception: definition of scope and stakeholder groups	Consultation with stakeholders.
September 2002	Component 2 Strategy workshop.	Plenary & breakout group discussion of approach.
September – December 2002	Preparation of the ToR for the Stakeholder.	International expert input.
October – December 2002	Mobilisation of international & local experts.	International expert input.
November 2002 – March 2003	Development of assessment of current monitoring systems and assessment of current data management systems.	Interviews with stakeholders. Existing materials from previous projects.
January 2003	1st meeting of Working Group 6.	Presentation & discussion of main findings of assessment of current data management systems & assessment of current monitoring systems.
February – May 2003	Development of Gap & Deficiency Analysis of Environmental Monitoring & Data Management Systems.	International expert input.

Time	Main Activities	Methods employed
February 2003	2nd meeting of Working Group 6.	Presentation & discussion of the Gap Analysis
March – June 2003	Development of the environmental legislation in the field of monitoring & data management in horizontal legislation, legislation for waters, nature conservation and waste and hazardous waste.	Coordination of local experts in Components 1 and 2.
April – September 2003	Working on elements for environmental data management strategy.	Local expert input
September - October 2003	Draft strategy	International & local expert input
November 2003	Comments & improvement of the draft strategies for environmental monitoring & data management	Local experts' input.
December 2003	Final report	Summary of results.

The following documents were produced in the process of the development of the DMS:

- Assessment of Current Data Management systems
- Assessment of Current Monitoring systems
- Gap and Deficiency Analysis of Environmental Monitoring and Data Management Systems
- Working Draft: Environmental Data Management Strategy
- Draft Environmental Data Management Strategy
- Working Draft: Environmental Monitoring Strategy
- Draft Environmental Monitoring Strategy
- Logical Framework tables and other texts from the workshops
- Minutes of meetings of the Working Group and Core Group

The Assessment of current monitoring systems is fully integrated into the strategy for monitoring in the form of Annex 9.

This report itself was prepared by Andreas Jasch, International Data Management Expert and Mr. Andrea Kulakov, Local IT Expert. This report benefited from inputs from Jernej Stritih, Task Leader of Component 2, Zoran Lozanovski, Local Junior IT Expert; Biljana Mileva, Local Junior Communication/Data Management Expert as well as all core WG 6 members.

Chapter 3 Background

3.1 DEVELOPMENT OF DATA MANAGEMENT CONCEPT

For more than a quarter of a century, EU environmental policy has developed so rapidly that there are now over 100 major pieces of legislation in place, encompassing the entire spectrum of environmental issues from global climate change and stratospheric ozone depletion to the protection of local biodiversity. These Community laws now set the framework for the environmental policies of all 15 current Member States, are followed by the three countries of the European Economic Area who are also EEA Members, and will soon be applied in 13 Candidate Countries as the Community enlarges.

The complexity and continuing flood of environmental legislation in many countries, combined with the increased level of public involvement in environmental issues, environmental liabilities and customer pressure have led to the development of new instruments aimed at the thorough integration of environmental monitoring strategies in national policies.

To assess whether Community environment policies are working, data and information is collected by the Member States and reported and analysed at EU level. Although there are a myriad data and information reporting obligations at the international, EU and national levels—so much so that Member States often complain of 'reporting fatigue'—much of the information currently gathered is of limited use in assessing the impact of environmental measures. As the 'Bridging the Gap' conference concluded:

> *'...some of the systems for monitoring and gathering information about the environment in European countries are inefficient and wasteful. They generate excessive amounts of data on subjects which do not need it; and they fail to provide timely and relevant information on other subjects where there is an urgent policy need for better focused information, and for consistent environmental assessment and reporting.'*

Historically, furthermore, environmental agencies have been organized into units that implement separate and distinct regulatory programs on air pollution control, surface water pollution control, hazardous and solid waste disposal control, and so on. In most agencies, each of these program offices has been responsible for meeting its own data management needs, including maintaining information about its regulated entities and regulatory activities (for example, permits, site inspections, and enforcement actions) pertaining its field.

As a rule, agencies have not established standards for data system design, allowing program offices to create systems entirely independently of each other, often without any reference to data management methods used elsewhere in the agency. As a result, data management at many state agencies consists of a patchwork of small, unconnected databases and islands of automation unsuitable to agency-wide needs and mandates.

In recent years, mounting pressures for more efficient and 'customer-focused' government have prompted environmental agencies to re-evaluate the way they have traditionally operated. Many agencies are now seeking the following kinds of improvements:

- Reducing the time and effort involved in issuing permits and licenses, determining compliance, and pursuing enforcement actions against violators
- Developing multi-media permits
- Responding more quickly to requests for information from the public and regulated industry
- Streamlining data collection efforts by the agency and the regulated community
- Improving cross-program analysis and reporting capabilities

Chapter 4 Strategy for Environmental Data Management

4.1 MEPP´S ANSWER TO THE CHANGE IN ENVIRONMENTAL DATA MANAGEMENT

WG 6 is responding to the challenge presented by the growing need for change in environmental data management. Considering the results of the previous WG 6 reports (especially Technical Report No. 16.4), this document provides step-by-step guidelines for the implementation of a standardized architecture for software and data structures that can accommodate data from multiple regulatory programs—such as air pollution control, water pollution control, soil and noise control and hazardous waste management—and that can provide integrated (i.e. cross-program) access to data. In parallel with the technical roadmap that guides the implementation of the necessary EIS modules, the Environmental Data Strategy addresses the human factor challenge of how to avoid frictions between the involved parties and build cooperation while at the same time motivating the users. The users will require special training in parallel with the hardware and software installation, but they must also be motivated and informed about the benefits of using the EIS in their daily work. In the end, the Ministry of Environment and Physical Planning (MEPP) will adopt a data management approach that promotes efficient, well-integrated data management within each environmental program area and also facilitates cross-program data viewing and multi-program retrievals.

This Data Management Strategy of the Ministry of Environment and Physical Planning (MEPP) of the Republic of Macedonia provides the guiding principles and framework for implementing a national environmental data management program. Future environment protection depends upon modernized and highly unified data services to maintain reliable, secure, and efficient information-sharing in the face of expected growth in demand for such services. Effective data management is at the core of these services supporting the MEPP's mission.

As with many large public and private organizations, the MEPP's information systems have evolved over the past years to meet specific requirements. Most of these systems have been created through the donations of different donors. This has led to a proliferation of data systems. As a result, environmental data is difficult to share, costly to assemble, and hard to assess in terms of integrity and accuracy. At the same time, there is an increasing need to share information externally with domestic institutions, international environmental organizations and the public.

There is general agreement that the MEPP should implement an integrated data management program. This data management program needs to be narrowly focused on the areas of greatest potential benefits for the Ministry. The process should be evolutionary, with an emphasis on collaboration where it makes sense, standardization of core data elements, better communication along the information chain, and discrete projects addressing areas of greatest need. The Macedonian Environmental Information Centre (MEIC) within the Ministry will be a focal point for data management activities. Stakeholders will work with

competent personnel at MEIC and the Administrator for Information Services at MEIC to implement this Data Management Strategy and subsequent program.

The following guiding principles represent the vision for the MEPP's data management program:

- Data is viewed as a resource with which to make informed decisions.
- Data is available in a timely, easily accessible, and understandable format for all users who need it.
- Data is managed throughout its life-cycle from creation to disposition at a data-warehouse.
- Core data is standardized for increased interoperability and increased accuracy.
- Data-sharing between Stakeholders and the MEIC is conducted in accordance with a standardized methodology.
- The MEIC helps stakeholders develop future Data Management Systems.

The primary goal of the MEPP's data management program is to make reliable information available quickly. The specific goals needed to achieve this primary goal are as follows:

- The establishment of an Environmental Information System (EIS) managed by the MEIC
- An increase in data-sharing
- An improvement in data availability in terms of timeliness, access, and quality
- The promotion of collaboration on data management activities
- The provision of maximum benefit with existing data infrastructure.

The MEPP will carry out a three-phase approach to the establishment of a data management program. The following table summarizes the key objectives to implement this technical program by phase:

Table 2. Key Objectives to Implement Technical Program by Phase

Phase I	• Obtain consensus on this strategy. • Identify core data elements for external customers. • Identify core data elements for internal customers. • Upgrade the Environmental Information System
Phase II	• Develop interfaces to data of existing systems managed by stakeholders. • Establish a meta-data repository. • Begin to identify and archive obsolete data. • Add module on licenses • Add module on Complaints Management

Phase III	• Add different GIS capabilities to the system. • Integrate the Environmental Information System with the Cadastre of Polluters • Add module on grants and projects • Add multi-media capabilities to the system (video, audio & photo) • Add module on simulations and forecasting

Table 3 summarizes the key objectives for the motivation and cooperation program by phase:

Table 3. Key Objectives for Motivation & Cooperation Program by Phase

Phase I	• Obtain consensus on this strategy. • Establish a steering committee. • Invite other Ministries and Organisations • Organize workshops for external customers. • Use teambuilding methodology for internal customers.
Phase II	• Organize workshops for stakeholders. • Use taskforces wherever possible • Invite donors and show progress. • Prepare press documents/flyer/. • Seek cooperation and synergy with other Ministries
Phase III	• Organize workshop for all involved parties • Try to cooperate with the Chamber of Commerce/industry • Introduce an award for the best poster of EIS (in cooperation with industry) • Organize a press conference with the donors and the Minister

Table 4 summarizes the key objectives for the training program by phase.

Table 4. Key Objectives of the Training Program by Phase

Phase I	• Document an IT strategy for the MEPP • Document the whole network of MEPP • Document the security strategy of MEPP • Give all MEPP staff a beginner-course on IT 1. Use of office software 2. Use of mail systems 3. Use of antivirus 4. Use of EIONET/CIRCA 5. Inform about EIS 6. Inform about GIS 7. Overview about the benefits of EIS • Special training for the administrators using the database software • Start on-the-job training for all users of EIS
Phase II	• Organize training workshops for Stakeholders. • Special training for administrators. • Study tour for the administrators to the EPA. • Invite other involved parties to user-training of EIS.
Phase III	• Special training for GIS users. • Special training for GIS administrators. • Special training for modelling software

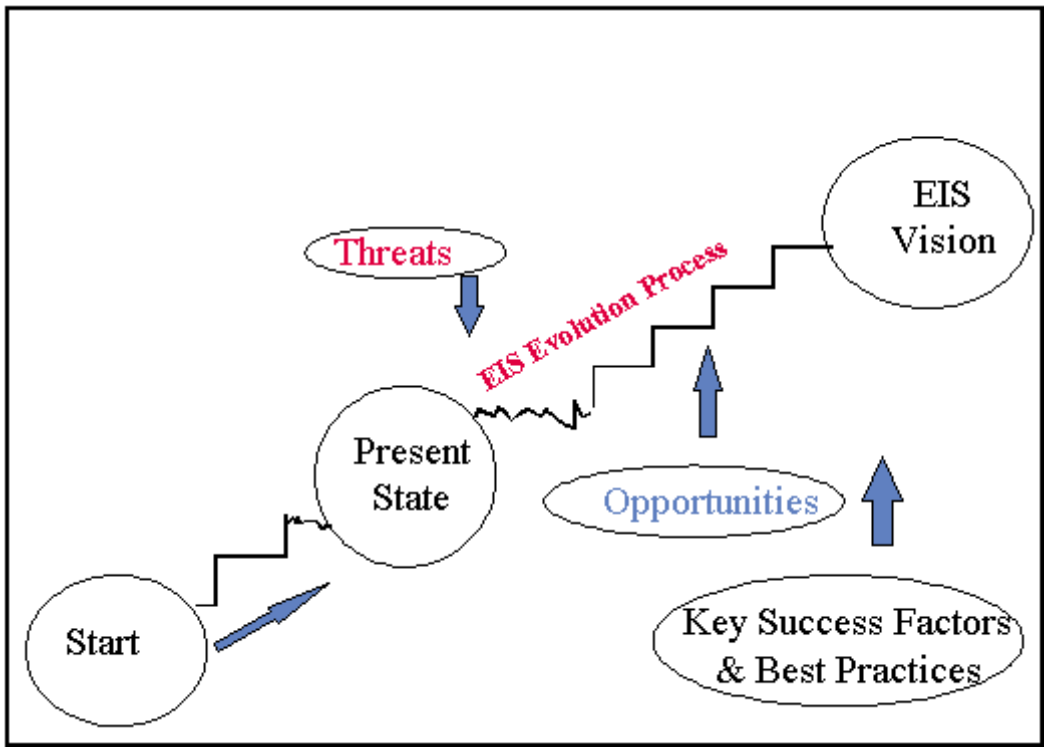
The whole strategy includes the following components:

1. Information system development
2. Definition of data provided to MEIC
3. Principal database design
4. Data reporting
5. Increase awareness and cooperation with all involved parties
6. Use moderated teambuilding workshops to enhance efficiency
7. Establish steering committee between Ministries and other parties involved
8. Develop taskforces for special needs
9. Start awareness raising actions with donors, universities, industry
10. Ask public for sponsorships for monitor stations
11. Award students for best EIS poster and place 10 best on MEPP homepage
12. Identification of staff needed
13. Training programs, including study tour for administrators to EPA
14. Maintenance and future development costs

4.2 EIS DEVELOPMENT PROCESS

This report considers the build-up of an EIS to be a process that depends heavily on the political, economical and institutional framework of the country. Figure 1 shows a model of this EIS development process.

Figure 1. EIS Evolution Process



The EIS evolves from the starting point towards the desired final stage. Whether this evolution is promoted or hindered depends heavily on the opportunities or threats presented by the system environment. Certain key success factors and best practices have proven to be crucial to successful system implementation. The collection of factors shown below represent the view of the expert.

4.3 KEY SUCCESS FACTORS

The following points have been presented as some of the key success factors in the development of a Macedonian EIS:

- Common purpose
- Open information-sharing & exchange culture
- Common EIS vision & strategy
- Co-ordination body
- Political support at the highest level
- Definition of standards
- Harmonization of classification schemes
- Cost recovery and sufficient budget allocation
- Data availability

4.4 OPPORTUNITIES

The following activities and initiatives may serve to enhance the development of the EIS:

- An increased need for environmental information arising from conventions, public awareness and EIA policy
- Decentralization of decision-making
- Environmental legislation reform
- Growing availability of training institutions
- Donors willing to support activities
- Existing good will, e.g. GIS network
- Growing awareness of EI at political levels
- Increasing cooperation between institutions
- State of the environment reporting process

4.5 MAIN THREATS AND DIFFICULTIES

The development of the EIS from its current state to the desired goal of sustainable development faces a series of threats and difficulties as follows:

- Lack of a shared EIS vision for Macedonia
- Lack of co-operation between Sub-EIS units
- Lack of co-ordination at donor and government levels
- The existing 'communication culture' in public administration being unfavourable to information-sharing; one of the main obstacles for any EIS development
- Perfectionism in systems implementation
- Lack of standards
- Lack of a mandated co-ordination body
- Low sustainability

4.6 BEWARE OF INFORMATION OVERLOAD

By its very nature, the term, 'environmental' encompasses a wide variety of information from many diverse disciplines. There is information on flora (plants), fauna (animals), soils, climate, topography (the shape and form of the earth's surface), World Heritage Areas, water quality, rivers, lakes, pollution, vegetation cover, census, population, socio-economic factors, the state of the environment, endangered species, climate change, environmental monitoring, land degradation, etc.

This information takes many forms, including the following:

- maps
- reports and documents
- data files

- themes and layers in a Geographic Information System (GIS)
- satellite imagery and other remotely sensed data
- records in a Relational Database Management System
- images (including photographs)
- bibliographies
- sequences of images as animations;
- links to related World Wide Web documents

The revolution brought about by the World Wide Web and other new technologies is opening up access to a burgeoning amount of information. Never before has it been so easy to access information or to make information available.

It is already obvious that we are swamped with surfeit of information and we need to have intuitive means of navigating our way through it. The EIS offers a user-friendly solution, but only if access is available to the correct data! Without data—or with wrong or insufficient data—we may as well forget the whole EIS. To obtain the data in time and in validated form will be a number one priority. From the technical point of view, the implementation of an EIS does not present a great problem. The budget will be the limiting factor on the design of the roadmap as to whether hardware or software will or will not be added, but winning over and motivating people to cooperate with the MEPP will constitute the primary task. It will be necessary to provide appropriate training course to different users and this could be delivered by national companies.

From international experience, we advise the establishment of a steering committee shared by MEPP aimed at enhancing cooperation between the Ministries and other organizations involved. The CIRCA server may be used for this and other purposes. Furthermore, it may be a good idea to work with small taskforces, hammering out procedures to collect data in electronic format and in time. Within MEPP, a moderated teambuilding process could help integrate the GIS department without too much friction. To raise awareness, a set of workshops involving all country-wide users and stakeholders must be realized. The EIS needs as much support as possible. Lectures at the university and meetings with the Chamber of Commerce may also be arranged by MEPP staff. The EIS will be an opportunity for national industries too, but this must first be promoted and explained to industry. A meeting with all international donors under the umbrella of the Minster with a press conference should be organized after a testing phase of the databank software. An award to students for the best EIS poster should be founded by the MEPP in close cooperation with industry and perhaps the banking sector. Sponsorship should be sought wherever possible.

Chapter 5 INFORMATION SYSTEM DEVELOPMENT

5.1 GENERAL DESCRIPTION OF THE ENVIRONMENTAL INFORMATION SYSTEM

The term *'environment information system'* has come to be considered more as an institutional and technical framework than merely a technological solution, essential for improving the flow and use of information in environmental management. This framework includes strategies, policies, procedures, data management, communication tools and networking mechanisms that ensure access to environmentally-relevant data by a wide variety of potential users at national, sub-regional, continental and ultimately global levels.

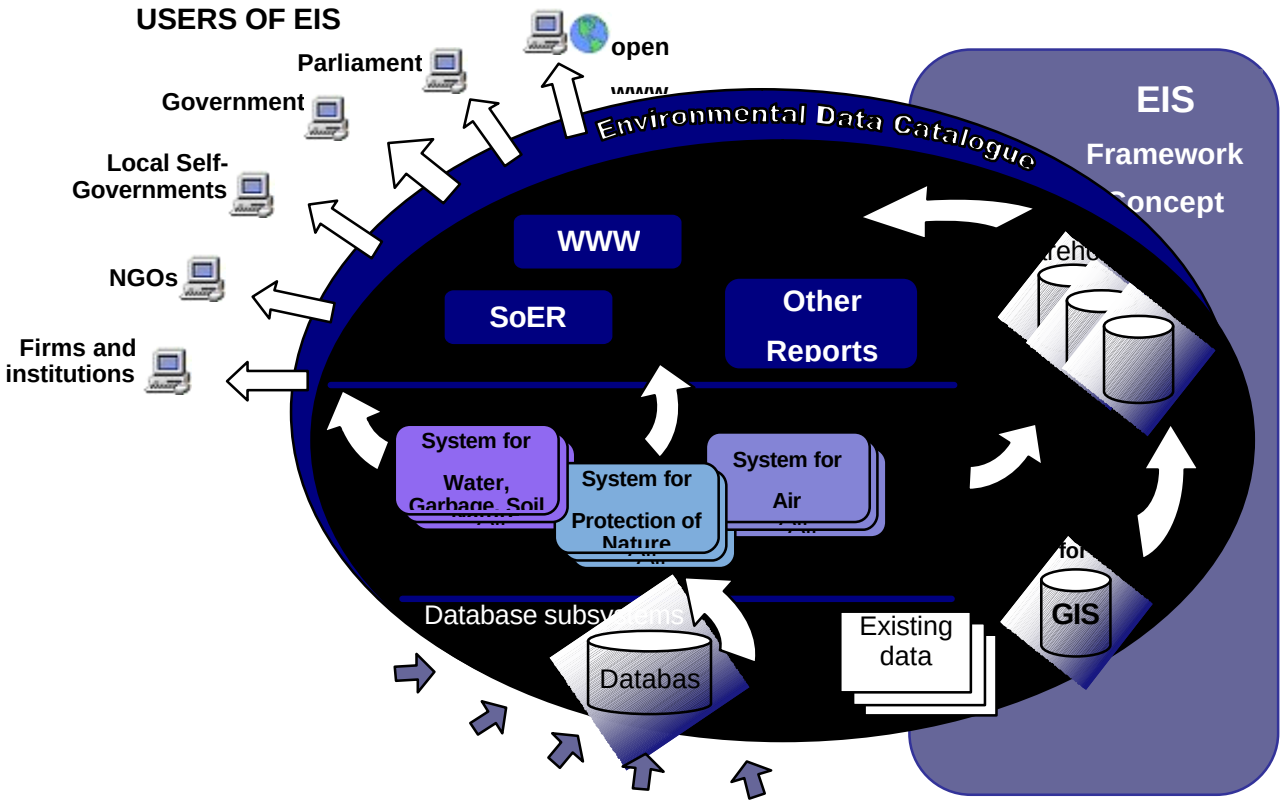
The operational objective behind the implementation of EIS is to increase the quality, efficiency, and accountability of decision-making processes through applications that systematically use environmental information. In this regard, EIS development seeks to enhance the use of harmonised environmental data-sets through improving data availability; facilitating access to data; ensuring that data is internally consistent; and ensuring that different data sets match each other. The concept of an EIS for MEPP is a network-based institutional framework, supported in the near future by geo-information technology within a supportive data policy setting. This allows for environmental data to be collected, integrated, shared, analysed, and the resulting information and products to be disseminated and used in support of decision-making at all levels in a sustainable development environment.

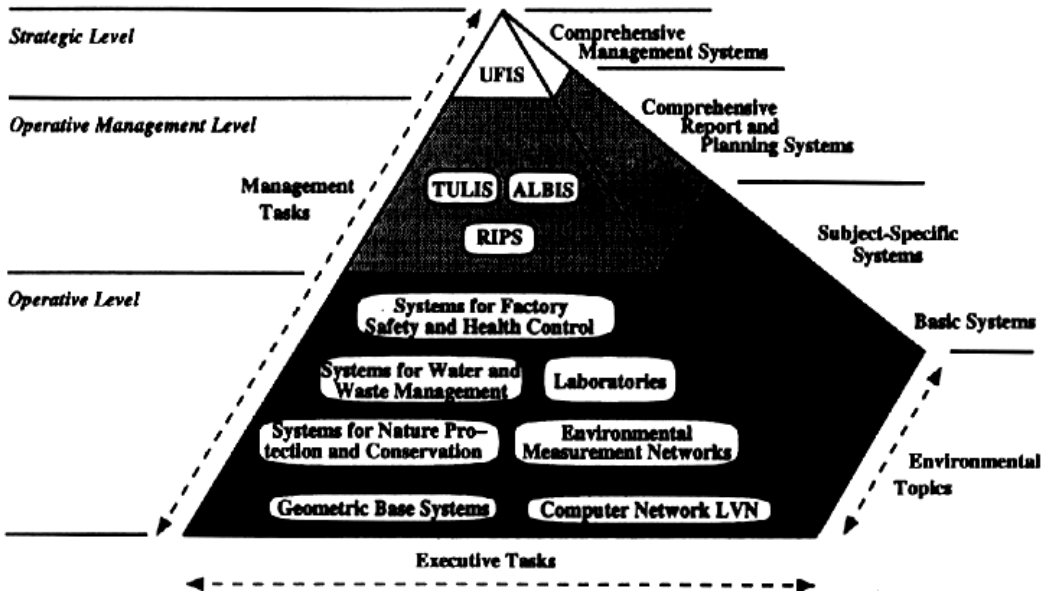
A common approach has been adopted for the development of EIS in different countries, starting with the identification of a set of policy-related driving forces in which the information system would be anchored. These 'driving forces' include a range of national policy frameworks on environment and sustainable development, as well as country obligations to various international 'environmental' conventions. These provided a platform for consensus-building among all stakeholders and serve as the instruments through which actions required for meeting the needs for environmental information may be implemented. However a successful EIS network can only be built on the acceptance of the importance of a multi-disciplinary approach. This would require the input and participation of all the institutions and a cross-sectoral approach to the dynamics of the network.

Large-scale environmental information systems, especially those operated by public organizations, are usually based on a variety of data sources. The underlying systems are heterogeneous, both on a technical level (e.g. different operating systems such as VMS, UNIX, LINUX and PCs running Windows; different database systems, e.g. relational database systems, pre-relational database systems, and geographic information systems) and on a semantic level, i.e. heterogeneous with respect to their content. Some of the relevant information may not even be available online at all. Due to the diversity of the implemented systems and their respective user interfaces, the art of retrieving required information is restricted to a fairly small group of users who have the necessary technology and knowledge at their hands.

As an example of such a system, Figures 2 and 2a illustrate the concept of the environmental information system of UIS Baden-Wuerttemberg, Germany. In three-layer architecture, systems are organized hierarchically and vertically.

Figures 2. & 2.a. The Component Categories within the Environmental Information System (UIS), Baden-Württemberg, Germany Platform identification





Perhaps in 5 or 8 years the MEPP will develop an equally powerful EIS, but for now the focus must be upon the implementation of a core set of EIS modules.

In the following sub-chapters, the topics about Platform identification, Users, Security and Independent Validation and Verification of the development of EIS will be briefly reviewed. More discussion about the topics discussed here can be found in the Annexes 5, 6 and 7.

5.2 PLATFORM IDENTIFICATION

5.2.1 HARDWARE

The hardware platform should take into consideration the current state of the equipment present at MEIC. The current IT situation should be consolidated, as proposed in the closing-gaps list added to the Annex, before proceeding with the implementation of other modules. An estimated 35.000€ will be necessary to close the most important gaps.

For example, a standby server should be added, which is a second server that can be brought online if the primary production server fails. The standby server contains a copy of the databases on the primary server. A standby server can also be used when a primary server becomes unavailable due to scheduled maintenance. For instance, if the primary server needs a hardware or software upgrade, the standby server can be used.

The mission-critical equipment should be kept in closed racks (specified in the Annex), while less critical equipment can be kept in open racks. The installation CD-s should be kept in a solid box in a safe location. All installations should be documented within the coming 6 months. This job could be performed by a local IT expert from outside of the MEPP. Over the coming months, the MEPP administrator will have a large amount of other jobs to do, so there will be an urgent need for other high skilled administrators in 2004. A written IT strategy plan for the whole MEPP would be an asset.

5.2.2 SOFTWARE

The number of Operating systems used by the whole MEIC network should be kept as low as possible (preferably one or two). This would lower the maintenance costs in terms of:

- Reduced time to solve problems
- Easier update of the operating systems
- Less training needed for the staff

Currently, the two most popular operating systems on the world market are Window-based and Linux-based. Each has its own advantages. One server version of Windows operating system should be used (Windows 2000 Server Family) and one or two client operating systems (Windows 2000 or Windows XP). Also, only one Linux version should be used at the MEIC.

Nevertheless, the software development of the Environmental Information System should be made without any operating systems specifications so that an easy transfer to a different operating system can be performed later if such a need arises.

5.2.3 DATABASE MANAGEMENT SYSTEM

The Database Management System (DBMS) should be an object-relational DBMS since they are the most prevalent on the market. Also a DBMS should be used that provides transaction control, such as Oracle, SQL Server, POSTGRES or MySQL, depending on the chosen Operating System. The choice of object-relational DBMS will allow easy upgrade to future functions of the system. The DBMS should provide easy backup, restoration, data transformation services, as well as data warehousing and data mining functionality.

5.3 USERS

Depending on different functions and privileges in relation to data management, five types of users should be defined. For easier set-up and maintenance, user rights should be maintained at group levels, where each individual user is a member; not at user level. The five user-types are as follows:

1. Administrators
2. Users able to add data
3. Users able to change data
4. Users only able to read data
5. Users only able to read data available on Internet

These different types of users will be described later in section 0

DATA-ACCESS PRIVILEGES HIERARCHY.

5.4 SECURITY

The following security demands should be taken into consideration during the design of the EIS at the MEIC: **confidentiality, integrity**, **authentication**, **non-repudiation** and **authorization**. These principles may be obtained by using the **Public Key Infrastructure** together with use of **Digital Certificates**.

Potential security threats should be defined and possible defence measures should be engaged, such as use of Firewall, Antivirus software, Encryption, etc. All of this should be included in the future **Security Policy** that should be developed at MEIC.

Software products usually contain some security errors. Hackers always find ways to circumvent security measures that are undertaken by the software developers. Therefore, very often software producers publish software updates and patches on their web sites. These update programs should be downloaded and installed as soon as possible. A part of the security policy should thus be to have the latest updates and patches installed and to check regularly on the Internet for new ones. Ensuring that security patches and service packs are up-to-date can prevent many attacks.

The Antivirus software should also be supplied with the latest virus definition supplied by the Antivirus software producer.

The database should be accessed only through authorized applications. Any access to the database through other forms, such as console applications, should be considered as a security problem and addressed accordingly.

The administrative account in a production environment should be given a complex password. A complex password protects the database server from anyone easily obtaining administrative access to the server. The administrative password could also be split in two parts and each part of the password should be known only by one administrator. This administrative password should be printed and kept in a safe deposit at the MEPP, accessible only by the responsible person at the Ministry, and changed at least whenever staff responsible for the database is changed.

Every change in the database records should be audited.

5.5 INDEPENDENT VALIDATION AND VERIFICATION DURING THE DEVELOPMENT OF THE ENVIRONMENTAL INFORMATION SYSTEM

Independent Validation and Verification (IV&V) is a process to test systems or software applications during the development process. Validation answers the question 'Are we building the right system?' and verification answers the question 'Are we building the system right?' IV&V is conducted by an objective, independent agent of the system or of the software development team.

IV&V should be conducted continuously during the development process. The IV&V agent should assess the status of the system or software development in terms of schedule, cost, and feasibility. Conducting IV&V throughout every stage of the project allows for early adjustments to requirements and provides decision-making criteria for the next development phase.

The IV&V agent should examine the products and specifications of the new system at each development phase to answer key questions, such as:

- Does the system or software meet the needs or requirements of MEPP?
- Does the system or software meet the designed specifications?
- Is the system or software error-free?
- Is the system or software design effective and efficient?

The IV&V agent should perform system or software testing, requirements analysis, design analysis and performance analysis. If errors or inefficient design criteria are identified at any phase of development, the IV&V agent should report this to the management of the MEPP for review.

The proposed EIS at MEIC will involve several complex technical components. IV&V will be a critical tool throughout the development process to assist in keeping the project focused on developing and implementing effective design specifications and on meeting the prescribed needs of the end-users at the MEPP, stakeholders and the general public. In addition, IV&V will help ensure that the MEPP's investment in the EIS at MEIC is sound by helping to keep the project focused and on target. By employing IV&V techniques, the MEPP will also be able to avoid costly system development errors that might not be identified if IV&V were not conducted through the life cycle of the EIS at the MEIC.

5.6 INDEPENDENT VALIDATION AND VERIFICATION DURING THE DEVELOPMENT OF THE CENTRAL DATA REPOSITORY

Independent Verification and Validation (IV&V) is a process to test systems or software applications during the development process. Validation answers the question, 'Are we building the right system?', while verification answers the question, 'Are we building the system right?'. IV&V is conducted by an objective, independent agent of the system or software development team.

IV&V is conducted continuously during the development process. The IV&V agent assesses the status of the system or software development in terms of schedule, cost, and viability. Conducting IV&V throughout every stage of the project allows for early adjustments to requirements and provides decision-making criteria for the next development phase.

IV&V procedures are specific to the system or application in question and must be adapted and customized to examine the specific needs and requirements of the system or software application. The IV&V agent examines the products and specifications of the new system at each development phase to answer key questions such as:

- Does the system or software meet the needs or requirements of the customer?
- Does the system or software meet the designed specifications?
- Is the system or software error-free?
- Is the system or software design effective and efficient?

IV&V consists of activities such as system or software testing, requirements analysis, design analysis, and performance analysis. Essentially, the IV&V process examines the project in each phase of its life cycle: conceptualization,

requirements, design, testing, development, and operations and maintenance. If errors or inefficient design criteria are identified at any phase of development, the IV&V agent reports this to management for review.

The proposed EIS at the MEIC will involve several complex technical components. IV&V will be a critical tool throughout the development process to assist in keeping the project focused on developing and implementing effective design specifications and on meeting the prescribed needs of the end-users. In addition, IV&V will help ensure that the MEPP's investment in the EIS at MEIC is sound by helping to keep the project focused and on target. By employing IV&V techniques, the MEPP will also be able to avoid costly system development errors that might not be identified if IV&V were not conducted through the life-cycle of the EIS at MEIC.

Chapter 6 DEFINITION OF DATA PROVIDED TO MEIC

6.1 BASIC INPUT DATA NEEDED FOR FURTHER PROCESSING

The input data should be collected according to the Environmental Monitoring Strategy, where the also are priorities defined. A National Core Set of Environmental Indicators should be developed and, in accordance with this, the data should be collected and sent to the EIS.

However, if monitoring systems are to serve a viable social function, then priority should be given to monitoring environmental problems that offer potentially large social payoff relative to the costs of monitoring. Realizing favourable benefit/cost ratios is more likely if:

- The environmental problems selected for monitoring will have high environmental or social costs if left unchecked
- The monitoring system is designed and used in a way that leads to rectification of the environmental problems that are being monitored;
- The monitoring system is designed and operated so that it is cost-effective.

6.2 VALIDATED DATA

Validation should be performed at two levels: automatic and manual.

Mechanisms must be put into place to ensure the best possible quality of data submitted by data entry. For all data entered into the EIS, a check for validity should be made according to predefined rules available to the users and expressed in a table. Other data-checking mechanisms must be implemented along the following lines:

- Data driven measurement entry form

  Only those parameters that are applicable for the specific emission source will be displayed. Therefore, no results can be entered against a non-applicable parameter.

- Batch Totalling

  The measurement results for the sample to be entered will be summed up. This batch total will need to be entered before using the data driven measurement entry form. After entering all the measurements, the total of the results entered will be compared to the batch total and any discrepancy reported to the user. This will reduce simple mathematical data entry errors.

Manual validation should be performed by authorized users who can meaningfully analyze the supplied data and correct it where necessary.

6.3 LIST OF PROVIDERS

Institutions, organizations and companies will be obliged to submit validated data to the MEIC. Different organizations, depending on factors such as the particular industry sector, size, location, etc., should have different obligations concerning parameters measured, the frequency of delivery of the data and other factors. thoroughly detailed in their license terms.

6.4 PROCEDURES FOR VERIFICATION OF DATA COMPLETENESS

Besides validation, a procedure should check whether the data provided from a certain institution or organization, includes all obligatory data stated in the terms of the issued license for that organization.

Chapter 7 PRINCIPAL DATABASE DESIGN

7.1 DEFINE DATA STRUCTURES

The following table structures are a suggestion for the EIS database. Some of these structures may change a little during the implementation phase. Final structures will be known when all front-end applications have been designed and implemented.

Table 5. Suggested Structures for the EIS Database

TABLE - PARAMETERS		
FIELD	**DESCRIPTION**	**EXAMPLE**
Parameter_ID	Unique Identity Number	1
Parameter_Name	Environmental Parameter Name	Sulphur Dioxide
Parameter_Symbol	Parameter Symbol	SO2
Measurement_Unit	Measurement Unit	ml/dm^3
TABLE - TOPIC_AREAS		
FIELD	**DESCRIPTION**	**EXAMPLE**
Topic_Area_ID	Unique Identity Number	1
Topic_Area_Name	The name of the topic area	Water Quality

TABLE - TOPIC_PARAMETERS		
FIELD	**DESCRIPTION**	**EXAMPLE**
Topic_param_ID	Unique Identity Number	1
Parameters_ID	Foreign key (FK) to table PARAMETERS	1
Topic_Area	FK to table TOPIC_AREAS	1
Low_Limit	Minimum Limit	10.5
Up_Limit	Maximum Limit	12.5
Start_Date_For_Limit	Date since these limits are enforced	15.7.2001
Comment	Comments	

TABLE - SAMPLING_METHODS		
FIELD	**DESCRIPTION**	**EXAMPLE**
Method_ID	Unique Identity Number	1
Method_Name	The name of the sampling method	1 hour mean
Standard	According to which standard	

TABLE - SAMPLES		
FIELD	**DESCRIPTION**	**EXAMPLE**

TABLE - SAMPLES		
FIELD	**DESCRIPTION**	**EXAMPLE**
Sample_ID	Unique Identity Number	1
Date_Measured	Date when this sample was taken	23/11/2003
Date_Submited	Date when this sample was submitted	25/11/2003
Submiter_ID	FK to table USERS	1
Method_ID	FK to table SAMPLING_METHODS	1
Date_Validated	Date when this sample was validated…	28/11/2003
Validator_ID	…by this Validator (FK to table USERS)	1
Location_ID	FK to table LOCATIONS	1
Comment		

TABLE - MEASUREMENTS		
FIELD	**DESCRIPTION**	**EXAMPLE**
Measurement_ID	Unique Identity Number	1
Sample_ID	FK to table SAMPLES	1
Parameters_ID	FK to table TOPIC_PARAMETERS	1
Measurement_Time	Time when the measurement was taken	10:30
Result	Floating point value of the measurement	12.58

TABLE - LOCATION_TYPES		
FIELD	**DESCRIPTION**	**EXAMPLE**
LocTypeID	Unique Identity Number	1
Location_Type	Location Type	River Station, Municipality, Factory, …

TABLE - LOCATIONS		
FIELD	**DESCRIPTION**	**EXAMPLE**
LocationID	Unique Identity Number	1
Name	Location known under this name	Ohrid lake
Description	Description of the location	Natural lake
In_vicinity_of	In vicinity of which other location	Ohrid municipality
LocationTypeID	FK to table LOCATION_TYPES	1
Geometry_Type	Whether it is point, line or polygon	‘p’ for polygon

TABLE - LOCATIONS		
FIELD	**DESCRIPTION**	**EXAMPLE**
Number_Of_Points	Number of points defining the location	35

TABLE - LOCATION_POINTS		
FIELD	**DESCRIPTION**	**EXAMPLE**
LocationID	FK to table LOCATIONS	1
Point_No	Order number of the point	1
Latitude	Latitude coordinate	42°04″
Longitude	Longitude coordinate	21°37″
Altitude	Height above sea level	245m

TABLE - ORGANIZATIONS		
FIELD	**DESCRIPTION**	**EXAMPLE**
OrganizationID	Unique Identity Number	1
Name	Organization Name	INVESTAS
Address	Organization Address	Veles bb

TABLE - USER_GROUPS		
FIELD	**DESCRIPTION**	**EXAMPLE**
Group_ID	Unique Identity Number	1
Name	Group Name	Add_only
Privilege_Level	Privilege level for different system functions	2
Description		

TABLE - USERS		
FIELD	**DESCRIPTION**	**EXAMPLE**
User_ID	Unique Identity Number	1
First_Name	User's first name	Neda
Last_Name	User's last name	Nedeva
UserName	EIS user-name	n_nedeva
Password	EIS password	kdiwh653
Organization_ID	FK to table ORGANIZATIONS	1
Group_ID	FK to table USER_GROUPS	1
Comment		

TABLE - REPORT_TEMPLATES		
FIELD	**DESCRIPTION**	**EXAMPLE**
Report_ID	Unique Identity Number	1
Name	Name of the report template	Weekly SO2 report
Description	Description of the report template	
Creator_ID	FK to table USERS	1
Date_Created	Date when this report template was created	14.11.2003
XML_Template	XML format of the Report template	
Privilege_Level	Minimum required privilege level to use this report template	3

TABLE - LICENSE_LIMITS		
FIELD	**DESCRIPTION**	**EXAMPLE**
Limit_ID	Unique Identity Number	1
Parameter_ID	FK to table TOPIC_PARAMETERS	1
Organization_ID	FK to table ORGANIZATIONS	1
Low_Perm_Limit	Minimum limit according to license	8.5
Up_Perm_Limit	Maximum limit according to license	15.5
Frequency_Of_Delivery	Frequency of delivery of data	'd' for daily 'w' for weekly 'm' for monthly …

TABLE - COMPLAINTS		
FIELD	**DESCRIPTION**	**EXAMPLE**
Complaint_ID	Unique Identity Number	1
Topic_Area_ID	FK to table TOPIC_AREAS	1
Description	Detailed description of the complaint	
Complaint_Date	Related Date	6.10.2003
Location_ID	FK to table LOCATIONS	1
Submitter_Name	Name of the person who submitted	Kiro Kirov
Submitter_Address	Address of that person	Veles
Submitter_Contact	How to contact that person	043/111-111
Date_submitted	When was the complaint submitted	7.10.2003

7.2 META-DATA STRUCTURES

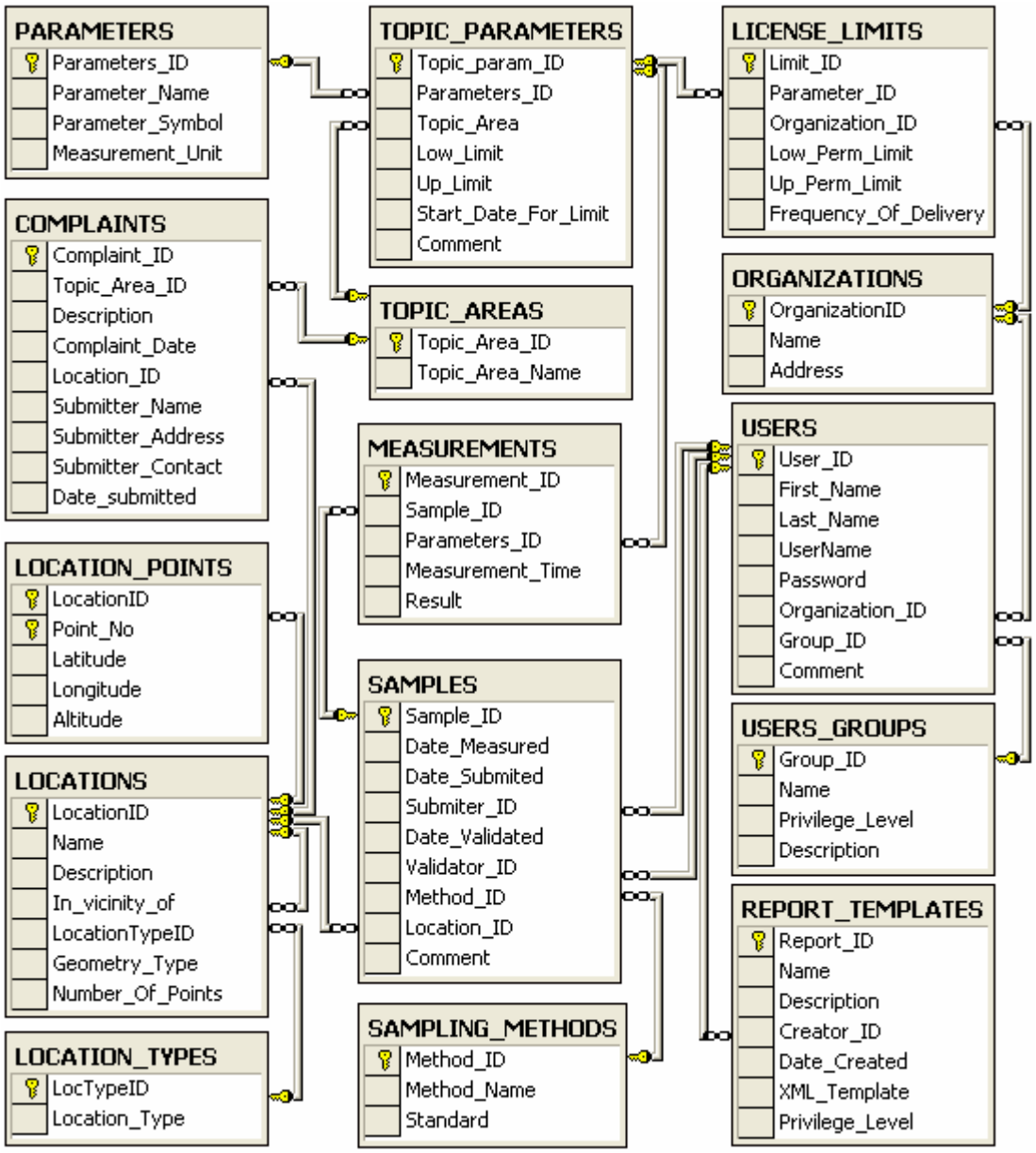
Sampling method, submitter of the data, license permission limits for organizations, frequency of delivery, geometry types and similar data are

considered to be supplementary data to the core data about the measurements, and are called *meta-data*. These meta-data help in the organization of the data, searching and sharing the data with other institutions.

Other meta-data should be kept in a parameter table since they relate to the EIS as a whole. These meta-data include, data/time format, Coordinate reference system, time difference from Mean Greenwich Time, etc.

7.3 PRINCIPAL DATABASE DIAGRAM

Figure 4. Principal Database Diagram



7.4 DATA-ACCESS PRIVILEGES HIERARCHY

Administrators

There should be at least one staff member with system security privileges on the NEIS database, possibly two members.

Users able to add data

A separate group of users should be able to add data to EIS both through the Internet and through the desktop application on the local network.

Users able to change data

The desktop application should also deal with users who have been assigned permission to change other owners' data and also data from the past. Security policy could state that two passwords would be required for changing old data.

Users able only to read data

Another group of users should be able to access *all* data in EIS for analysis purposes related to decision-making, only from the local network. They should be able to make ad-hoc queries, to use data-mining techniques and create new report templates.

Users able only to read data available on the Internet

The users in this group need no authentication and thus are able to read only data available from previously prepared reports. Depending on the performance of the web server, this user group could read data from a replicated server.

7.5 PROCEDURES FOR BACKING-UP AND RESTORING THE DATABASE

A database backup creates a duplicate of the data that is in the database when the backup completes. This is a single operation, usually scheduled at regular intervals. Restoring a database backup re-creates the database and all of its associated files that were in the database when the backup was completed. However, any modifications made to the database after the backup was created are lost. To restore transactions made after the database backup was created, transaction log backups or differential backups should be used.

To ensure against bss of data, the system should log transactions as they are performed, and a suitable backup strategy should be developed that includes periodic full and incremental database backups. This strategy should be designed to prevent loss of data, to minimize interference with operational transaction processing and provide for rapid recovery from system malfunctions.

Full database backups should be made at longer intervals, differential database backups at medium intervals, and transaction log backups at shorter intervals. For example, database backups should be created weekly, differential database backups one or more times per day, and transaction log backups every ten minutes. All this should be designed so as to function with minimum intervention from the administrator.

Concerning the data warehouse which stores massive amounts of stable historical data that is updated on a managed periodic schedule, the backup strategy for the data warehouse should be designed to minimize full backups and to use incremental backups for data updates.

The backup copies should be kept on a separate server and on removable media kept at a fire-proof location.

7.6 STANDBY DATABASE SERVER

Implementing a standby database server involves the following three phases:

1. Creating the database and ongoing transaction log backups on the primary server.

2. Setting up and maintaining the standby server by backing up the database on the primary server and restoring them on the standby server.

3. Bringing the standby server online if the primary server fails.

7.7 REPLICATION, DATA-WAREHOUSING AND DATA-MINING

A data warehouse is a database that contains historical data from the operational database and is used as the basis for a decision-support system. Data in a data warehouse should be structured and optimized for decision support. Replication is used during data transformation as a data warehousing management and deployment tool. Replication can be used to distribute data to read-only databases, thus reducing the burden on the server, when long-lasting ad-hoc queries would be sent to the server for analysis purposes. Data warehouses are designed to overcome problems encountered when the users attempt to perform strategic analysis using the same database that is used for online transaction processing (OLTP).

When the OLTP database becomes populated with large amounts of data, a data warehouse should be created where some of the non-actual data can be transferred. For example, for previous years, only aggregated data (mean value, variance, sum, etc.) of each sample should be archived, omitting individual measurements.

An analysis should be made concerning the relevant data that should be kept for purposes of later analysis and for which parts of the data warehouse the data-mining model would be an OLAP data mining model or Relational data mining model. OLAP provides a multidimensional presentation of data warehouse data, creating cubes that organize and summarize data for efficient analytical querying. The design of the data warehouse structure affects how easily these cubes can be designed and constructed.

Different data-mining tools can be used for analysis and prediction. A data mining model enables analysis of the data for patterns and making predictions based on the patterns found in the data.

Chapter 8 DATA REPORTING

8.1 OBLIGATIONS

Free access to environmental Information and data has been a longstanding desire of the public in almost all European countries, dating back to the Stockholm UN-Conference on the Human Environment in 1972, if not before.

The US Government, with the Right to Know Act and other laws, has demonstrated the way in which administrations can treat the problem of public information in general.

It took almost a decade to realize such European legislation as Council Directive 90/313/EEC on freedom of access to information on the environment. A further step with a broader approach was introduced with the 5th and 6th Action Program of the European Communities and the implementation of the 'Rio Declaration on Environment and Development' (Earth Summit `92, 1992), including Agenda 21, Chapter 40 and others.

8.1.1 EU-LEGISLATION

The main elements of EU-legislation influencing the activities of the MEPP in the field of environmental statistics and information are as follows:

- *94/808/EC Council Decision of 15 December 1994* adopting a 4-year development programme (1994-1997) relating to the environmental component of community statistics (under constant renewal)
- *Council Regulation (EEC) 1210/90 of 7 May 1990* on the establishment of the European Environment Agency and the European Environment Information and Observation Network of the Council of the European Communities (modification is under preparation)
- *93/464/EEC Council Decision of 22 July 1993* on the framework programme for priority actions in the field of statistical information 1993 to 1997 (renewal is constant)
- *85/338/EEC Council Decision of 27 June 1985* on the adoption of the Commission work programme concerning an experimental project for gathering, coordinating and ensuring the consistency of information on the state of the environment and natural resources in the Community
- *Practical Steps towards the implementation of the Communication from the Commission to the Council and the European Parliament on Directions for the European Union on Environmental Indicators and Green National Accounting (COM(94)670 final).*

In 1994, the UNEP initiated a program to support environment assessment reporting and data management capacities in countries with economies in transition in Central and Eastern Europe. This includes identification of needs and the formulation of project proposals to meet these needs. With partner agencies and other donors, UNEP seeks to leverage finances to correct any imbalances. This activity is a part of UNEP's global ENRIN (Environment and Natural Resources Networking) program, which is a direct follow-up of Agenda 21,

chapter 40 on information for decision-making. This chapter underlines the need for easily accessible environmental information at all levels, from senior environmental decision-makers to grassroots. An agreement has been made with the GRID-Arendal centre in Norway for implementation of the ENRIN program in Central and Eastern Europe.

As a consequence of the various international cooperation activities, the European Environment Agency (EEA) fosters the development of a European Catalogue of Data Sources (CDS), carried out by the Land Niedersachsen (European Topic Centre, CDS) in cooperation with ISEP (Technical Secretariat esp. for the Thesaurus development).

The objective of the project was the building of a European Environmental catalogue of meta-data. As an important instrument for the environmental data catalogue, a multilingual environmental Thesaurus and an environmental Terminology for the uniform coding of the data is being developed with the technical support and coordination of ISEP.

The main goal behind the establishment of a terminology database was to support all EEA and EIONET activities by providing standardised terminology and coding guidelines, thereby promoting the exchange of European environmental data and information. The terminology database represents one of the major EEA achievements towards its main objective: of providing comparable and consistent information to the Community and the Member States.

EIONET

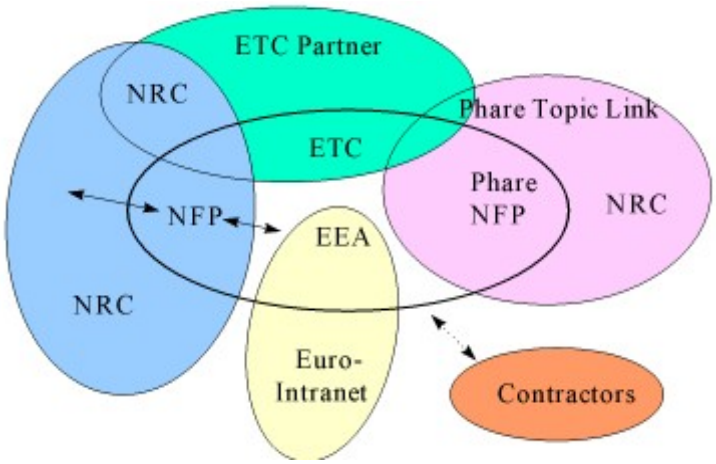
The EIONET (European Information and Observation Network) was established in parallel with the European Environment Agency (EEA) in 1994 within the framework of an overall environment assessment at European level. It is both a human and administrative EEA mechanism, as well as an applied telemetric network aiming at:

- Dissemination of objective, reliable and comparable environmental information at European level
- Interconnection of all countries
- Promotion of the development of national environmental networks

The EIONET started as a 'closed' INTRANET network and finally became an EXTRANET (operation through INTERNET with access control system). Its physical nodes are installed in the National Focal Points of the EEA member states, the relevant Focal Points of the PHARE countries (Eastern and Central Europe), the European Topic Centres, as well as in the EEA and the European Union.

The operation of EIONET is based on the use of the CIRCA group collaboration tool, which is an extension of a software package initially developed for EUROSTAT. This tool enables the exchange of documents and information between users belonging to the same Interest Groups, as well as communication via lists and e-mail, newsgroups, etc. In future, EEA aims at extending the use of CIRCA in applications related to data exchange between the member states and the European Topic Centres.

Figure 5. Overview of CIRCA



National Focal Points

European Topic Centres

National Reference Centres

Main Component Elements

PHARE & EFTA Countries

8.1.2 NATIONAL LEGISLATION

'Everyone has the right to a healthy environment to live in.

Everyone is obliged to promote and protect the environment

The Republic provides conditions for the exercise of the right of citizens to a healthy environment' – ***Constitution of the Republic of Macedonia***

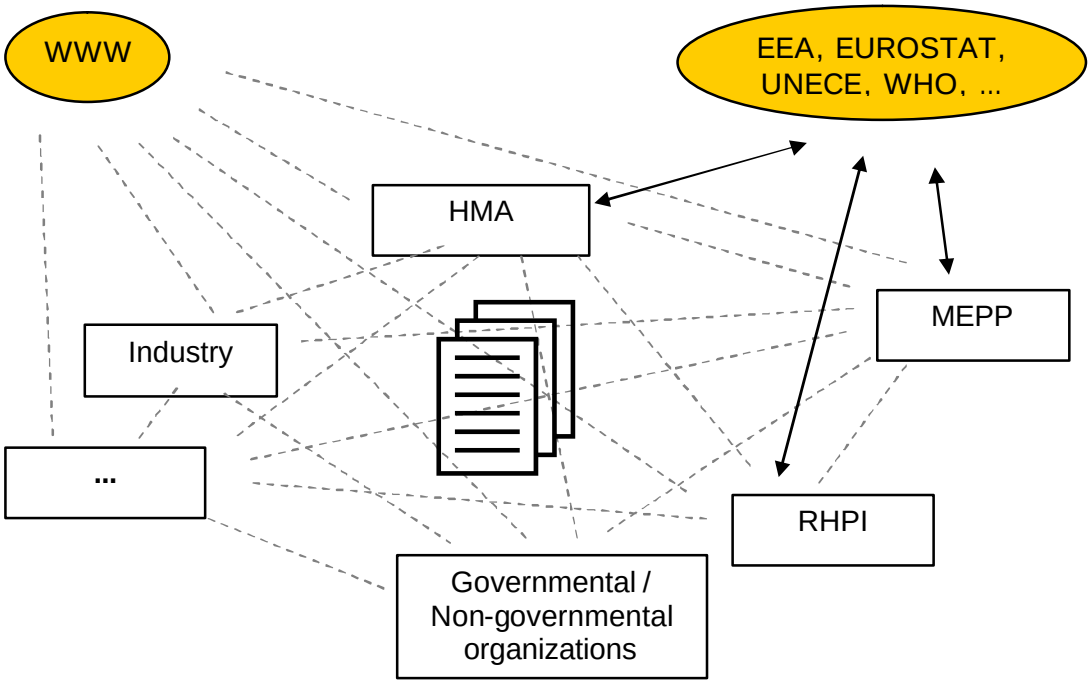
The Macedonian public, whose awareness of the importance of the environment is growing, demand to be informed about their environment: about issues connected to the environment and measures undertaken for the purpose of preventing, mitigating or eliminating problems in the environment. Taking into account the public nature of this information, such demand should be responded to not only by timely provision of the relevant information, but also by its active promotion and interpretation, with the ultimate objective of educating the population and making them aware of the situation around them and encouraging them to take part in environment protection and preservation.

To coordinate all relevant information, carry out systematization and standardization of that information, as well as provide the required transparency and delivery to the end-user, the Macedonian Environmental Information Centre was established in April 1998 (based on Article 8 of the Law on Environment and Nature Protection and Improvement of 1996). For more detailed information, see the Environmental Awareness raising Strategy.

8.2 DATA DISSEMINATION

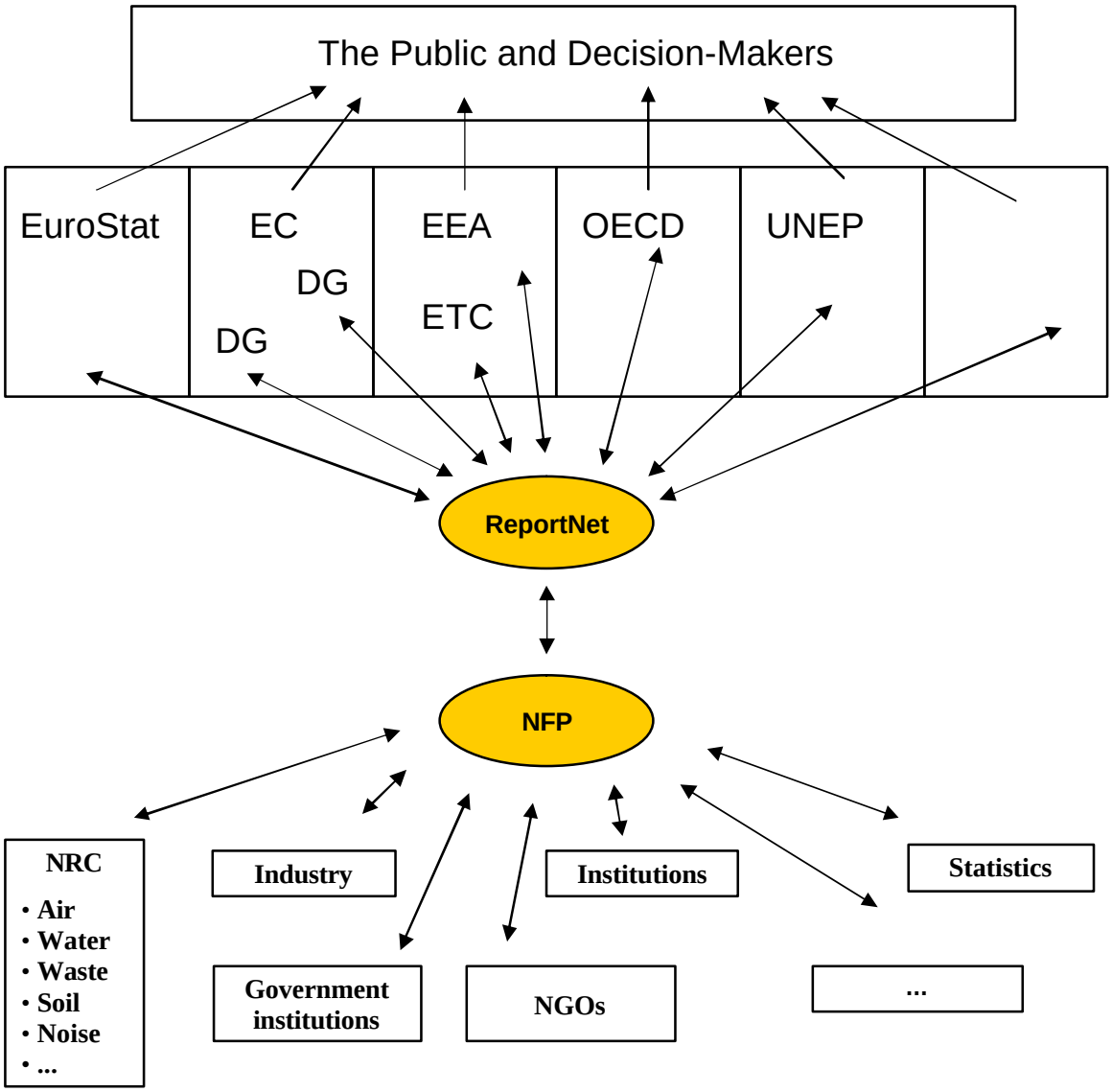
Communication among institutions exists, but is mostly performed on paper on an irregular basis and usually with difficulties. However, reporting to international bodies *is* performed on a regular basis. Current data and information flow is presented on Figure 5.

Figure 6.Current Data & Information Flow



The implementation of EIS will provide the basis for optimized data and information flow as presented in Figure 6.

Figure 7. Optimal Data & Information Flow



8.2.1 MINISTRY OF ENVIRONMENT AND PHYSICAL PLANNING

The MEPP is the focal point for environmental data in the Republic of Macedonia. For this reason, various methods for information dissemination are required.

The MEPP has reporting obligations towards international bodies: EEA, UNECE, EUROSTAT, WHO. The reporting obligations, both national and international, are conducted by the MEIC.

- The MEIC sends annual reports to the EEA and UNECE on a regular basis. The DEM is used for air-pollution data synchronization with EEA. These data are available in AirBase. AirBase is the air quality information system of the EEA.
- The EIONET (CIRCA) is used for information exchange with the EEA. CIRCA is an extranet tool, developed under the European Commission IDA

programme, and tuned to Public Administration needs. It enables a given community (e.g. committee, working group, project group, etc.) to geographically spread across Europe in order to maintain a private space on the Internet where they can share information, documents, participate in discussions and various other possibilities. The MEIC is trying to introduce the Macedonian EIONET node as a general information exchange tool with all institutions, NGOs, stakeholders, etc.

- The State of Environment Report (SoER) is produced in the MEIC. Three reports have been produced so far. According to EEA recommendations, SoER reports should be produced every 3-5 years. These reports exist only in electronic form and are available on MEPP web site.
- Reports to EUROSTAT and WHO are sent upon request - these reports are based on questionnaires.
- Questionnaires originating from the Convention on the Protection and use of Transboundary Watercourses and International Lakes (Helsinki) are being processed as a preparatory activity for ratification.
- The MEIC sends general information about air pollution from the automatic air-pollution monitoring system by fax to the Skopje City Centre for Informing and Alerting on a daily basis.
- Monthly and yearly reports based on processed data are also prepared by the MEIC. Printed reports are delivered to RHPI and HMA. Official reports are available for different stakeholders in the Public Relations Office (PRO).
- Frequent reports are created upon request from NGOs, students, scientists, etc.
- A large amount of information is published on the MEPP web site, such as air pollution data, state of environment report, etc.
- While radio communication was used for the automatic air-pollution monitoring system, information was collected in the central station located in the MEIC and automatically transferred to the public display in the centre of Skopje. With the introduction of new automatic air pollution stations, this type of communication was abandoned and the public display is not functional at the moment. However, it is planned to purchase a larger and more visible public display with the next enlargement of the air-pollution monitoring system.

8.2.2 EU AND DATA DISSEMINATION

Almost all items of EU environmental legislation require Member States to report in some way to the Commission. Currently, the information requested falls into the following five types:

1. ***Legal transposition*** **–** details of Member States' national laws enacting EU legislation
2. ***Practical compliance*** **–** data on violations of environmental standards, limit values, national derogations, etc.
3. ***Environmental data*** **–** on environmental pressures and the state of the environment
4. ***Descriptions of policy measures*** **–** plans, programmes, instruments put in place by Member States to comply with EU legislation

5. ***Policy affects and effectiveness*** – the affects of these measures and the extent to which they achieve their objectives.

Greatest emphasis is given in the legal system to information-types 1, 2 and 4. All these different kinds of information are channelled from the Member States to the Legal Unit of DG Environment through periodic, national reports on implementation. In recent years, the Commission has made progress on publishing reports evaluating implementation at EU level, e.g. the Standardised Reporting Directive reports for water and waste. However, in many cases, the information provided by countries remains non-transparent both to other countries and to users outside the policy loop, e.g. NGOs and the interested general public. The Aarhus Convention will require a major change in information provision and access by all parties.

The system as it currently stands has grown incrementally as the Commission and the Member States have agreed reporting requirements for separate laws or sectors, in most cases independently of one another. The growth in the types of reporting requirements has therefore been organic rather than strategic. As a result, some valuable types of information are not collected at all; some officials who need access to the information that is available do not receive it; and Member States sometimes fail to report at all in response to a growing burden of reporting obligations, the value of which may not be immediately obvious to them. The EU institutions and Member States all suffer from this unsatisfactory situation.

In addition to legally based obligations, Member States are also required to respond to a myriad of 'moral' obligations, mainly emanating from EEA and Eurostat in the EU, and from OECD and International Conventions at the wider international level. These obligations focus mainly on type 3 information and there are overlaps and duplications of effort across institutions. Such obligations have been defined for purposes other than those defined in EU legislation, such as for trend analysis in state of the environment reports, monitoring progress under separate conventions, and more recently for the development of indicators to support reporting on progress with EU environmental policy, sectoral integration and— in the future—sustainable development.

The result is that we now have an increasing myriad of reporting obligations, developed incrementally over time, with overlaps and duplications across institutions, causing reporting fatigue in countries and overload or backlog in the recipient organisations. Yet it remains difficult to obtain the types of information needed by policy makers to assess the effects (using indicators) and effectiveness (using models, etc.) of EU policies and other international commitments. This has now been recognised formally by the Commission and the Member States under the 6th Environmental Action Programme, which includes a commitment under (draft) Article 9 to:

> *'…review and regularly monitor information and reporting systems with a view to a more coherent and effective system to ensure streamlined reporting of high quality, comparable and relevant environmental data and information.'*

8.3 TOWARDS A NEW REPORTING SYSTEM

The EEA and EIONET, through the Bridging the Gap process, have been considering how we can move towards a better balanced reporting system which meets policy needs and addresses the issue of reporting fatigue in Member

States. This process has yielded a number of broad and specific recommendations.

These recommendations cover the following four elements:

- Developing policy-relevant frameworks for assessment based on key policy questions and relevant indicators
- Streamlining the current reporting obligations to remove redundancies and duplication
- Developing new methods for collecting, analysing, modelling and comparing data at the EU level, utilising existing and new data to fill information gaps
- Optimising institutional cooperation so that information is reported once but used by many thus maximising efficiency

Work on indicators is developing rapidly. However, it will be some time (5-10 years) before reporting obligations have been retuned to deliver the data, information and assessments required for policy-relevant indicators. Proposals for streamlining the current reporting obligations have evolved from analysis of the Reporting Obligations Database (ROD) and other sources, but it will take time to unravel current legal obligations (2009 under the Water Framework Directive), so that for the foreseeable future countries are likely to be required to continue to meet existing obligations. New methods have been developed to support indicator production and policy evaluation (environmental accounting, scenarios/outlooks). And while these will deliver the better quality information demanded by Ministers, Commissioners, and Parliamentarians, in the short term they will add to the reporting burden. It is in the area of common frameworks and approaches (e.g. indicators) and streamlined institutional cooperation that most progress can be made. This is recognised in the new EEA strategy (EEA 2001) and the proposals to develop the common, shared information infrastructure on which the existing e-EIONET can be expanded to what is often referred to as Reportnet.

8.4 HOW CAN INFORMATION TECHNOLOGY HELP?

The principles underlying Reportnet are as follows: that countries should be required to report information only once and to do so in accordance with well-defined needs based on policy objectives; that this information is held in a well-designed repository to enable ease of access and development of a corporate memory; that those institutions at the international level who need this information access it when they want to; that countries share information to enhance policy learning; and that information is transparent and accessible, thus enhancing participation and improving quality through use and exposure.

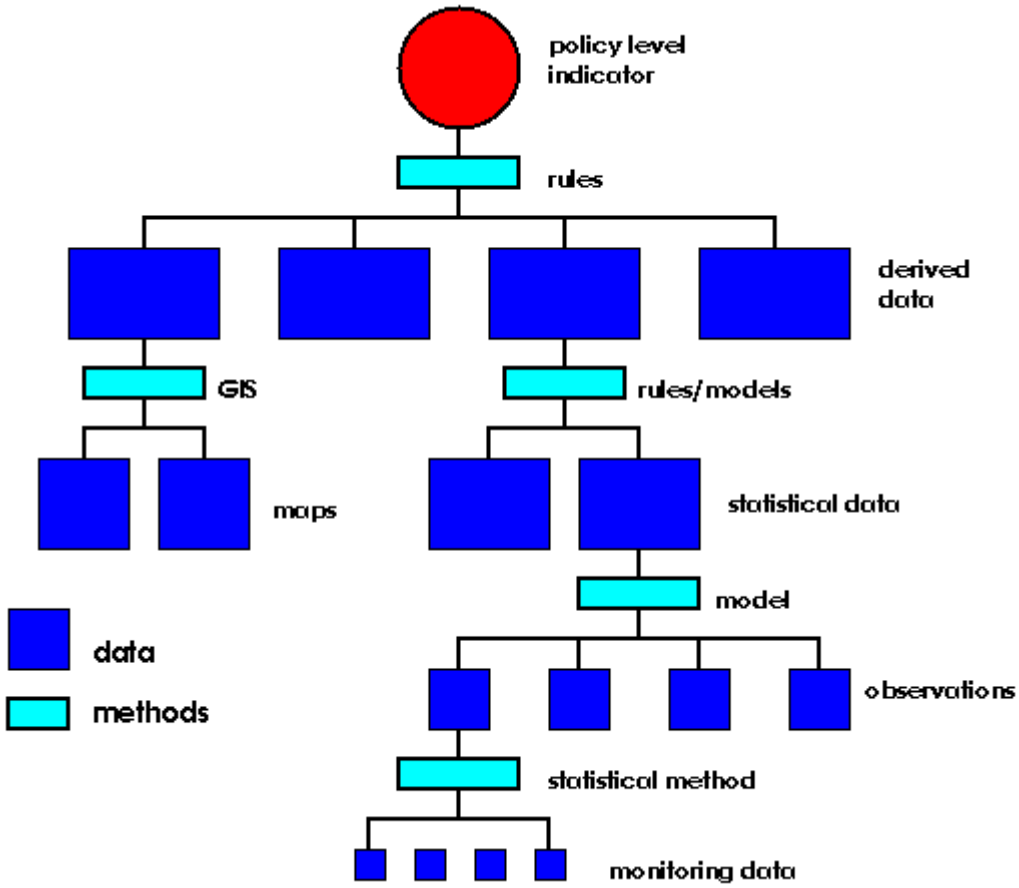
The development in recent years of the web means that IT tools and infrastructure can be designed to support implementation of the Reportnet principles. In particular, the current trends and tools in e-business, which are mainly based on applications of XML, make it feasible for organisations to interchange, share, and publish data much more effectively than has been the case in the past.

Besides a publicly available website for publishing results from the sampled data, the EIS should provide for easy publication of reports in different formats that are popular and easy for use for printed publications, such as PDF, DOC, XLS, etc.

8.5 DATA SHARING AND INTEGRATION WITH OTHER NATIONAL INFORMATION SYSTEMS

The Republic Health Institute, Republic Statistical Institute, municipalities and other bodies which already have—or plan to have—a separate information system which will also hold environmental data about the same or different parameters than the National EIS, will need to share data with the EIS. A Data-Exchange Network Blueprint is needed to allow shared and clearly defined terminology in addition to accountability and responsibility for elements such as data quality, timeliness and authority, exchange formats and methods, and access. This will allow each partner to operate independently on internal matters and in a coordinated fashion on external issues. Network members will build their interface-nodes as an extension of their existing Web and enterprise architectures.

Figure 8: Outline of a national data exchange network



8.5.1 DEFINITION OF DATA EXCHANGE PROTOCOLS

A Data-exchange protocol should be defined to support all critical requirements for data flows, including the ability to 'package' the relevant data using XML schemas developed by exchange partners and network participants. The benefits of using an open standard language such as XML to define the data-exchange protocol, can be found in the Annex 5.

8.6 GIS REPORTS

Organizations around the world are leveraging their information technology (IT) investments by integrating mapping and geographic information system (GIS) technology.

GIS allows us to view, understand, question, interpret, and visualize data in ways simply not possible in the rows and columns of a spreadsheet. Beautiful and interesting maps provide better decision making tools and analysis and make a difference to our world.

Approximately 80 percent of all business data has a location component. Linking location to information is a process that applies to many aspects of decision-making in business and the community. From retail, transportation/logistics, real estate, finance, and environmental agencies to all aspects of government, GIS software can integrate different systems to save valuable resources, visualize an organization's assets, and streamline workflow processes.

Today, the application of GIS is pervasive throughout our society. Geography and GIS help to tie together the intricacies of a multitude of fields by offering end-to-end systems for analyzing and sharing geographical information.

Effective management of geographic information involves knowing what resources are available, the uses to which the data can be applied, its quality, and its network location.

It also involves providing simple means of finding and accessing those data sets across a network. We need to be able to ask questions such as: 'Show me data sets about this topic—satisfying the specified criteria—that are relevant to this geographic region.'

The following issues should be considered in order to implement successful directories:

- Distributed indices at sites that are nodes of a computer network so that they are under the control of the relevant custodians. This ensures the data will be updated and otherwise maintained by those best able to do so.
- Documentation of data sets should be an easy matter so as to encourage the meta-data descriptions to be readily completed.
- Environmental information is a valuable resource. It is often expensive and difficult to generate. Before new work is carried out, a search should be able to be made to find out what information already exists so that it is not duplicated.
- Directories need to point directly to relevant information without the user having to wade through lots of data sets that do not suit the current purpose.
- The general idea is to discover data sets that are most likely to be relevant and then follow links to more descriptive information to see if the data suits the purpose and is fit for use.

There is currently a stand-alone GIS department (CORINE - Land cover project) within the MEPP. This department will be added to the MEIC to create full synergies and improve the work of the MEPP. A new server and new GIS software (25.000€ - 35.000€ according to the GIS software solution) will probably be necessary to face the coming challenge to be part of an EIS.

The layers from the CORINE - Land cover project should be used to create informative reports. Several layers of interest for GIS reports should be made available:

- Surface water bodies
- Groundwater bodies
- River basin districts
- Populated places
- Forests
- Agricultural fields
- Municipalities
- Protected areas
- Network of measurement stations
- City details (districts, streets, etc.)

There are many GIS layers already available in different state institutions in the Republic of Macedonia. Thorough coordination among these institutions should be achieved for the greatest benefit to the MEPP.

GIS tools will make available reports with different intersections among the layers and the locations of the samples. Also possible would be reports showing the surrounding of individual sampling locations.

8.6.1 COMPATIBILITY WITH INTERNATIONAL GEO-REFERENTIAL DATA

As a constituent part of GIS, reports should be include several meta-data elements in accordance with ISO 19115. These elements should include: Metadata language, Metadata character set, Metadata point of contact, Metadata date stamp, Dataset title, Dataset reference date, Dataset language, Dataset character set, Dataset topic category, Abstract describing the dataset, Spatial representation type, Reference system.

8.7 DEFINITION OF REPORT TYPES

Users with a certain privilege level should be able to create report templates with various possibilities for aggregate functions, such as mean values, standard deviation etc, for threshold counting functions (e.g. count number of days that this parameter was above the limit), and date-time operations, such as reports for the preceding week, for the preceding month, for a certain month, for a certain year, for the current year, etc. Adding charts to the reports would make analysis more effective.

These report templates can then be used to create on-demand reports by users with sufficient privileges.

8.8 SIMULATIONS AND FORECASTING

Information technology has played an increasing role in the planning and controlling of environmental issues at different scales and within various time spans. It has been a long journey from the establishment of ecology as a science

dealing with the relations of organisms to their environment (Haeckel, 1866) and the definition of the concept of ecosystems (Tansley, 1935), to the development of the field of simulations. Rapid developments in information technology made possible the development of computer models serving environmental policy that are currently part mainly of research endeavours.

Environmental systems consisting of geophysical and geochemical elements, abiotic factor complexes (atmosphere, hydrosphere, pedosphere) and biotic elements (growth processes, population dynamics) are complex cybernetic systems. Information technology has succeeded in developing adequate tools for modelling, simulation, planning and decision support for environmental protection. As a result, education aimed at transmitting an understanding of environmental systems is nowadays unthinkable without the use of computer techniques.

Considerable progress has been achieved in a number of different research areas:

- in theoretical areas, the use of High Performance Computing simulation has brought spectacular results in systems dynamics (evolution strategies, logistic growth, chaos research)
- in climate research, the long term analysis of global change
- in economics and ecology, the considerations of sustainable development
- in mathematics, the development of powerful algorithms for integration and decomposition methods for parallelization.

Interdisciplinary co-operation has benefited from computer networking. Parallel computation greatly assists in the efficient analysis of large-scale and complex environmental systems. Weather and ozone forecasts are based on parallel computation. Visualization techniques allow comprehensive overviews and thus assist decision support. Simulation gives numerical insight into the behaviour of complex environmental systems. Intelligent information technologies (neuronal nets, evolution strategies, expert systems) support modelling where relevant background structures from the natural sciences are unavailable. These information technologies can also assist data mining. Algorithms for optimization and poly-optimization provide a helpful aid for dealing with conflict situations which can evolve between the areas of ecology, economics and the needs of society.

The following list reflects the wide range of applications conducted in the field of environmental modelling and simulation:

- analysis of regional systems
- climate research
- air pollution modelling
- water pollution modelling
- modelling of natural resources
- modelling of traffic systems
- methods for modelling and optimization

- mathematical methods, partial differential equations
- simulation tools
- environmental risk management
- data management
- data mining
- visualization
- intelligent cartography

Within the annex, a list of free/shareware simulation software may be found. This software will give the user an idea of just how powerful and useful professional simulation software for daily work can be. Nevertheless, we recommend waiting until the implementation of the GIS has been completed and is fully functioning before the MEPP adds one or more simulation components to the EIS. For professional simulation software, the MEPP will need to buy a high-speed computer, as a normal server or workstation will be too slow for acceptable results in real time.

Chapter 9 INSTITUTIONAL IMPLICATIONS

9.1 ORGANISATIONAL CHALLENGES IN INTRODUCING NEW TECHNIQUES

The efficient exploitation of a new technology in an organisation often requires alterations in work routines and chains of command which, in turn, affect the overall organisation. In practice, altering an organisation may prove difficult, both because the organisational structure is intangible and hence difficult to define, and because there are invariably both formal and informal positions in all chains of command. Changing the organisation changes staff authorities and relationships, and staff changes always bring in human factors that are difficult to predict or control.

Consequently, organisational matters are vital in all initial implementations of EIS facilities. The organisational problems are often more complex and more crucial to success than are the technical problems involved. As a rule, technical problems can be solved in a straightforward manner, by purchasing and installing new equipment, new software modules, and so on. Purchasing incurs costs, but in a well-planned project, these costs are anticipated. Re-training, changing positions or job descriptions, as well as replacing staff members is less straightforward, and may trigger unanticipated problems. Hence, organisational matters usually require more continuous management attention than do technical problems.

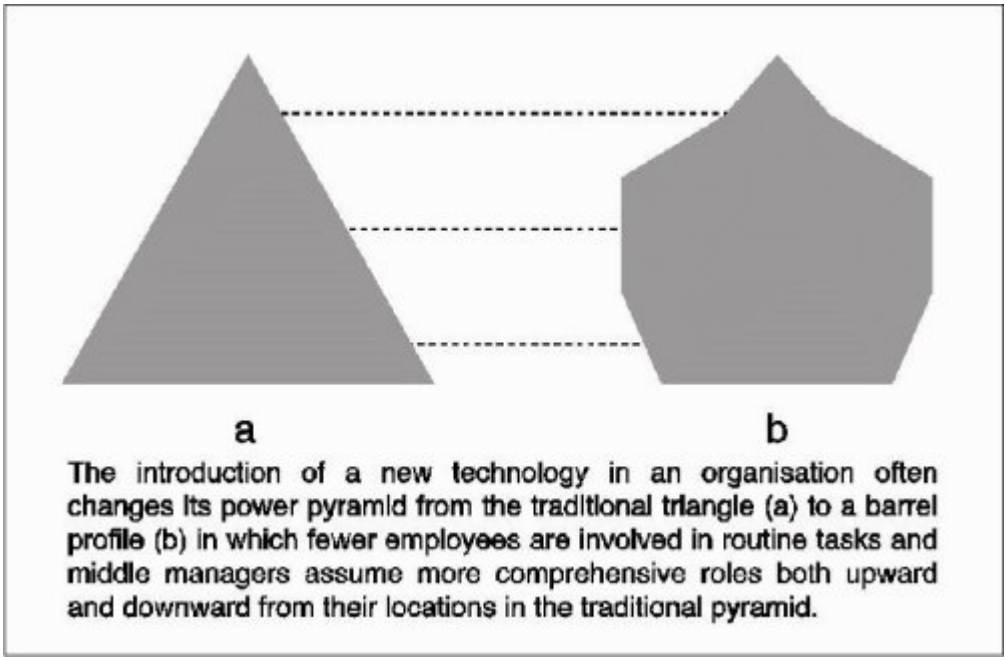
In principle, new tasks and new data flows should be described independently of the persons, groups or departments ultimately responsible. The implementation should start with the existing structure and the staff structures should be redefined and management modified after enough experience with new requirements is gathered in the pilot phase. After this, new staff positions must be described, complete with descriptions of tasks, duties and responsibilities.

Availability of information is vital to a viable EIS. Whenever information availability is restricted, EIS utility suffers. So the common penchant of an agency or department to monopolise its own information is one of the major foes of a successful EIS. Consequently, one of the main priorities in implementing an EIS facility may involve combating the bureaucracy that blocks information flow.

There are also other subjective factors that can further complicate the implementation of an EIS. Human habit apparently dictates that about a quarter of the personnel in any organisation always prefer the *status quo* and will oppose any change whatsoever. Except in high tech firms, executives are often indifferent to newer information technologies, partly out of ignorance and partly from being overly concerned with cutting costs rather than increasing benefits. Improving information exchange inside and outside the Ministry, including the EIS, is an important priority of the Vision 2008 and the Environmental Communication Strategy prepared within the same project. This provides the basic executive support crucial to the success of an EIS implementation, but it should be further generated by the utility of EIS in sectors known to be of interest to the executives concerned.

Successful projects are often enthusiastically conducted by middle management, who often seek the benefits of new technologies while resisting extensive organisational changes.

Figure 9. Affect on Organizational Hierarchies of Introducing New Technology



As shown in Figure 8 (above), the introduction of new technology often results in hierarchical changes within an organisation.

Specialists are essential in the execution of an EIS implementation, but are seldom capable of addressing the myriad of details involved in a project. For instance, computer experts are usually so engrossed in their disciplines that they lack the broader view required to tackle organisational problems. Operators and other direct users are similarly constrained within the frameworks of their jobs.

The need for expertise is often underestimated. Without the requisite expertise, progress can be frustratingly slow. Consequentially, maintaining and building staff expertise should be a top priority task. Personnel management for a transition to a new technology should include:

- identification of factors affecting personnel
- a plan for training, retraining and relocation
- concise job descriptions, including responsibilities
- employee involvement in planning
- clear definitions of positions and salaries
- a plan for job rotation
- delineation of the simplest possible organisational structure, including:
  - management authority
  - delegation of responsibility
  - division of work

- clear communication to and from executives, between organisations and within individual organisations
- retain the organisation's advantages and strengthen:
  - team work
  - goal orientation and adaptability
  - identification with the project
- suit staff proficiencies and size to the tasks involved
- create an environment of challenging work and career advancement

The most important organisational aspects of development of the EIS may be summarised as follows:

- Executive involvement is crucial to success.
- Organisational problems are usually greater than technical problems.
- Organising or reorganising should reduce the monopolisation of information.
- The introduction of EIS affects changes in existing routines for information interchange between, and within, individual units of an organisation.
- Altered work routines necessitate organisational changes.
- At least a quarter of the personnel in an organisation can be expected to oppose change.
- Operator co-operation must be enlisted.
- The initial stages of implementing a GIS facility may be project-oriented. The organisational alterations should be tested before being finally enacted.
- Long-term organisational changes should be made after the initial operational phase of a new EIS facility.

9.2 RECOMMENDED ORGANIZATIONAL CHANGES

Taking into account the fact that the new national environmental legislation which is in line with the EU *Acquis communitaire*, contains requirements which consequently impose the necessity for specific organizational changes of the Macedonian Environmental Information Centre as a part of the MEPP. According to the current organizational structure of the MEPP, the data management is conducted by its MEIC. The primary task of the MEIC is to establish, maintain and regularly up-date a base of relevant, properly processed (systematized and standardized), comprehensive, accurate, transparent and publicly accessible information on the state, quality and trends in all segments of the environment (water, air, soil, noise, waste and protected parts and objects of the nature). The basic function is performed by using and channelling of data from other information and statistical systems: geographical, topographical, population, economic, etc. data of diverse nature, as a support to the main activity, as well as through collection, systematisation, analysis, processing and presentation of specific information on the state, quality and trends in the environment (types,

monitoring parameters, sources, providers, formats, methodologies for assessing the quality, equipment, hardware and software, databases, system structure, safety, etc.)

Foreseen activates are implemented by MEIC's two units: Envirionmental Information System and Public Relations Office. In addition to its primary function, the Environmental Information System is also responsible for implementing the IT strategy, providing technical support and system maintenance.

Considering the current activities, foreseen actions and future development of the MEIC, as well as optimising the communication, data flow and overall performance, we strongly recommend to integrate MEPP's GIS unit into MEIC, as efficient use of environmental data requires integration with GIS data, i.e. geo-oriented data in order to present the environmental state and the trends in real time and space. The environmental GIS products are vital for appropriate presentation of environmental state, observing the relevant changes and broadcasting future developments under various scenarios, including the zero action scenarios.

We also recommend to split the Envirionmental Information System into two units making clear distinction between data management and IT aspects. The data management unit will deal with environmental data collection, processing and presentation, with the ultimate objective of responding to and achieving compliance with the national and international reporting requirements and obligations deriving from both national legislation and international agreements ratified by the Republic of Macedonia. The IT, as technically distinctive activity, will focus on data-bank establishment and maintenance, provision of services such as e-mail, www, file and print services, maintenance of Macedonian EIONET node, administration of MEPP's servers and LAN, provision of technical support, organization of training, etc.

9.3 STAFF AND OTHER RESOURCES NEEDED

In the next phase of the development of the EIS within the coming 2 years, the following staff and support from a local software company will be needed:

For the MEIC:

- Two network administrators
- One mail administrator
- One webmaster & web server administrator
- One database administrator
- One GIS administrator
- 6 persons entering existing and new data into the database
- contract for outside support with a local software company for programming
- contract with a local IT expert for writing the documentation and manuals
- contract with a local IT Consultant to provide a training course for all staff (3 months)

- one person must be responsible for an EIS helpdesk for other parties involved from outside the MEPP

For the Hydrometerological Administration:

- one additional administrator

After two years and/or the implementation of the recommendations included in this strategy, staffing and other resource needs should be re-examined and fulfilled.

9.4 TRAINING

System administrators and users will need tailor-made training in order to integrate rapidly the new hardware/software with that already in place. The goals of the general training courses should be not only to enhance technical skills but also to share information, identify issues and build consensus on how to deal with future requirements.

List of training needs:

- Database server administration
- Data-warehousing and data-mining
- Web-services
- Lotus Domino administration
- Microsoft server/network administration
- Linux administration
- Application programming (Delphi)
- Anti-virus, potential dangers when using Internet and e-mail; use of passwords
- Public Key Infrastructure implementation with use of Digital Certificates
- Introduction to GIS

The best way to tackle the general training need would be to make a contract with one local software company to provide two IT consultants for about 3 months. Such courses should cover general user needs but also provide on-the-job training. Such a contract would cost around 10.000 €. For the administrators, the training must be defined in accordance with the personal training needs of the users. One study tour for 3 administrators one week to Copenhagen EEA should be planned for 2004, affording an opportunity to discuss the future needs of EIS with the specialists.

9.5 COOPERATION OUTSIDE THE MINISTRY

From the technical point of view, the implementation of an EIS presents no great problem. The budget available will be the limiting factor on the design of the roadmap as to which hardware or software will or will not be added, but winning over and motivating people to cooperate with the MEPP will be the crucial task for the success of this Strategy. In order to achieve this, several activities will take

place in accordance with the Environmental Communication Strategy and Vision 2008. These activities are presented in the table below:

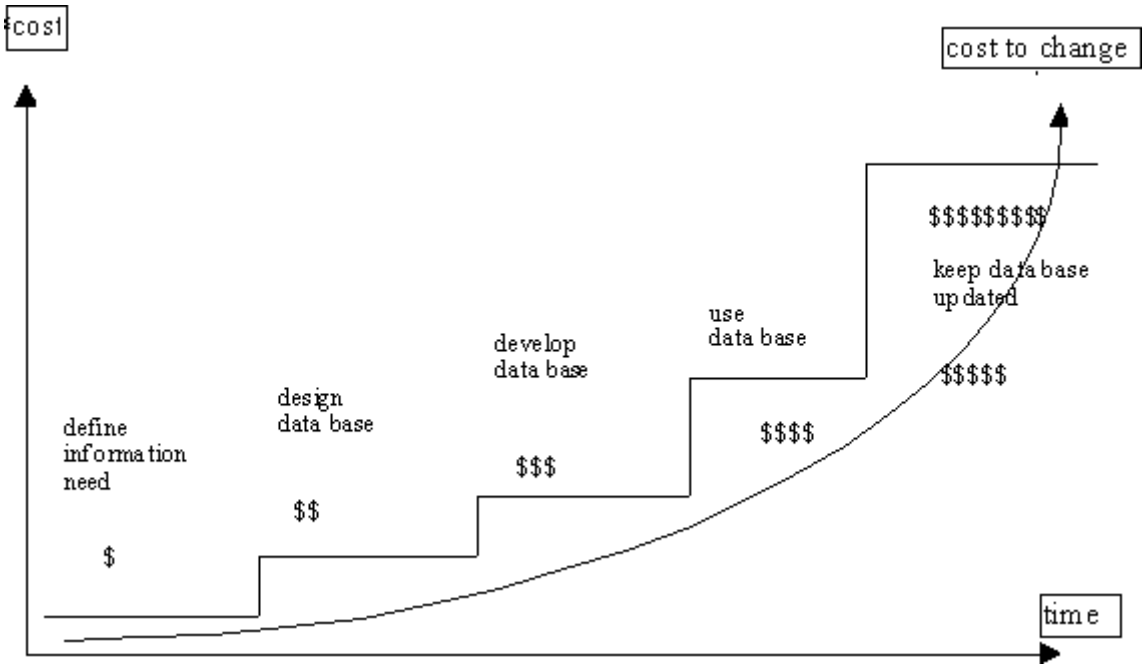
Table 6. Institutional activities related to the development of the EIS

Name of Activity	Competent Body	Description
Short-Term (2004)		
Establishment of a steering committee	MEPP/MEIC & other involved parties	A steering committee will be established, involving internal and outside information users and providers. It will meet on a regular basis and its role will be to: - Identify the needs for standards, equipment, software, training and other common activities - Coordinate activities - Exchange information and experience - Recommend standards for data management and exchange
Teambuilding process	External/ international moderator	Professional moderated teambuilding workshops will be conducted to bring together the involved parties inside and outside the Ministry with the objective of developing working cooperation networks and minimizing possible frictions.
Workshops with other Ministries and government institutions	MEIC using international moderator for the first workshop	Other Ministries will be informed about the EIS and invited to take advantage of it as well as to contribute information they may have. Special care will be taken to use synergies, cooperate with other Ministries and organisations (e.g. the EIS can help earthquake control or disaster prevention by providing information about hazardous material used and stored in company sites).
Donors' workshop	MEIC, donors	Donors will be invited to a presentation on the progress and future strategy of the MEIC and the EIS. Funding possibilities for subsequent steps will be explored.
Short to Medium-Term		
Taskforces between the Ministries for better cooperation	MEIC & other Ministries	**Taskforces** will be established between the organisations in order to accomplish specific technical tasks, such as securing communication

Name of Activity	Competent Body	Description
and synergy		lines, development of databases or ensuring data compatibility.
Workshop with industry	MEIC, Chamber of Commerce	After implementing the GIS module, specific workshops to build cooperation with the industry will be organised in relation to polluter reporting obligations and methods in the framework of the IPPC.
User Workshops	MEIC, external institutions, NGOs	User workshops will be organized with all stakeholders to share information and enhance motivation for using the EIS. Feedback on accessibility, relevance of information and demand for new information and services will be sought at these workshops.
Service Providers' Workshops		Training workshops will be organised regularly with all institutions/service providers who collect data, to give advice on how best to collect data.
Medium-Term		
Information for the public	MEIC	To increase demand, the EIS will be publicly promoted using approaches developed within the awareness-raising campaigns (see Environmental Awareness Strategy) One possibility is to provide an award to art students for the best design of an EIS Poster in cooperation with universities.

Chapter 10 MAINTENANCE AND FUTURE DEVELOPMENT COSTS

Figure 10. Costs of Design Change



Cost for design changes rise exponentially with the stage of the system implementation. The third generation of EIS, providing interactive information software for public users, are very expensive. Today such software is tailor-made and expensive, but standardized and affordable software will be developed within a few years.

Data acquisition is clearly the most costly exercise (barring technical assistance costs) during the implementation phase of EIS. This includes the costs of data purchase (e.g. satellite images and other digital data) and any necessary consultant service for the database development (e.g. image processing). Disregarding staff salaries for technical assistance, data acquisition costs usually comprise 50 % and upwards of the project costs. The following internationally applied formula gives a hint of the costs distributions:

Data collection: software: hardware = 100:10:1

Based on background description and experience from research work on the economics of GIS/EIS, one can assume that governments in countries in transition can also benefit from employing new information technology in an

economic way and increasing the value of existing and new information by introducing EIS.

Our ecosystem is a fine balance between areas and sectors, such as the quality of water and air, the development of forestry, agriculture, fisheries and industry, climate and population, wildlife, biodiversity, etc. A variety of government ministries and independent institutions are responsible for various parts of this ecosystem. Lack of co-ordination and co-operation between these parties constitutes the normal state of affairs. A Ministry of Environment, or any other body given a mandate to co-ordinate these efforts, needs an integrated system in order to put together and analyse data from the various sectors. Sector-integrated information presented in an easily understandable way is a basic tool for improved decision-making.

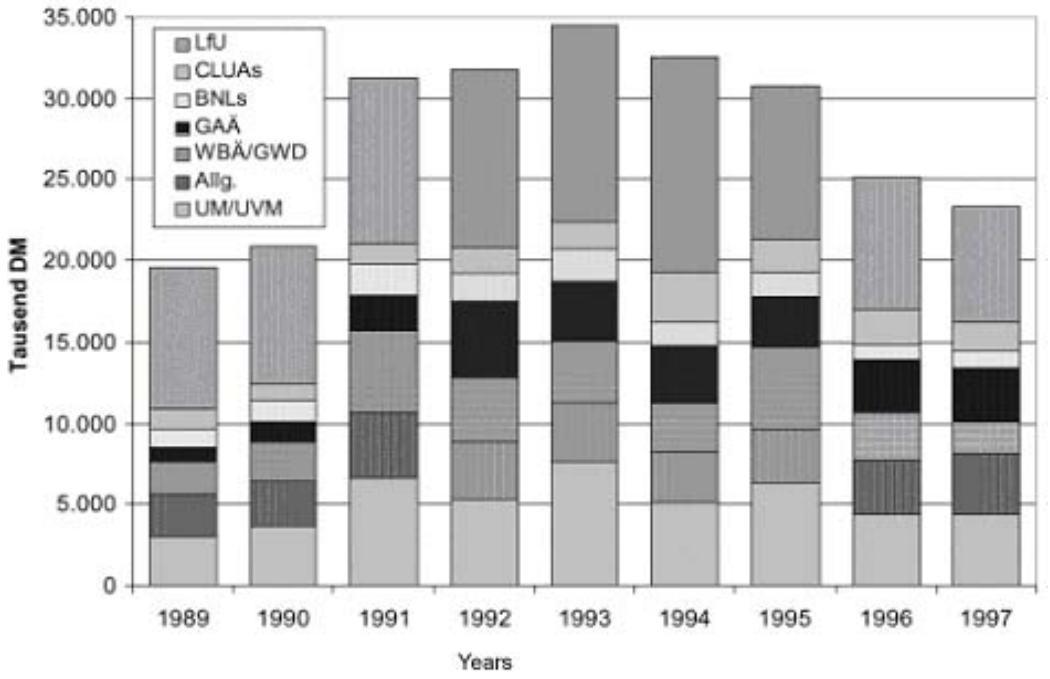
The establishment of an EIS in a country is the only cost-efficient way to improve this situation; no alternatives are known besides those of the status quo. In order to give the country access to proper EIS technology and data sets, management tools and the sharing of experience with similar systems in other countries, the system should be internationally compatible.

Let us illustrate this by using two typical examples of hindrances to maximum distribution of the benefits of information; examples which we assume to be characteristic of most developing countries today.

First is the example from **Lesotho**. This example is characteristic of the situation in most developing, and also in many developed, countries. Eighty major development projects in various sectors in Lesotho were investigated. Each and every project, without exception, needed geographical information as a basic input. And, even more interestingly, 50 of the projects produced geographical information useful for environmental assessment and resource management. In all 80 projects, a great deal of time and money were expended in the collection and integration of incompatible data from various sources. In most of the 50 projects that produced environmental or resource information, this information was simply discarded at the end of the project. In the best cases, information was filed in the form of reports. On completion of these 80 projects, the general availability of environmental information in Lesotho was not improved at all. If a national Environmental Information System is established, project-oriented information can be accumulated in a systematic way and shared with new projects in the future. The value of information can be increased many times if it is taken care of and made available in standardised form. An EIS in Lesotho will contribute to the increased value of information and better resource management and protection of the environment in Lesotho in the future.

The following figure shows the annual costs of EIS LFU **Baden Württemberg.**

Figure 11. Annual Costs of EIS LFU Baden Württemberg



This state-of-the-art EIS (see also Figures 2 & 2.a.) has more than 2000 IT user locations, several internal clients/services for other administrations and handles more than 400.000 000 data items per year. Compared to this, we can calculate the annual costs for an EIS in the Former Yugoslav Republic of Macedonia down to 100.000 – 150.000 € in the coming years. Larger countries—such as Uganda, for example—incur 500.000 € annual costs maintaining a EIS. Of course, each extension of the monitoring system will add investment costs, amounting to around 140.000 € for each automatic air monitoring station (mobile stations cost easily up to 180.000 €), or around 200.000 € for a mobile laboratory.

For the next 2 years we have calculated costs as follows:

- Closing the gaps/ consolidate the status quo of MEIC: 35.000€
- A new server and new GIS software: 25.000 – 35.000 €
- Contract with a local software company for programming
- Additional staff
- Contract with IT Consultant for general training: 10.000 €
- 128 k line: 200 € investment cost and around 500 € per month
- Training for the administrators: 15000€
- Study tour to Copenhagen for 2 administrators: 3000€
- Set of workshops 3 each year
- Teambuilding process with international moderator should be linked with the first workshop for all involved parties: 5000 €
- Press material (poster/folder/flyer): 3000 €
- Hardware/software update for Hydrometeorological Administration: 35000 €

Chapter 11 STEP-BY-STEP PLAN

Table 7 describe the necessary technical steps to be taken.

Table 7. Necessary Technical Steps

	Activity	By	Description
Short-Term			
1	Create & document a security policy	Expert group from MEIC & consultants	The existing equipment in MEPP (managed by MEIC) was provided from several sources. The usual approach was to configure the new equipment according to the pre-existing one. Due to the constant lack of sufficient IT staff, most of the activities were not documented. Certain security policies were implemented, but they are also not documented. Emergency procedures also have to be developed and well-documented. This activity will make clear identification of who can access which data and which kind of access will be provided to different users.
2	Develop a software application	External company	The 'core' component of the EIS. Most of the necessary steps, such as establishment of LAN, installation and configuration of servers and communications, dataflow identification and definition, have already been undertaken. In other words, the necessary technical requirements exist and it is necessary to develop the software part of the system as soon as possible. Main roles of the application are: to store all existing environmental data, simplify report generating process, automatically create standard reports, provide (www) access to the public. This will result in far better security, provide centralised backup, provide searching capability, automatic data processing, etc. End-user training must be organized and user-manuals must be produced. This will ensure a sufficient number of trained users capable of conducting routine

	Activity	By	Description
			obligations.
Short to Medium-Term			
3	Procurement and installation of new equipment at MEIC	MEIC	During the analysis of the MEPP LAN infrastructure, several gaps were discovered. The gaps comprise a small amount of additional hardware, hardware upgrades, supporting equipment (server racks), software products, services and training. More detailed description in Annex 2
4	Review of design and implementation of the software application	IV&V	Designing and implementing an Information System is a very sensitive task, i.e. a small error can make the whole system completely unusable. For this reason, an Independent Verification and Validation from an external institution/company is needed. This process will give answers to the question: Are we building the right system?
5	Testing the software application	MEIC, IV&V	The testing phase is the first necessary step after development and before real deployment of the software. During this period, all functionalities of the system must be tested and all malfunctions (if any) corrected.
6	Testing backups and database restores	MEIC	Backup of environmental data is imperative. The central database concept permits the efficient and speedy backup of all environmental data from one source. A daily, weekly and monthly backup routine should be implemented and adhered to at all times Another point is system up-time. This is a very important indicator for the system's availability. In many cases when a problem occurs, the only possible solution to bring back the required services is backup restore. Therefore, creating backups on a regular basis and testing the data restore is one of the key procedures that ensure maximum system up-time.
7	Employment and training of staff	MEIC, external institutions	To perform the functions required to manage the EIS, the MEIC must have a sufficient level of suitably qualified staff. At present, each staff member in the

	Activity	By	Description
			MEIC has more than one area of work and is stretched to cope with the work that presently exists. To cope with the existing work and also prepare for the increase in workload, greater staff numbers must be procured. Extra job positions must be created to fulfil requirements in new areas that will be produced by the implementation of this part of the project (database administration, web maintenance and administration, etc.). In order to be up-to-date with the technical developments, it is of a great importance to have frequent staff training as a means of ensuring that the personnel is capable of mastering the current technology level. IT trainings must be performed at least every six months. Training is especially important for the administrators due to the fact that current IT knowledge is outdated within 18 months.
Medium-Term			
8	Presentation of the system to stakeholders and user training	MEIC, stakeholders	Stakeholders must be aware of the existence of the EIS and its capabilities. We can say that the EIS will be fully functional when stakeholders start to use the system. Again, training for the stakeholders must be organized to ensure that they will be able to exploit its advantages.
9	Definition of data exchange protocols	MEIC, external company, partner institutions and consultants	Overcome current communication difficulties. For this purpose a Book of Regulations on the type, size, format and time of data submission and reporting should be developed.
10	Develop interfaces to data of existing systems at major data-providers.	External company	Even with the basic definition of the EIS, some environmental data will be automatically available on the MEPP's website. It is expected that the information provided on the MEPP's website will be sufficient for most of the interested parties. However, for cases when more detailed information is needed, proper interface and/or procedure must be provided.

	Activity	By	Description
11	Implementation Guides – intended for stakeholders who submit data to the EIS.	MEIC	Data exchange (submission) has been a big issue during the past years. After development of the Book of Regulations on the type, size, format and time of data submission and reporting, an Implementation Guide for external stakeholders must be developed by the MEIC. This guide will simplify and optimise the transition from current data submitting practice (mostly on paper) towards more practical and efficient electronic data exchange.
Medium to Long-Term			
12	Integration with GIS software	Expert group from MEIC, Office for GIS at MEPP, consultants	Spatial data fields should be implemented in the EIS to facilitate GIS integration
Long-Term			
13	Definition of data-warehouse	Expert group from MEIC and consultants	Data warehousing is a way to enable easy access to all data that is collected. The warehouse holds a snapshot of data from each disparate application. Data is loaded from the sources into the warehouse at specified intervals. In the past, this was commonly done on a monthly basis, as it was felt that the broad decision-maker type questions did not warrant the expense of more frequent data feeds. However, as decision-makers have come to rely on data warehousing and costs have come down, the data feeds have decreased to a weekly or even daily basis. The data in the data warehouses is usually structured as relational tables that are read-only. You can look at it, but if you want to change anything you do so back in the source application.
14	Addition of multimedia capabilities to the EIS	External company, IV &V	
15	Addition of module for simulation and forecasting	Expert group from MEIC, external company and consultants	

Chapter 12 REFERENCES

A wide range of documents has been reviewed in the course of the assessment, some in more detail and some in a more general way. The most relevant documents consulted are listed as follows:

- MEPP, National Environmental Action Plan NEAP, 1996
- MH, National Environmental Health Action Plan NEHAP, 1999
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- EAR (report by Krüger, VKI and Symonds), Phare Project 98-0377.00: Waste Water, Water Quality and Solid Waste Management in the FYR of Macedonia, 1999
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- JICA, Study on air pollution in the FYR of Macedonia, 1999
- EAR (report by J. Novak), Needs Assessment and Preparation of Tender Documents
- EAR (report by DEVCO), Phare Project MA-9702.0101: Institutional Strengthening and Capacity Building, FYR of Macedonia, 1999

Chapter 13 ANNEXES

Annex 1: Contacted institutions

Annex 2: Rules of Procedures

Annex 3: List of Core Group 6 and Working Group 6 Meetings and List of WG6 members

Annex 4: Current State and technical needs

Annex 5: Software Standards of EEA and EIONET

Annex 6: EIS in other countries

Annex 7: Simulation and Forecasting Models

Annex 8: Methods for Calculating the Economic Value of EIS

Annex 9: Assessment of Current Data Management Systems