Midas

An example of an environmental data strategy

This report is part of a package of projects launched by the Danish Ministry of Environment and Energy for the support of the European Environment Agency (EEA). The scope of the report has been defined in a co-operation between the EEA and the Danish Environmental Protection Agency (Danish EPA).
The project was initiated in February 1996 and completed in December 1996.

1. Preface.

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Why have an environmental data strategy ?

The main task of the EEA is to produce and present environmental information for the use of decision makers so that they can take the requisite measures, so that they can assess the results achieved, and so that the public is properly informed about the state of the environment.

Environmental data are also important to the Danish EPA that uses them as a basis for its work. To improve this data basis the EPA has set up a data strategy that defines the objectives and ways of achieving them. It focuses on areas such as:

- organisation
- human resources
- data technical prerequisites (set-up of databases)
- data contents

The Danish EPA has since 1991 been developing and implementing its environmental data strategy, called MIDAS (in Danish an acronym for environmental data strategy). The MIDAS-project was initiated because there was an awareness of the necessity of having a comprehensive, well-organised and easily accessible set of environmental data at hand for the Danish EPA in decision making processes at all levels of competence.

Part of the experience from the process of developing and implementing such a strategy can be relevant to organisations such as the EEA. Still it is important to emphasise that the aim of the project is not an adoption of the elements of the MIDAS project by the EEA, but an attempt to pass on the experience gained in the Danish EPA and thereby provide inspiration for such work in other organisations.

Objectives.

The main objectives of this project are:

* To transfer knowledge and experience of the MIDAS project to the EEA

* In brief to examine a few relevant data strategic elements from other countries / agencies

* To contribute to the development of the data strategic work of the EEA and the EIONET

* To supply ideas for combining and presenting key data

Scope of report.

As already mentioned the main idea of this report is to present the experience gained from developing and implementing a specific environmental data strategy; and to make some suggestions as to how this experience can be used in an EEA context.

Data strategic initiatives of other agencies are therefore only discussed as a supplement to the MIDAS strategy and to broaden the perspective.

It should also be mentioned that the questions of hardware-strategies, computer networks etc. are not relevant to this report. It is the questions of organisation, identification of data needs and the use and presentation of data that are in focus in this context.

Structure of report.

This report has three sections: Section I supplies context and background for the report. Section II describes the component elements of the MIDAS project itself, and section III discusses the perspectives of applying data strategies in organisations.

Chapter 1 and 2 make up section I. Chapter 1 is the present chapter, and chapter 2 provides the background for the development of the MIDAS strategy.

Section II starts with an answer to the question: how was the task carried out (chapter 3). This chapter also provides a short presentation of all the component elements of the strategy. The most important of these elements are then presented in detail in the following chapters: in chapter 4 the conceptual framework. In chapter 5 the thematic analyses. In chapter 6 the structuring / levels of data. In chapter 7 the idea of an environmental key data system. Finally, in chapter 8 the implementation of the MIDAS strategy is discussed.

Section III begins with a discussion of organisational parallels and differences between the EEA and the Danish EPA. Experience from the United States is reviewed and some important preconditions for implementing data strategies are summed up (chapter 9). In chapter 10 approaches to further development in both the Danish EPA and the EEA are discussed Chapter 11 sums up the conclusions and recommendations.

Chapter 12 presents an executive summary of the whole report.

Acknowledgements and sources of information.

This project was carried out by a project group consisting of Annelise Ravn and Kit Clausen of the Danish EPA.

We have received invaluable help from colleagues working with or having worked with environmental data strategies. From the EEA, especially Jef Maes and Sigfus Bjarnason have been involved in the project. Furthermore we have had discussions with a.o. Lynn Singleton of the Washington State Department of Ecology, Steven Newburg-Rinn of the US EPA / Washington DC, YanChing Zhang of the US EPA Scientific Visualization Centre and Reena Shah and Peter Bartelmus from the UN office of Statistics.

We would like to express our thanks to all the people we met in connection with the making of this report for the kind support and valuable information received.

2. Background.

This chapter describes the starting point of the MIDAS project: the situation with regards to environmental data in the Danish EPA back in 1991; the prerequisites for the start of the project; and the setting up of the task force to carry out the project.

What is a data strategy in the 'MIDAS' sense of the term ?

First of all it is relevant to define what is meant by the term 'environmental data strategy' when it is used in a MIDAS context.

Environmental data strategy in this sense of the word is the setting up of a set of clearly defined objectives and an action plan to reach these objectives. It should be based on an analysis of the state of affairs, of problem areas and useful experience. The experience aspect is useful for supplying ideas and concepts for the action plan. The action plan should set up realistic suggestions for activities that cover all the important aspects of environmental data work: organisation, data contents, human resources and database aspects (cf. chapter 3).

It was with such a concept in mind that the MIDAS project was launched.

The idea of having such a strategy is of course to improve the performance related to environmental data in the organisation: defining needs for data; collection of data; storage, manipulation and presentation of data. The overall objective is to improve the performance of the organisation by improving the basis of environmental data on which (part of) its work is built.

The point of departure.

At the starting point the data work of the Danish EPA was characterised by these facts:

- the computer technological starting point was satisfactory as the computer systems were fairly standardised, all terminals were linked to a common network and a standardised code system was used for nearly all environmental data. That provided possibilities for sharing data and combining them across data-bases and fields of expertise.

- most of the staff was familiar with the use of computers, and there was a growing awareness of the importance of having and using environmental data

- when it came to data contents the selection was often too limited and often too much defined by 'local' interest, viz. the interests of individual staff members or departments rather than the EPA as a whole.

- the external co-operation on environmental data was often difficult and lacked co-ordination.

- in the EPA the co-operation between departments was often weak, and there was a tendency towards what the MIDAS task force termed 'departmentalisation', viz. wanting to use data collected by other people or departments, but not being willing to let them use your data.

- the existing data were not utilised in a satisfactory way, and often they were only accessible to a very limited number of staff members.

- the approach to working with environmental data was very traditional: either you focused on emissions or you focused on the environmental state of the recipients. Data on the behaviour of the polluters, on environmental impact, on economy, on regulation etc. were scarce.

There was an awareness of these problems in the EPA, but often in a more vague form: an awareness that things could be improved, without being able to pinpoint the exact problems or their causes.

The organisational prerequisites.

The MIDAS project was started at a time when a new organisational set-up had provided important preconditions for the idea of setting up an environmental data strategy. A new department had been formed: the Research and Development Department. One of its main tasks was to look into the way environmental data were handled in the EPA. Furthermore, resources were allocated for the task in this department and in the Data and Information Department.

The management of the Danish EPA put much focus on the project and the facts that they fully supported the idea and that they expected the strategy report to be delivered by the summer of 1992 were important.

To understand the background and the scope of the MIDAS project, it is important to have in mind that environmental data is *not* the main raison d'être of the Danish EPA. The main task of the EPA is environmental administration. This includes advising the minister; administering environmental legislation; regulation of environmental conditions related to domestic and commercial sectors as well as energy and transport sectors; regulation of waste deposits; tasks related to groundwater and surface water, air, climate, chemicals, pesticides, bio-technology, noise , recycling and clean technology. Tasks include making proposals for legislation; making reviews and action plans; handling authorisations and complaints; making inspections and control; advising counties and municipalities; dispersing information and handling subsidy schemes - and collecting and handling information and managing monitoring of the environment.

Environmental data is vital in this work as a tool for

- assessing the state of the environment
- pinpointing problem areas
- prioritising efforts
- suggesting new initiatives
- forecasting development in the state of the environment and effects of new initiatives

- assessing results of regulations

Thus, when it comes to tasks and objectives, one of the most important difference between the Danish EPA and the EEA is that while collecting and dispersing environmental data is so far the most important task of the EEA, it is only one among many tasks of the Danish EPA.

MIDAS: the task and the task force.

With the establishment of the Research and Development Department it was decided to set up a task force within the agency with these terms of reference:

a. evaluating the data work of the Danish EPA so far; pinpointing problems and analysing useful, positive experience

b. setting up a strategy to ensure the best possible data basis for the work of the Danish EPA. The strategy was to devise an action plan defining what steps to take to obtain such a basis.

The task force members were staff from the Research and Development Department, the Information and Data Department, and the Department of Economics. This last department was included because of its expertise in economical data on the environment, and because this department was at that time responsible for Environmental Statistics in the EPA.

3. The approach of the MIDAS strategy.

We have just looked into the background for the initiation of the MIDAS project. This chapter describes how the project was carried out and in brief what the main component elements were.

The overall frame of reference of the analysis.

When looking at the data work of any organisation there are four main factors to take into account. These factors are depicted in this figure:

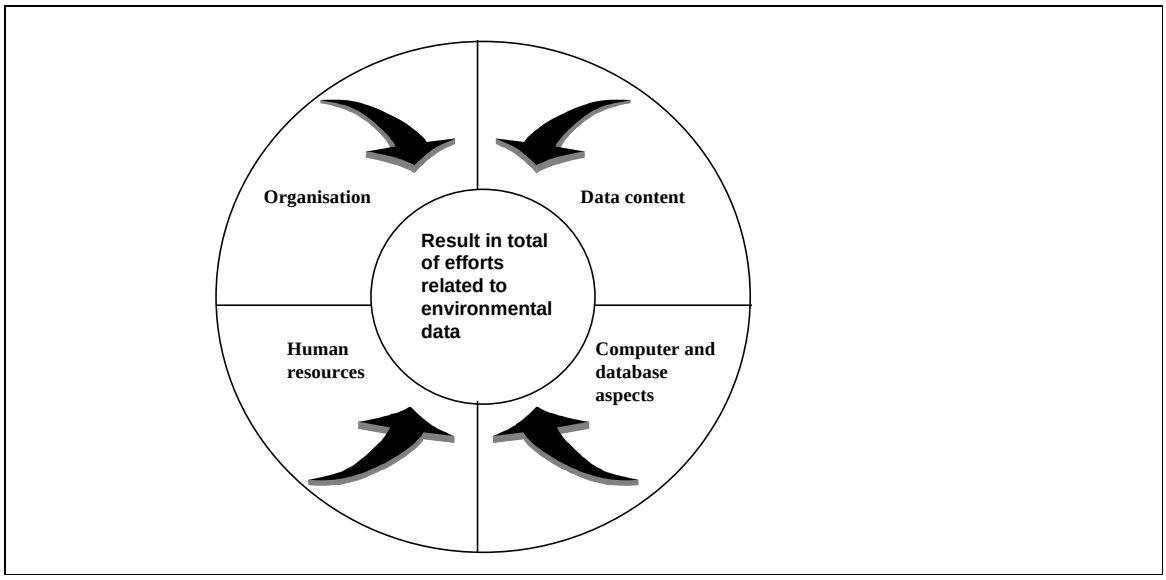

Figure 3.1: The factors deciding the outcome of data work.

These four factors are crucial for the result of the efforts related to producing environmental information. Therefore it is important to take all of them into account when assessing the data work of any organisation and when setting up strategies and action plans.

Organisation is the division of responsibility and competence; it is the way that the interrelationship between different data and different persons working with data is secured; the way that resources are distributed; and the way that the organisation co-operates with other organisations on environmental data.

The computer and database aspects are related both to the hardware and software equipment, and to the technical development and set-up of the databases. The development of (environmental) databases is a complicated process. It stretches from the hatching of the idea to the first report is produced on the basis of the data base. It does not only apply to the production and use of isolated databases, but also to the overall concept for the organisation of databases, their use and their inter-relationship.

Data contents or the subject matter of the databases must be in accordance with the needs of the organisation to be of use as a resource. This is not as simple as it might seem. To decide what data are relevant, you must have a clear picture of the objectives

for the work of the organisation. You must have an overall picture of the world in which the organisation operates (in casu the interrelationship between society and nature and the problems created by it). And you must be able to analyse in some detail the problems that it is relevant for the organisation to look into.

Human resources are important for the quality of the environmental data work. This is especially related to the *use* of data. This must based on the knowledge, expertise, experience and software tools at hand. Important is also the way we 'perceive' data - what kinds of environmental data are relevant ? How are they to be used etc. ?

This approach was a framework that was important in shaping the MIDAS report. In the work process focus was on organisation, data content and human resources. The question of computer and database aspects was e.g. taken care of through the production of a short manual for making databases. It is an important point that this aspect was in the MIDAS context mainly related to the structuring of data and the organisation of data in levels.

The phases of the first part of the MIDAS project.

The first part of the MIDAS project was the period until the publication of the strategy report. The work process at this stage was divided into 3 partly overlapping phases:

1. The status and problem analysing phase.
2. The experience analysing phase.
3. The strategy establishing phase.

The status and problem analysing phase.

The status and problem analysis phase was carried out by a series of interviews with members of staff in the different departments of the Danish EPA.

The aim was to establish an overview of the state of affairs in the area of environmental data: what computer-based data were available ? What computer-based data were needed ? What were the main problems and obstacles in data work ? How many resources were used ? What were the priorities ? How were things organised ?

At this stage it was not possible to go into any detail. The interviews only provided an overview, but it was realised that it would be necessary to go into greater detail at a later stage, cf. chapter five.

The result of this work was a list of main points describing the state of affairs. This was only a list of 'symptoms', and to be able to base the rest of the strategy work on this, it was necessary to analyse the *reasons* behind these symptoms. The analysis of the task force pinpointed these main reasons:

- internal organisation - at the time of the MIDAS report, one might describe the data work of the Danish EPA as decentralisation without co-ordination. It is important to underline that decentralisation in itself can hold many advantages. Decentralisation

of responsibility is often the best way to encourage creativity and interest at the local level. Nevertheless, *some* level of co-ordination is necessary to achieve the unity that is necessary e.g. to make sure that data can be used by more than one person and be combined with data from other databases. The crucial point is to achieve the right balance between co-ordination and decentralisation.

- external organisation is both related to the co-operation with the other parts of the Ministry and with other organisations outside the Ministry. Again the problem was to find the right level of co-ordination. Furthermore this area was much less well structured: there was a great number of stakeholders with very varying interests.

- demand for data decides supply of data. The analysis clearly demonstrated that the areas with an expressed external and / or top-down demand for data had most high-quality data. This was e.g. the effect of the Danish Aquatic Action Plan: it entailed an articulated demand for data to assess the state of affairs and the effects of the action plan. - Data were supplied in large amounts and furthermore used actively in the annual reporting. This was facilitated by the accompanying allocation of resources, cf. below.

  In other areas where the same demand did not exist the supply of environmental data was typically more scarce. In a situation with a limited amount of resources, the products that are in clear demand get the highest priority. Where data products were not in high demand, few data were produced.

- training and attitudes. Training programmes were typically focused on individual software tools and their use. This meant that there was no general training available in the production and use of environmental data. Furthermore, the time for trying out the possibilities of the different software tools was limited. This factor was important as the soft-ware tools were at that time fairly complicated to use. The computer system was terminal-based and the software tools were less user-friendly than they generally are today.

  This also meant that there was a general feeling that working with environmental data was complicated. Furthermore, there was a lack of knowledge of the potentials of working with environmental data, e.g. the possibilities for documenting and forecasting.

- resources. Because of the way tasks were prioritised, there was a fairly limited amount of resources for data related work. This meant that the hatching of new ideas was very limited and that there were problems with the quality of the data related projects.

Experience analysing phase.

The experience analysing phase was based on a couple of useful examples: the Danish Aquatic Action Plan and its monitoring programme and the work on environmental data in the Netherlands.

The Danish Aquatic Action Plan was well known to the members of the task force as the Danish EPA was the main agent in setting up the plan and the monitoring programme.

The Dutch experience was examined through a visit to the relevant ministries in Holland where key persons were interviewed and computer programmes demonstrated.

Some of the main points from these two examples of successful data work were the importance of these factors:

ON ORGANISATION:
Basing your work on a co-operation between organisations / departments with complementary expertise that in combination constitutes the best available knowledge on the relevant subject
Having some level of decentralisation / allocation of tasks to ensure involvement and flexibility
Regulating the co-operation through clear agreements and an active co-ordinating body to supplement the decentralised organisation
Regulating through well-defined ideas and concepts that helps ensure co-ordination and unity
Having clear, top-down defined (or defined from outside the organisation) objectives and expectations for data work. This is important as an incentive for this kind of work
Making sure that such clearly defined objectives are well known to all involved
Locating databases with the people that are the primary users of them and distributing responsibilities in a way that is clear to all involved

ON DATA CONTENT ETC.:
Basing your data work on a common 'view of the world' (or data model) defining the relevant objects and their interrelationships
Using standards and paradigms when collecting, exchanging and reporting data to make sure that data work at all levels is coherent and comparable
Basing work on a definition of outputs, and planning with the aim of providing the relevant products. This is the best way to focus your work and make sure that you do not waste time collecting and handling data that are not really relevant
Using data as a tool for politicians and other decision makers. Using data in the political process for identifying objectives, and prioritising and monitoring effects of regulations. This helps focus data work and give the necessary priority to it.
Using experience from the use of data in other sectors, e.g. the economic sector
Using data in models, forecasting etc. and using GIS tools for the presentation and analysis of data

ON HUMAN RESOURCES:
Having the necessary resources available and having a realisation of the necessity of providing adequate resources
Having inventive 'front-runners' that are able to act as initiators, resource persons and driving forces in the work related to environmental data in the organisation.

Many of these points were important as sources of inspiration for the MIDAS report.

The objectives and the strategy establishing phase.

The strategy establishing phase combined the symptom-and-cause analysis with the analysis of useful examples and with the general knowledge of the MIDAS task force on data work. Another important element was an analysis of the data-needs of the Danish EPA based on an examination of the tasks of the EPA, of the agenda for environmental policy and of different user interests.

The overall objective of inventing and implementing the MIDAS strategy was to establish a collection of environmental data that is coherent, consistent, quality ensured and easy to access. The data were to fulfil the needs of the organisation with a minimum of resources required.

Some of the main sub-objectives were:

Objectives on organisation:
Data must support everyday work
Clear statements and demands from management on data work
Data-work must be connected across departments, areas of work etc.
Decentralisation **and** co-ordination
Responsibility for databases must be placed with the people working with the relevant data
Access to all data for all staff members
Access to inventories of databases for all staff members

Objectives on data content etc.:
Data must be usable in a strategic context (trends, causes, consequences, priorities)
Data content must reflect overall priorities in the work of the Danish EPA and develop according to them
All data work must be related to products (reports etc.)
Rather few high-quality data than large quantities of data that are not used
Use of data in models etc. is important

Objectives on human resources etc.:
Realism in relation to the outputs of data work in a situation where resources are scarce

The final report containing the strategy and action plan was presented in the summer of 1992.

Main elements of the strategy.

For the Danish EPA itself the central part of the MIDAS report was the establishment of a set of objectives and an action plan. For outsiders the means and methods (the toolbox) are the most important elements, as they are the parts from which most can be learned from their point of view.

Seen from this perspective, the most important component elements are these:

The conceptual framework defines the main categories of data relevant for most data work in the Danish EPA. It can be used as a sort of checklist when made into a form with a number of blanks to be filled in. The form is meant as an aid in the process of analysing the data needs. The idea is to make sure that any given environmental problem is described and analysed on the basis of a *comprehensive* set of data. Sectors in society are an important feature in the form. This is because they are important in environmental regulation as they are the target groups for most environmental policy. Other important elements of the framework are:

- data on the state of the environment related to the relevant environmental problem (quality indicators and defined objectives)
- data on the sources of pollution. Here the sectors in society are important. Especially emissions and behavioural patterns causing the pollution are relevant.
- data on regulation and administration in relation to the problem.

The conceptual framework is explained in detail in chapter 4.

The idea of having data in different levels to make it easier to combine data and in this way make better use of the existing stock of data. In the MIDAS report this involved the development of a hierarchy of data according to level of detail and form of presentation. And it involved having a computer based *catalogue of databases* and a *database of common data* - data used in more than one data base and codified in a uniform way.

The idea of data organised in levels is presented in chapter 6.

The concept of thematic analyses was developed because it was impossible to go into detail with the problems and data-gaps in the different areas during the first phase of the MIDAS project. It was decided to go through the different areas one by one to make detailed strategies for each with the aim of improving the data quality in each area. An area is e.g. production and treatment of solid waste.

Chapter 5 supplies an example of a thematic analysis.

An environmental key data system was suggested in order to have a computer based tool for combining, structuring and presenting environmental information for decision makers. The system was to combine map-based data and graphic presentations of data (pie-charts etc.)

The environmental key data system is presented in chapter 7.

Guidelines and procedures for environmental data projects were important to make sure that the same concepts were applied for all the different database development projects in the Danish EPA. Main points were:

- focusing on products when developing databases, viz. defining the output in the form of e.g. reports or map-based presentations when developing the database. This was a way to make sure that the data were used for practical purposes and not just collected because somebody thought it *might* be useful.

- making it possible for all interested departments to join in the projects. This was to make sure that the data produced fulfilled the needs of all parties with an interest in the relevant area.

- technical standards for the development of databases to ensure a high and uniform database-technical quality and to provide the possibility for combining data across databases.

- the obligation to give a presentation to the staff of the EPA of the finished database so that all potential users know about its existence and know how to get information on the access to and use of the database.

Clear definition of responsibilities in the EPA when it comes to environmental data. The main principles here were 'co-ordinated decentralisation' and a combination of bottom-up and top-down approaches in bringing forth ideas for data projects.

The MIDAS strategy report also set down the responsibility for different specific tasks for the different departments in the Danish EPA.

Standard agreement with data suppliers to make sure that you do not have to go into complicated negotiations each time you want new data to be delivered. This part of the MIDAS strategy is at present (1996) carried out for the Danish Ministry of Environment and Energy as a whole.

Training courses aimed not at specific software tools but at the general concepts for working with environmental information: what are the phases of an environmental database project ? How do you get the data to put into your database ? What are the possible sources of data ? What are the important considerations when setting up a database ? How can data be presented ? How do you apply the conceptual framework of the MIDAS strategy ?

Strengthening the data co-ordinating group in the ministry. This proved to be a very important part of the implementation (cf. below) as it supplied a forum for implementing ideas together with some of the most important partners for co-operation on the area of environmental information.

Past part one of the MIDAS project - after the strategy report.

In the autumn of 1992 the strategy report was delivered to the management of the Danish EPA together with a memorandum summing up the recommendations and describing the way to carry out the action plan. This memorandum was endorsed by the management and phase 2 of the MIDAS project was begun by the turn of the year 1992 - 93.

The responsibility for the implementation of the strategy was shared between two departments of the Danish EPA: the then Department of Data and Information, and the then Department of Research and Development.

The first stages of the implementation was the carrying out of some pilot projects and - on the basis of these projects - an evaluation and adjustment of the strategy.

4. The conceptual framework.

In the previous chapters we have described the state of affairs regarding the collection and use of environmental data in the Danish EPA before the MIDAS project. The main points were firstly that we had many data on various subject areas, but that the overall degree of coverage was not high enough taking into account the very large range of needs for information in the EPA. And secondly that the possibilities for combining and presenting data across the different subject areas were generally poor.

From these conclusions the next question was how to perform a top-down analysis of the data needs of the Danish EPA.

The basis for analysis.

The basis of a top-down analysis should be a clear identification of the objectives and tasks of the organisation in question. The objectives define the criteria to be used when evaluating the progress of our efforts. In the case of the Danish EPA the primary objective could be defined as 'protection of the environment (against pollution)' - as the acronym EPA indicates. To reach this objective it is necessary to have information/knowledge/data concerning at least the following issues:

- development of the state of the environment (including pressure on the environment)
- environmental problems
- sources of pollution and their emissions
- administrative aspects such as legislation and societal economy

This chapter describes how these issues were handled in the MIDAS project, including suggestions for a conceptual structure. Finally the issues are combined in an overall picture of the world.

Data on the state of the environment

Data on the state of the environment are the kind of data usually referred to when speaking of environmental data. That is, data primarily describing quality aspects of the recipient in question. E.g. the concentration of oxygen in the sea, the amount of nitrate in groundwater, the concentration of CO_2 in the air etc.

The identification of a relevant set of parameters related to the various recipients is a continuos project which is often carried out under the headline 'environmental indicators'. The idea is to select among the numerous possible objects for measurement one or more parameters which are significant for the description of environmental quality. It is of course also crucial that the choice of parameters is realistic, viz. that it is possible to set up a monitoring programme producing the required time series of data.

Parameters / indicators are needed at many different levels of detail. At the most general level one could speak of indicators on the quality of air, water, nature and soil. Depending on your definition of the term 'environmental' it might also be relevant to

include indicators on urban areas and e.g. human health. At the more detailed level you may have indicators describing the water quality of every lake and stream based on measurements concerning the biological, physical and chemical state of the recipient in question.

The level of detail for indicators depends on your policy needs. The question is, at what spatial and temporal level do you need to document the state and trend of the recipient. In this context an important question is how to aggregate data from one level of resolution to another.

The most important use of data on the state of the environment - at least seen from an administrative and policy oriented view - is to get an overview of the development within the relevant area. Is the quality of the recipient getting worse or better?

For policy oriented purposes it is also useful to have data on the objectives for the various types of recipients and their different levels in the hierarchy. This information is used in combination with the indicators to survey whether the development of the state of the environment is satisfactory or not.

The possibility of combining these information types in a meaningful way presupposes that the objective and the indicator(s) are substantially equivalent or at least comparable.

If the trend deviates significantly from the objective, it is important to put some effort into the identification of the reasons for this, and if possible to take new actions to alter the development.

The pressure on the environment is another important aspect: what is the actual 'load' of various pollution-causing substances to the recipient in question?

The total pressure is of course identical with the total amount of emissions from all sources of pollution; but for any specific recipient, the actual pressure may very well differ from the summed-up emissions of the local sources of pollution. E.g. the imission of nitrogen to a specific lake can not be calculated just as the sum of nitrogen emissions from farming, sewage cleaning plants, air-borne depositions etc. Chemical, physical and biological processes influence the amount actually carried to the lake.

Our suggestion for structuring the relevant data on the state of the environment is for each type of recipient in question and for the different levels of detail:

Quality parameters/indicators	Defined objectives for environmental quality	Pressure (type and quantity)

Data on environmental problems.

In the formulation of environmental policy it is necessary to have detailed and sufficient data on the various environmental problems which threaten us both at local, regional and global level.

In one way data on environmental problems may be viewed as a subset of the data described in the former paragraph. Seen from this point of view an environmental problem is nothing more than a deviation from some state of normality or balance. However, in many contexts it seems reasonable to draw a distinction between general data on the state of the environment and data on environmental problems. And so we have chosen to do in this data model.

Data on environmental problems basically comprises two dimensions: location and gravity. Where are the problems located and how severe are they? The first part includes locating the problem in time and space (where and when/for which period), and the second dimension presupposes a set of parameters describing the problem.

As described earlier the identification of relevant parameters is not a simple task. Taking eutrophication as an example, one may choose to describe the problem as measured concentrations of oxygen in sea waters below a certain limit-value; or as the observation of widespread occurrences of dead fish in specific areas. The first parameter is in one sense the cause of the other as occurrences of dead fish may be caused by the low concentrations. Both parameters can equally well be said to describe relevant aspects of the problem.

Data on environmental problems are necessary for at least two reasons. Firstly, they give you the possibility of identifying the location and extent of the problem in question. Combined with knowledge of the causes of the problem (cf. the following section) this supplies you with an instrument for defining a set of regulatory initiatives.

Secondly, data on environmental problems should also be used to get an overview of the problem field as a whole. Sometimes the agenda of environmental policy is influenced more by the mass media focusing on conspicuous environmental catastrophes than by long-term, well-considered assessments of the gravity of the various problems. A solid basis of data on these matters might contribute to aiming the efforts in the right direction.

As was the case with data on the general state of the environment it is also in this case relevant to include information on quality objectives defined in existing legislation, international conventions or other types of regulation oriented towards environmental problems.

In this way the data needs in this area includes the following elements:

Location and extent of the environmental problem	Defined objectives for quality

Data on the sources of pollution

Seen from the point of view of a policy-oriented agency such as the Danish EPA this kind of data is of very high importance.

The task of formulating environmental regulation has over time been based on changing assumptions/views of the world. Focus has been shifting from cleaning up polluted areas, to using filtration techniques, to focusing on the sources of pollution, on human behaviour and on cleaner technologies[1].

To be able to define and implement regulation oriented towards change of 'behaviour' it is necessary to know a lot about the internal structure and existing patterns for activity related to the various sources of pollution, e.g. industry, agriculture, energy production - but also households, sewage cleaning plants and waste management.

The analysis of which set of parameters is the most important for each societal sector etc. should be based on a relationship between the various environmental problems and a relevant set of pollution sources. This relationship is based on knowledge of which emissions are causing the pollution problems in question.

Taking industry as an example, different sorts of industrial activities may contribute to different environmental problems, such as hazardous substances in water, air pollution and waste production. The task is to identify where and how the relevant emission-producing activity is taking place, and transforming this knowledge into data requirements. Sometimes it is possible to transform activity descriptions from one dimension to another, e.g. by setting up an equivalence between production and some sort of economic indicator.

Thus the relevant set of data describing sources of pollution encompasses aspects on structure and behaviour, socio-economic data, as well as estimations or measurements of emissions.

As was the case with data on the state of the environment and on environmental problems, information on existing regulatory objectives is also relevant here. E.g. it is important to be able to combine data on emissions of phosphorus from waste water treatment plants with the objectives for this kind of emission. Relevant data on sources of pollution can be categorised as follows:

Structural/behavioural aspects	Emissions (type & amount)	Defined objectives

Data on regulation.

There are many kinds of environmental regulation. As described above regulation may sometimes be oriented directly towards specific recipients and their level of environmental quality; towards specific environmental problems; or towards specific sources of pollution, e.g. societal sectors. Sometimes legislation comprises all these aspects.

[1] Although focus has been changing between the different strategies for pollution prevention all of them may of course be taken into use where helpful. The use of filtering techniques may well be used together with legislation on emission limits and the use of cleaner technologies.

Another way of viewing regulation could be based on a classification of the type of the regulation. Is it e.g. a law, a Government Order, a directive from the EU Commission or an action plan?

A third way of describing regulations is the spatial/geographical point of view: is it introduced at and oriented towards a local (municipal), a regional (county), a national or an international level.

Information on different kinds of regulatory actions may in this way be used and viewed from several relevant points of view. In connection with the MIDAS strategy we have chosen to focus on the substantial aspects of regulation more than on the formal ones. A way of characterising regulation in a useful way (at least for the Danish EPA) includes answering the following questions:

- which are the specified environmental objectives
- which measures are to be taken to reach these objectives
- what is the time schedule (when is the objective to be achieved)
- what are the estimated costs of the initiatives

An environmental objective may be to (re)establish a certain level of environmental quality; to reduce emissions (as a whole or from a specified set of pollution sources) to a well-defined quantity; or to try to impact societal activities in order to reduce an environmental problem.

Information on environmental objectives together with time schedules and estimates of expenditures constitutes a basis for evaluating the progress of efforts in the field of environmental regulation. Using a buzz-word from the management world an important critical success factor for these activities can be defined as: fulfilling the environmental objectives within the time limit and without exceeding the economic limitations.

Obviously it is very difficult to make such evaluations in practice, primarily because the problem area in itself is very complex. For example it may prove to be extremely expensive to make the necessary monitoring.

Based on an objective-oriented view a relevant sub-structuring of data on regulation could be:

Specified objective	Measures to be taken	Estimated time limit	Estimated expenditures

Data on economy

Just as in the case of regulation, economy may be viewed both in connection with environmentally oriented themes and as a set of data in itself.

Regarding the first point of view one might wish to connect societal and private expenditures and income with the treatment of specific pollution problems and also with different sources of pollution. E.g. it may be useful to know the societal expenditures

used for monitoring and cleaning up oil spill at sea. Or the expenditure on sewage cleaning plants at different levels of administration.

On the other hand viewing data on e.g. societal expenditures and incomes (taxes, fees) related to environmental protection as a whole may be interesting, especially if it is combined with knowledge of the different environmental problems and their severity, and of the sources of pollution. Are we using our economic capacity in this area in the right way, or are we e.g. using a lot of money trying to cope with a minor, but easily regulated problem?

Other kinds of economic data are of course also relevant. One way of describing the activity level of the private sector is to put economic figures on the specific trades e.g. gross domestic product at factor cost.

Another relevant set of figures concerns the EU subsidising in different fields of production, especially in the agricultural sector. Subsidising one specific crop or way of production may in this area have much more influence on the degree of pollution than many national action plans and legislative initiatives.

In the MIDAS concept we do not at present work with a general further structuring of economic data, apart from the connection to the other types of relevant data which has been described earlier.

The whole picture: a core set of data and a relevant set of views of the world.

A basic idea in the MIDAS strategy is that establishing collections of data on the different subject fields described above is not sufficient. Data are not put into real use (and made into relevant information) before they are viewed as a whole. That is, before a given subset of data (e.g. data on regulation) can be connected to and viewed from the other entries (e.g. environmental problems and sources of pollution).

Looking at e.g. regulation through a sector entry there is a set of laws, action plans etc. for reducing the pollution problems imposed by industry. Seen as an environmental problem entry such as solid waste, a subset of these regulatory data may be connected to the waste issue. But there will also be other relevant regulations connected to other sources of pollution, e.g. households and sewage cleaning plants.

Put together the basic concepts of the MIDAS strategy regarding data-structuring can be described as follows:

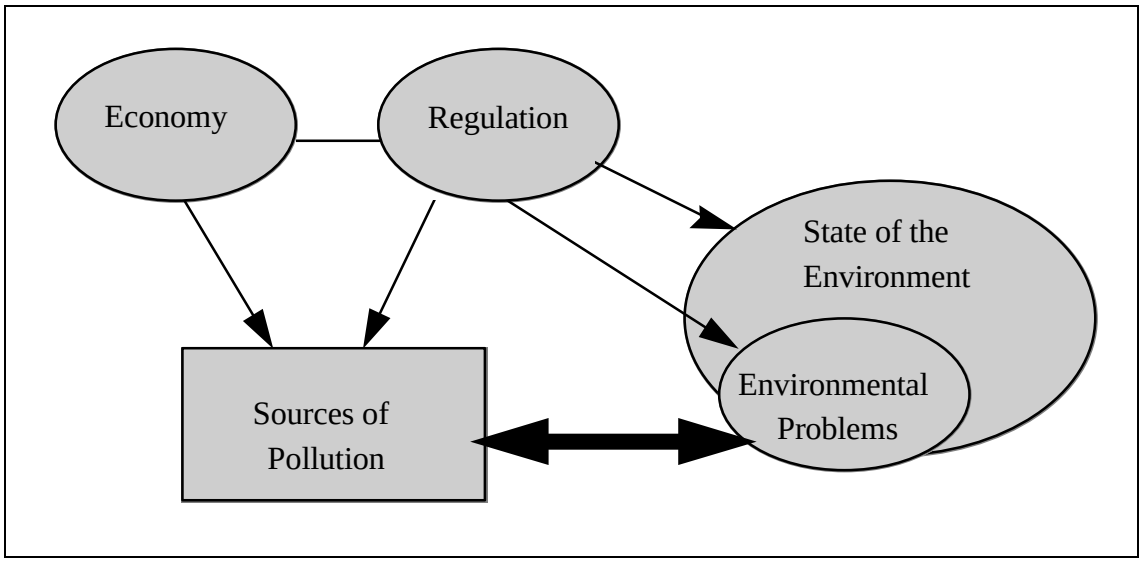

Figure 4.1: Basic concepts of the MIDAS strategy regarding structuring of data.

Ideally, every piece of information from the different areas

- state of the environment
- environmental problems
- sources of pollution
- regulation
- societal economy

should be connectable to the other entries or points of view where relevant.

The total collection of data may in this way be viewed as a prism where a slight rotation produces a different insight into the same core set of data.

5. Thematic analyses.

In Denmark there is a saying: 'What is the best way to eat an elephant ? - One bit at a time !'

This in a way is the idea behind having thematic analyses: they are a way of dealing with the problem that there are so many aspects of environmental management and thus also of environmental data. The idea is to look at subject areas one by one, but still without loosing the links between the different areas.

The objective of a thematic analysis is to assess the state of affairs in the relevant area; to pinpoint the problems and data gaps; and to set up recommendations or an action plan to remedy any short-comings. In a way it is a mini data strategy for a specific field of work. By going through the areas one by one you will eventually have covered the whole field in a way that allows you to go into detail with each subject.

To be able to do this it is important to have a framework for doing it. When making the first thematic analysis the MIDAS working group set up some rules of thumb for their work:

1. Look at environmental problems/themes, not at organisational departments.

2. Do not look at the object of analysis as an isolated issue - remember the data links to other environmentally relevant areas. E.g. data on chemical waste deposits are relevant to both industry (industry is one of the sources of chemical waste) and to ground water quality.

3. Base your analysis both on interviews, existing data bases and written material. Remember to ask both the users and the producers of data on the relevant problem.

4. When defining data needs and pinpointing shortcomings use the conceptual framework (cf. chapter 4).

5. Have a clear strategy when interviewing users and producers of data.

6. Put focus not on needs for databases but on products. Asking: "What databases do you need ?" does not lead to the same answer as "What products is it necessary for you to supply ?"

7. Use the methodology and line of action that was used in the general MIDAS strategy (cf. table 11.1, chapter 11).

An example: production and treatment of solid waste.

It was decided that the first subject for thematic analysis was to be the environmental theme: production and treatment of solid waste. This area had high political priority and it was realised that not all the relevant data were available.

Several departments in the Danish EPA had interests in data related to solid waste: especially the department working with the industrial sector and the departments working with recycling and waste production from industry and households.

The working method was simple: relevant persons in the different departments were interviewed and written material on the solid waste area was collected and scanned. The information was assessed against the conceptual framework (chapter 4); different action plans (one on waste and a more general one); the EU directive 91/156/EØF and against the general knowledge of the MIDAS task force on environmental data work.

The result was a brief 12 page report with the aim of consolidating and improving the access to and use of environmental data on solid waste etc. The report contained an assessment of the state of affairs; an analysis of the data needs not met and a set of conclusions and recommendations.

The report also included an analysis of the needs for data and the objectives of data work within the area of solid waste. This is important to be able to assess the state of affairs and pinpoint relevant areas of priority. It is also important that there is a clear connection between the objectives of data work and the general objectives for environmental management within the area. If for instance an increase in recycling has high political priority, high priority should accordingly be given to collection of data and establishment of a database on e.g. the development in the level of recycling of different products.

Data needs and objectives of data work.

The analysis of data needs and objectives for the data work centred around a model of the main component elements of environmental management (and accordingly data) in the waste area.

It is important to have knowledge and information on the regulatory tools themselves. And it is important to have information on the factors this regulation is aimed at: the waste itself and the import, production and consumption causing the production of waste; collection and treatment of waste; and the emissions caused by the treatment of waste.

The model in figure 5.1 supplies at one and the same time a depiction of the regulation and its objects *and* a description of the main categories of data needs.

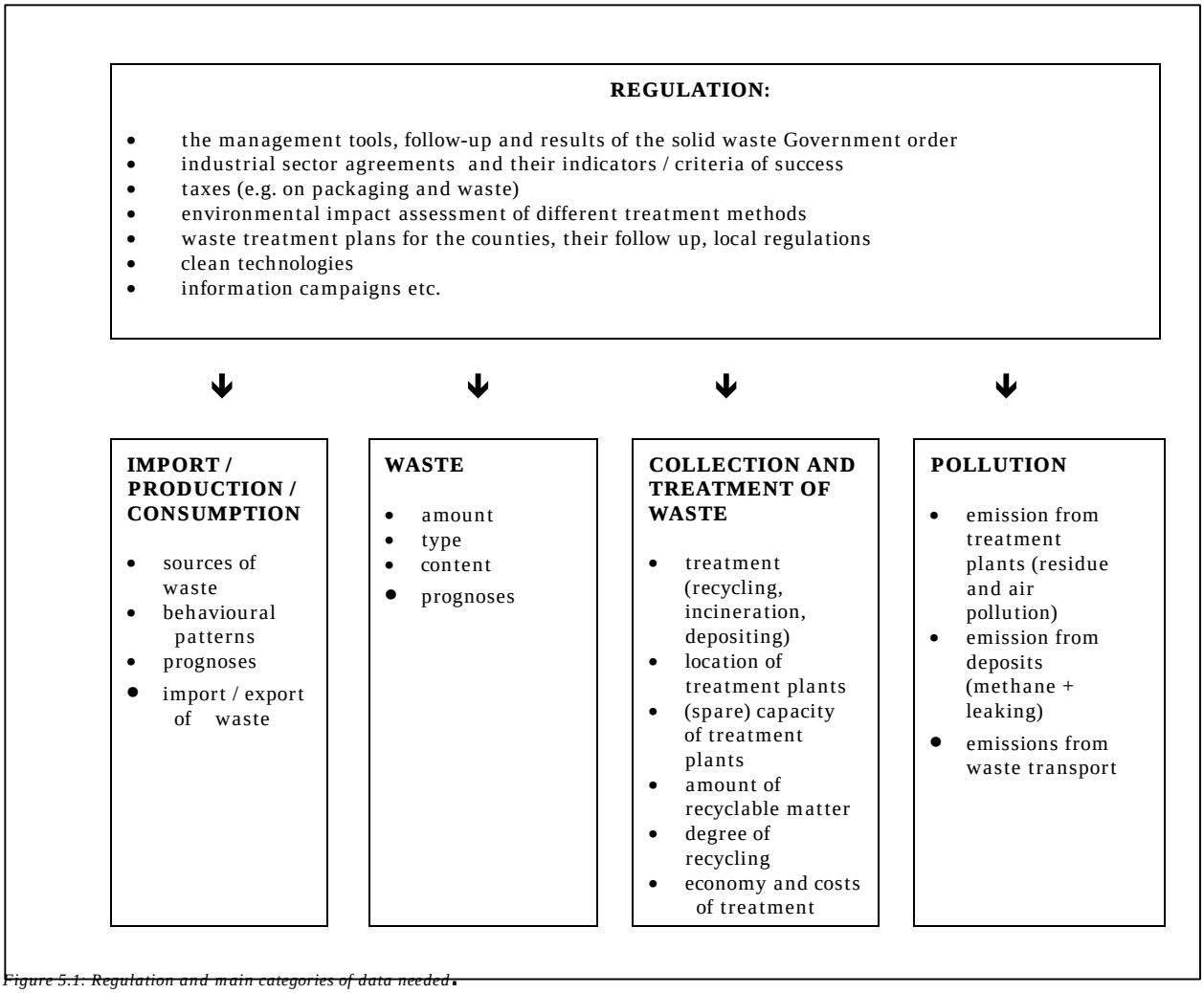

Figure 5.1. Regulation and main categories of data needed.

State of affairs.

This model was important when assessing the state of affairs and pinpointing the areas where data were needed. The existing data were described in their main categories, main external data sources were described and the main internal parties of co-operation were summarised. A main finding was that many reports contained important information, but that there was a need for more computer based information to make data more easily accessible, to ensure updating of relevant time series and make it easier to work with data.

Data needs not met.

Based on the two first parts of the analysis, a description was made of the data still needed. This was summed up in a table along these lines[2]:

[2] The column 'coverage' is not filled in as the information from the original analysis is no longer valid.

DATA FIELD	PRIORITY	COVERAGE	COMMENTS
MAPPING OF PROBLEM			
Amount of waste, types, composition, origin, treatment	1		ISAG database
Collected amounts of recyclable material, degree of recycling	1		
Waste production prognosis	2		Prognosis model needs data on industries
Data on packaging	2		
Composition of renovation	2		
Amounts and composition of industrial waste	2		Pilot study going on
	2		
TREATMENT			
Localisation and type of treatment plant / deposition site, economy and cost of treatment	1		New data will be coming in every 4th year
Emission from treatment plants	2		Taken care of via emission project
Environmental and economic assessment of alternative ways of treatment	1		
REGULATION / ADMINISTRATION			
Collocation of the waste treatment plans of communities and their regulations	2		Okay for 1st generation of waste plans
Behavioural patterns of producers and consumers i.a. seen in the light of:	2		
Different types of regulation, their costs and effects (e.g. industrial sector agreements, information, agreements on collecting waste	2		
Environment-economical analysis (in progress on organic waste, paper and beer cans)	1		
Economical data on collection and treatment of waste	2		
Effects of taxes	2		

Table 5.2: result of analysis of data needs.

Use of the conceptual framework.

An important part of the background analysis was the use of the conceptual framework. It was used to provide examples of relevant data; to describe data in connection / context; and to pinpoint areas where data were still needed.

A very simplified version of the result is this:

SOCIETY/SECTORS:				REGULATION:			
SECTOR:	STRUC-TURE:	BEHAVI-OUR:	CONTRIBUTION TO ENVIRON-MENTAL PROBLEM	OBJECTIVE	REGULATION	EF-FECT	COSTS
1: DOME-STIC	Number of households Waste production	Patterns of consump-tion Participa-tion in collection arrange-ments	Garbage from households	x % recycling	(Compulsory) collection arrangements 'Green' systems for recycling		Subsidies: x mill. DKK Establishment: x mill. for green systems, x mill. recycling of garden waste, x mill. recycling of large sized garbage
			Large sized garbage	x % recycling			
			Garden waste	x % compost			
			Chemical waste	Prevention	Clean technology Recycling Establishment of receiving stations		x - y DKK pr household.
2: INDU-STRY INCL. TRADE	...						
3: CON-STRUC-TION	...						
4: ENER-GY	...						
5:TRANS-PORT	...						
6: AGRI-CUL-TURE	...						
7: RECYC-LING (PLANTS)	...						
8: INCIN-ERATION	...						
9: DEPO-SITS	...						

Table 5.3: Background analysis based on conceptual framework.

In the original form, the areas with no data were marked. The state of affairs has changed since then, so that the marking is no longer relevant. With many other environmental problems, there would of course also have been a column for environmental quality at the far left. In this context this was not included as waste is so closely related to sectors and to regulation. The way that waste affects environmental quality is included in the column 'contribution to environmental problem'.

Conclusions and recommendations of the thematic analysis on waste.

The conclusions centered on the use of report-based data versus computer-based data; on the use of resources for data work; on the potentials of the ISAG-database (production and treatment of waste); and on the main categories of data needed.

Some of the most important recommendations were:

- the establishment of a database on spare capacity of treatment plants
- the establishment of a recycling database
- use of data on waste in a key data system
- identification of relevant economical data
- high priority to ISAG database
- clarification of relationship to important suppliers of data
- clarification of internal channels for co-operation on waste data in the EPA
- focus on publication of data

These recommendations were presented to the management of the Danish EPA and on the basis of them, an action plan was set-up for the waste data area.

6. Organising data in levels.

One of the findings of the MIDAS project was that the existing databases were seldom used in connection with each other. They were typically used as separate sources of information and they were usually very closely tied to the department/the experts who had the responsibility for updating and maintaining data.

Knowledge on the existence of databases as well as accessibility of databases across departments were low. Furthermore, it was difficult to get an overview of the Danish EPA's collection of data as a whole.

These problems were not primarily caused by technical limitations. They existed because the organisational set-up did not support a better knowledge of and access to the databases.

This chapter describes the strategy chosen to cope with these problems. The primary objective was to put data to better use seen from an organisational perspective.

A catalogue of databases

In order to provide an overview of existing databases it was decided to establish a catalogue of databases. This would give experts from different departments the possibility of searching and finding relevant sources of information in the organisation as a whole.

It was recommended that

- the catalogue should be accessible to everybody in the Danish EPA
- all existing and future databases within the scope of the MIDAS project should be registered
- the catalogue should for each database comprise both environmentally relevant information about the contents and some administrative information concerning ownership, accessibility, frequency of updating etc.
- the department responsible for an actual database should also be responsible for providing the required information about this database to the catalogue system
- updating data or modifying a database should immediately be reflected in the descriptions of the catalogue.
- a search in the catalogue system should at least be possible from four different points of view: administrative information (e.g. updating frequency), a thematic entry (e.g. solid waste), the general contents of the database and finally a more specific description of the contents[3].

[3]One could e.g. choose to get an overview of the databases connected to a specific department; or to find all databases relevant for the theme "solid waste"; or to locate the database comprising all "waste water treatment plants" in Denmark; or finally to use a search word such as "cadmium" to

The kind of catalogue system described above merely provides "data on data". It does not give the possibility to directly require data from the actual database when a match to a search has been found. A feature like this would of course be very useful, but it would also be quite expensive to develop. So it was decided to regard it as a future possibility for further development.

A common set of codifications/code lists.

If you want freely to combine data from different databases it is necessary that objects and properties of the same character are identified and codified in the same unique and unambiguous way. That is, if a sewage cleaning plant appears in two databases, this plant should be referred to in both databases by the same unique identifier (key).

On the attribute level some important common variables are substances and units of measurement. If data on these parameters are codified in the same way it becomes possible to sum up e.g. emissions of the substance from various sources of pollution.

Establishing a common set of code lists covering the relevant pieces of information in the field of environmental data is not a straight-forward and simple task.

Firstly, many data relevant for the Danish EPA are already collected, codified and stored somewhere else, e.g. in the municipalities or counties. The chance of a common set of code lists being used at this level of data collection is very small. The best solution of this problem is to ask the local collectors of data to make a conversion of their data to a "global" format before delivering them to the central database. The first couple of times this manoeuvre requires a close dialogue concerning specific conversion problems. But after a period of time there is a possibility that local data collectors may adopt the "global" nomenclature, if not for any other reason then because this will spare them the trouble of converting data.

Secondly, it is in it self not easy to introduce generally accepted unique identifiers referring to objects and qualities of the real world. The set of appropriate characteristics may differ quite a lot depending on your point of view and the tasks you are supposed to carry out.

Furthermore the world is not static. If for example a specific industrial production is moved from one geographical location to another, should the unique identifier of this plant then be substituted with a new one or should it be kept?

In the Danish EPA we have worked for several years with the problems of data modelling and generation of common code lists in the context of STANDAT[4]. We have chosen to use the code list system of STANDAT as the basis of a set of common references. In this way the most urgent requirements for codification are covered.

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locate databases having data on this specific substance.

[4] STANDAT is described in detail in the report "STANDAT - the Danish format for exchange of environmental data", Danish EPA, February 1996.

Presentation of data in levels.

As mentioned before the Danish EPA is an organisation with a very wide-ranging field of expertise. This implies that the educational background and areas of knowledge of the professional staff varies a lot. There are many biologists, engineers, chemists and other persons educated within the field of natural science. But there are also many economists, legal experts and others skilled in social sciences. Furthermore the level of knowledge concerning use of computer based systems differs very much.

To make environmental data usable for such a heterogeneous group of people requires several levels of presentation and tools.

One sort of user is the person responsible for maintaining and using the data of a specific **expert database**. This person probably knows in detail the expert field concerned. His or her primary needs are to be able to make a quality assessment of new input data before updating the database; to get continual output from the database such as specific reports, graphical presentations and maps in an easy way; and if necessary to be able to produce ad hoc analyses on data.

This is the kind of user and usage of data which was in focus during the period before the MIDAS project. There was a basic level of data, namely a series of mostly unrelated expert databases, which were rarely used in connection with each other:

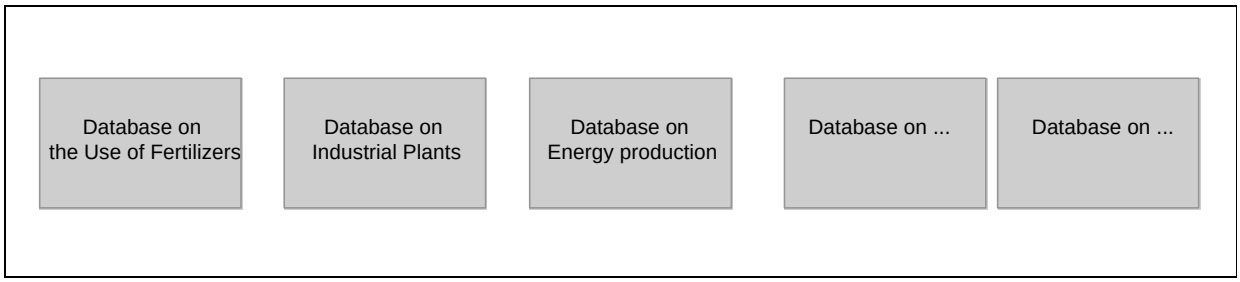

Figure 6.1: Level 1, expert databases.

But the analysis unveiled another sort of potential user and usage: the need of viewing data from a thematic point of view. That is, within the scope of an environmental theme to be able to get a complete presentation of the existing relevant data. These data may concern any of the various angles described in chapter 4. E.g. when analysing data on bathing water quality it may be very relevant also to include data on location and emissions of sewage cleaning plants, as storm water effluents are an important source of pollution in this context.

A natural "tie" between different types of environmental data is the geographical dimension, that is the geo-references connecting data to specific locations in space. And the obvious tool for presenting **thematic data** of this kind is of course GIS.

This brings forward another conceptual layer of presentation:

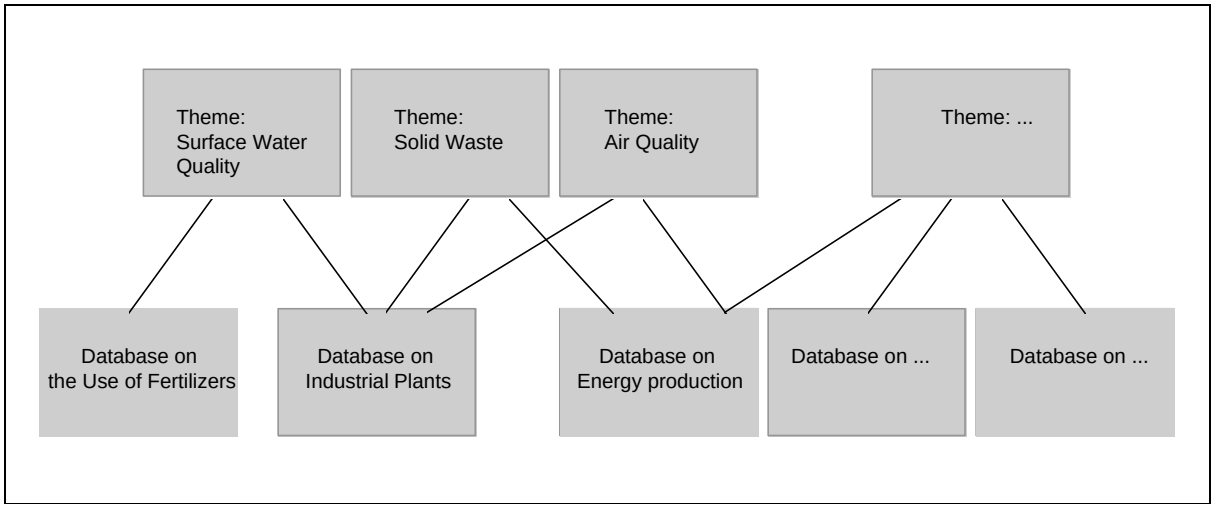

Figure 6.2: Level 1 and 2, expert databases and themes.

Different strategies may be chosen for establishing thematic presentations. One strategy would be to define a theme, e.g. eutrophication and produce a specially made GIS-application including only the thematically relevant sets of data. This would result in a series of dedicated presentations and leave no possibility for viewing data in new, user-defined connections.

Another strategy could be to use the GIS as a general frame for acquisition and presentation of data, connecting every geo-referenced collection of data with the system. This provides the user with the possibility of combining data freely. A possible drawback of this kind of solution may be that as the set of different data collections grows, it may become difficult to keep an overview of the system as a whole.

The final part of the data presentation hierarchy concerns the **key data.** This concept is described in detail in chapter 7.

The key data and the key data system are to be conceived as a possibility of getting an overview of (aggregated) environmental data relevant to the Danish EPA as a whole, and selecting and presenting these data in a structured and user-friendly way. Data may concern e.g. trends in the state of the environment and key figures showing relevant development parameters related to e.g. societal economics.

Key data should be used in strategic planning, e.g. by using data as input to simple models calculating future trends and economic/environmental consequences of various scenarios. Key data are also useful in the work of developing and calculating environmental indicators and to some degree environmental statistics.

In the MIDAS report it is recommended to develop a key data system according to the following guidelines:

- there was to be a general read-only access for all staff of the Danish EPA
- the department of Development and Data, and the Department of Economics were to co-ordinate the collection of key data

- key data based on expert data bases were still to be the responsibility of the relevant departments
- key data were as far as possible to be retrieved and aggregated directly from existing expert databases in the Danish EPA
- key data may also be required from sister institutions in the Ministry, from the Danish Statistical Bureau and from other sources
- the accessibility, flexibility and general user-friendliness of the key data system were of the utmost importance. It should be easy to find data via the system and to produce relevant presentations on the basis of them.

On the overall level one of the MIDAS strategy recommendations was to organise data in the following conceptual hierarchy:

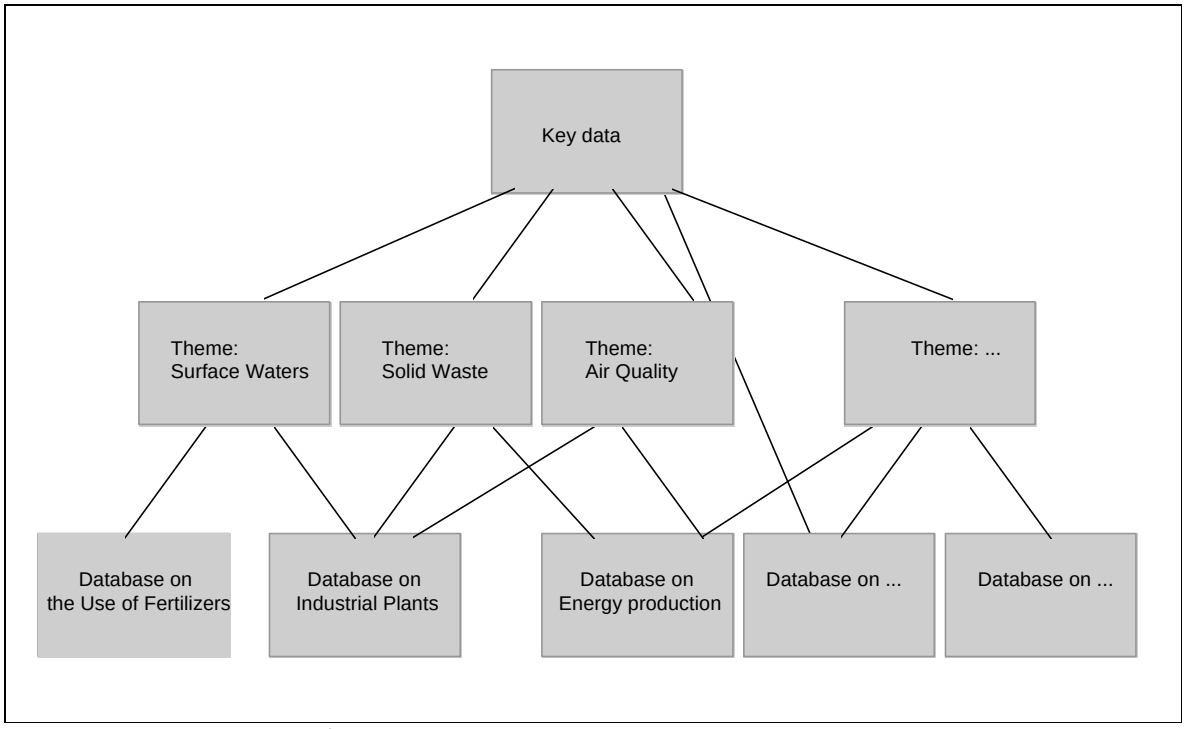

Figure 6.3: The three conceptual levels of data.

7. A presentation system for environmental key data.

In the previous chapter an organisation of data in levels was described. The top level was the so-called key data level. This chapter outlines design considerations and decisions concerning the Danish EPA's prototyping of a computer based system for presenting environmental key data.

Key data and user groups.

The interpretation of the notion 'key data' does not exclusively depend on the subject area in question. Also the organisational level of the potential user group has influence on how a relevant set of data is to be selected. For example the top management has other, typically more aggregated information needs than the expert responsible for a specific subject area.

In the case of the key data system of the Danish EPA the group of users is very heterogeneous. At first hand the system may be seen as an executive information system. But the user group at management level is very small and it is generally not using computer based information systems a lot in its day-to-day work. So, apart from the executives the most important target group for a key data system is the expert staff. This group of persons has highly varying educational background, very different areas of expertise and different levels of training in the use of computers.

User requirements for a key data system.

The range of both the subject area and the user group makes severe claims on the design and implementation of the key data system:

- the system must be easy to use, also for the untrained user
- data must be structured in a way that makes it easy to find the relevant set of data and to move around in the system
- the scope of data must be large enough to cover all the main topics of interest for the Danish EPA
- the level of detail of data must be low enough to satisfy the needs for surveying trends, and high enough to supply the necessary basic information
- it must be easy to move up and down in aggregation level (i.e. to 'drill') concerning temporal, spatial and other types of hierarchical resolution
- production of different types of presentation such as data on maps and in various graphic formats must be easy and the results must be of high quality
- source identification, update specification and remarks on data quality must be present for every set of data in the system.

It is described below how we have tried to cope with these demands in the process of designing and developing a key data system for the Danish EPA. Firstly, our suggestions for structuring data are presented. Next, the choice of software for developing the key data system is described. The third and final issue concerns design considerations.

Structuring of data

In chapter 4 we described a general framework for structuring data of relevance for an institution like the Danish EPA. This framework consisted of 5 main entries, namely

- environmental problems
- the state of the environment
- sources of pollution and their emissions
- legislation, conventions etc.
- societal economy

A more detailed level of structuring for each of these entries was also suggested.
For an overview of the complete view of the world please refer to figure 4.1, chapter 4.

It is our assumption that having these five headlines it is possible to organise most of the data that may be relevant for a key data system[5] in an adequate way.

In the prototyping project we have decided to restrict the subject area to surface water.

Choice of software tool

At first it seemed obvious that the software tool should be one of the existing EIS-tools. Many software-houses provide these tools which include facilities for developing a Windows-oriented presentation system with business graphics, drill-down-functions, traffic lights etc. But at that time most of the EIS-software packages lacked a very important facility for presenting environmental data: the possibility of showing data on maps and to make simple manipulations of such presentations.

Another possibility would have been to choose a GIS-tool. But an investigation of the software available in this area at the time of decision proved that these tools did not offer of the more general EIS-facilities needed.

Therefore, it was decided to make the development software ourselves. MicroSoft Visual Basic was used for this because it a. o. reasons was presentation oriented, inexpensive, easy to use and already in use at the Danish EPA. Furthermore it allowed for extensions in the form of so called Custom Controls. In our case the required extensions were primarily oriented towards GIS-like functionality. A detailed specification of requirements was elaborated, and a software house contracted to develop the necessary Custom Controls.

Today the trend is that EIS-tools and data warehouse oriented products (and also other types of software such as e. g. spread sheets) comprise map-presentation features, and

5 Subject areas such as chemistry and biology does not fit into this structure as stand-alone entries. But much valuable information from these general areas of expertise may be part of the information supplied in other entries. E.g. information on toxic and eco-toxic qualities of specific substances may be connected to the emission part of data on sources of pollution. This is one kind of solution based on the assumption that this kind of information is supplementary and not to be regarded as key data in itself. If on the other hand another view of the world is taken, one might include a sixth entry in the key data system, comprising these subsets of data.

that end-user oriented GIS-tools include more general presentation facilities. If the decision were to be made today these factors would have to be taken into account.

Design considerations

Design considerations concern four main aspects of the key data system:

- the menu flow
- the possibilities for presenting data
- the features for manipulating data in a presentation
- management and control of flow and presentations

Regarding the main menu, the ordering and flow follow the principles for structuring data described in the beginning of this chapter. That is, the sequence of possible menu 'steps' reflects the picture of the world that the key data system is based on.

The main entries are: Recipients, Environmental Problems, Sources of Pollution, Regulation and Economy.

Besides this rather rigid path through the system, there is a need for establishing links between different parts of the system. For example by connecting data on recipients such as streams and lakes with data on relevant legislation.

In this context the interpretation of the term 'relevant' defines the actual design specification. E.g. the legislation relevant for a Danish stream such as 'Gudenåen' may be defined at a very general level as every piece of legislative information related to surface waters as a whole. Or, in the other extreme relevance may be restricted to legislative documents related to Gudenåen at the precise time (year) defined in the actual context. Depending on the interpretation, more or less meta data[6] will be necessary.

Concerning the question of facilities for making different presentations of data, this has from the beginning been an important feature of the key data system. There are three obvious ways of presenting environmental data: on maps; in various graphical forms; and as 'raw data', typically in a table.

We have chosen to implement these choices as buttons in the frame of the presentation window. This makes it easy to choose a new way of presenting your selection of data.

Obviously the user should be allowed to utilise as many as possible of the options available for designing and modifying a presentation. For map presentations this includes zooming in and out; moving around the map; adding and removing various thematic layers such as administrative regions, forests, cities etc.; deciding on legends (number, size of symbols, colours). Concerning graphics the features of the business graphic tool in use should be available for the user. And regarding table-oriented presentation it should be possible to use data in a spread sheet.

This set of features allows the user to adapt her presentation fairly freely.
Working with data in a presentation window comprises two aspects:

[6] This concept is explained later in this chapter.

a. making a selection of data on basis of the *variables* available in the actual data set
b. making a further selection of data on basis of data *values*.

Ad a.: Data on live stock are relevant in Denmark as agriculture is an important source of pollution. Data describing live stock can for example be outlined by three variables, viz. year, county and type of live stock (cattle, sheep, chickens etc.). And the numbers counted may relate to either the number of animals or the number of farms having this specific type of live stock.

You are free to choose a specific combination of these parameters for presentation, e. g. the year of 1994, all counties and sheep. And to choose a presentation showing the number of animals.

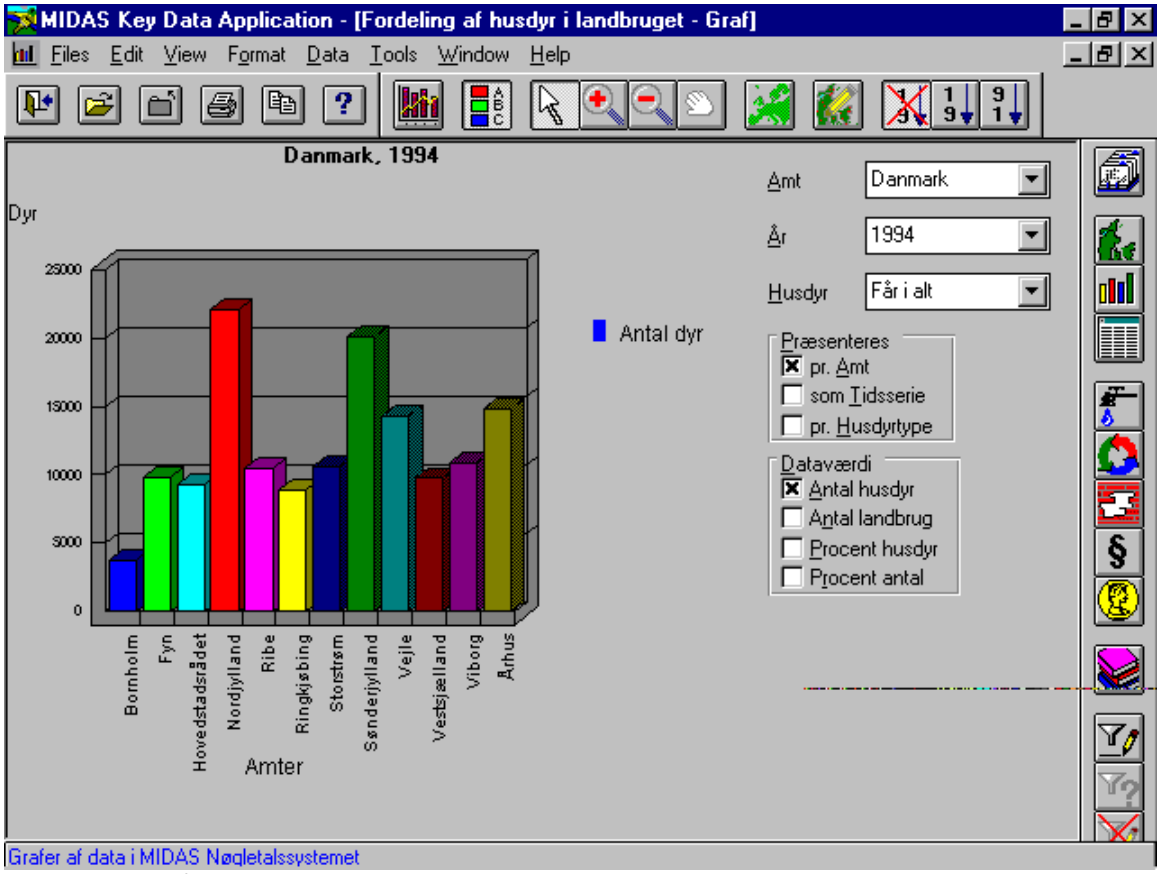

Figure 7.1: Example of data presentation in key data system.

Ad b: You may also want to restrict your selection of data to comprise only the counties where the number of sheep exceeded 10.000 in the year of 1994. This may be relevant e.g. when working on an action plan concerning the production of manure.

In the prototype this kind of selection is described in a specific button-activated window as showed in figure 7.2.

Finally the sub-selection of data may be presented as e.g. a map, cf. figure 7.3.

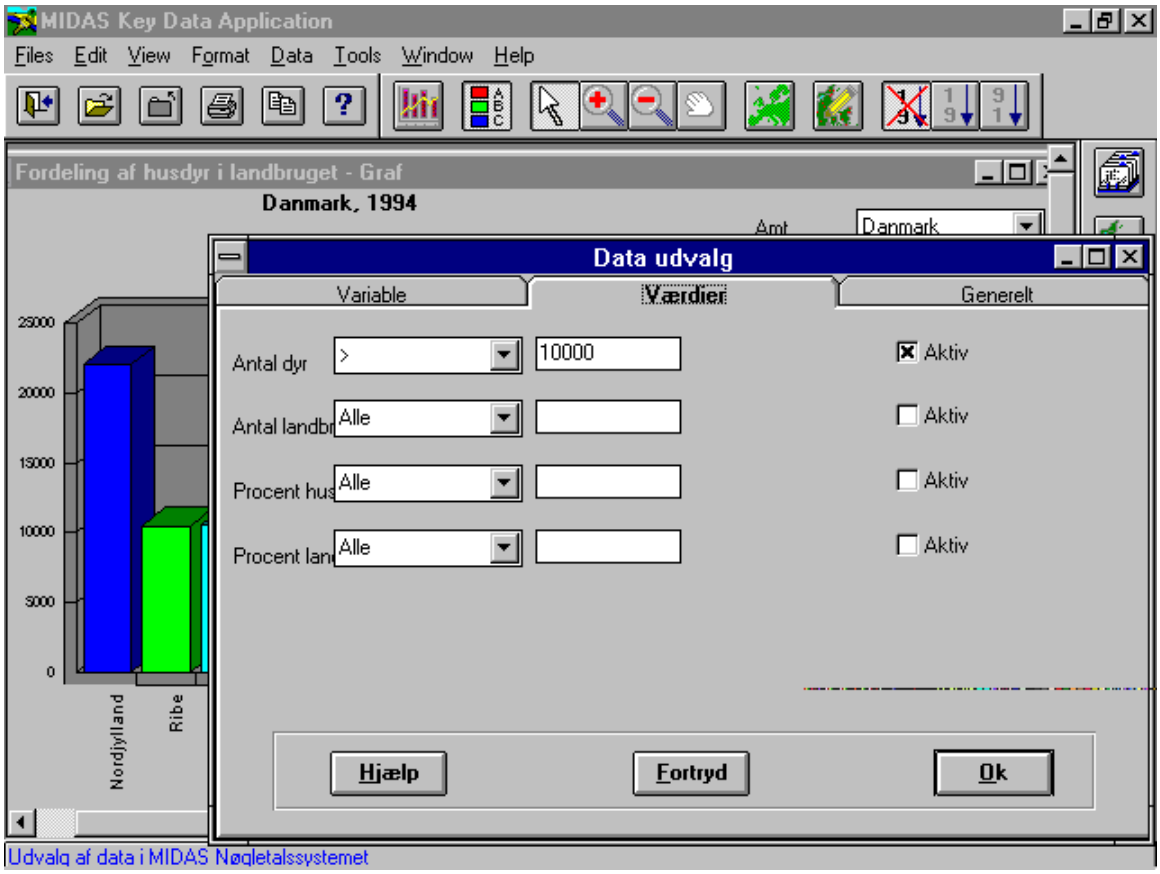

Figure 7.2: Example of selection of data.

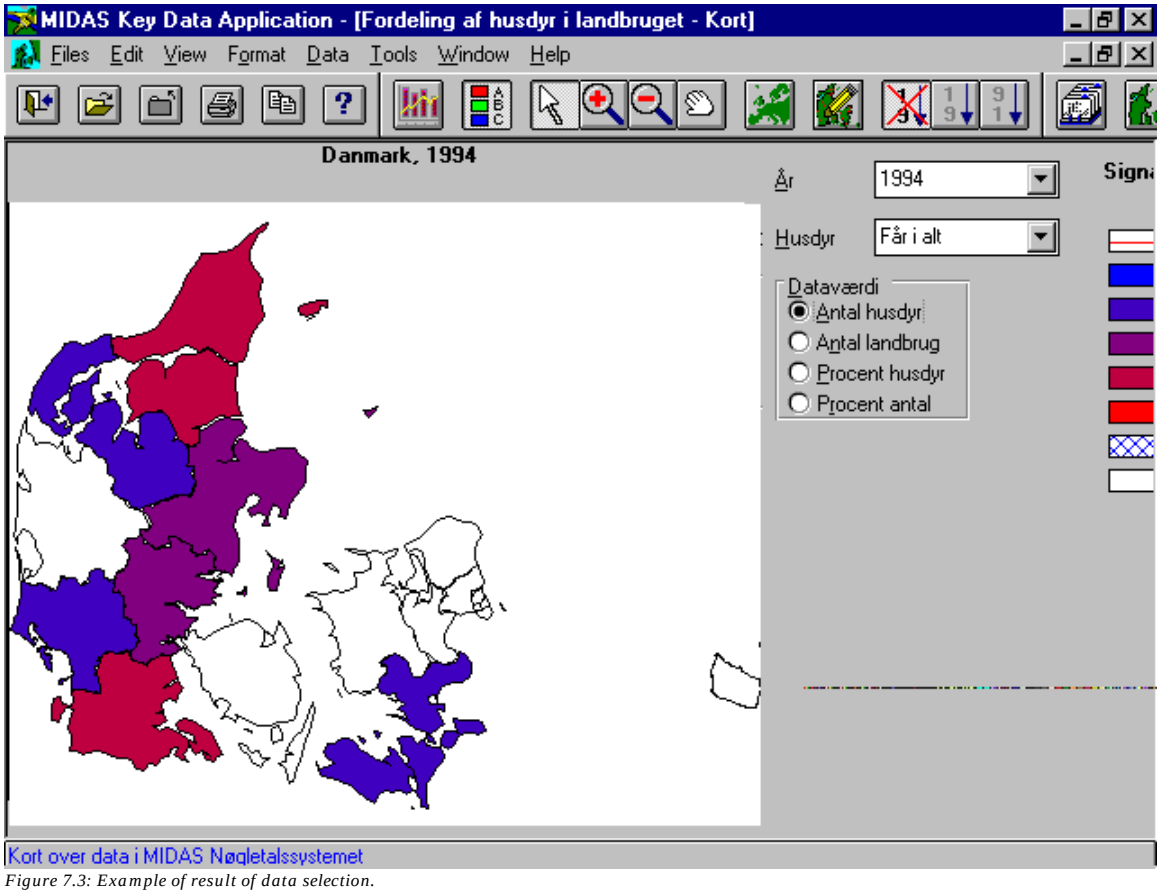

Figure 7.3: Example of result of data selection.

The future may reveal further user requirements for data manipulation of this kind.

Lastly, but in no way less important comes the question of controlling menu flow and presentations in the key data system.

At first our idea was to make a straightforward application of the prototype, of course having an overall design strategy but adding a new window for each new type of data to be presented. After making an initial estimate of the number of windows necessary just for the prototype theme surface water, it became clear that to be able to keep an overview of data and to manage addition of data and system developments it was necessary to choose another strategy.

So we decided to base the application on a meta data approach. That is, to make the application data-driven in the sense that flow and presentations are generated at run time on the basis
of meta data on structural aspects and data contents.

The prerequisites for this approach are at least that

- one or more templates for presentations of data and further menu selections etc. are established.
- the menu structure is described as data matching the menu template
- the connections/links between different parts of the system are described as data matching the connection template
- each set of environmental data are described according to the specifications of a presentation template
- an application for generating a series of presentations on the basis of the above data and user selections is developed.

In this way the application becomes a kind of 'presentation system generator' in the sense that if the overall design elements of another key data system equals those of the prototype and the necessary set of meta data are elaborated, then the application should be able to generate a presentation system for another view of the world/another set of data.

Apart from the elements mentioned above it is crucial for the usability of the system that one more application is developed to maintain and add new meta data, This is necessary when expanding the key data system with new or revised data sets, links or menu elements. If such an application is not available the possibility for keeping track and overview of meta data is poor. And with the huge field of data potentially being included in an environmental key data system, the question of overview and precision is of utmost importance.

8. The implementation process.

The previous chapters explained the main component elements of the MIDAS strategy. This chapter describes the implementation process after the issuing of the original MIDAS report.

The process.

In the first phase of the implementation process the focus was on the thematic analyses of the waste area (described in chapter 5) and on the development of a key data system.

Especially the development of the key data system became a prolonged process. This was mainly caused by the want of adequate software tools. At first, it was tried to set-up the key data system by combining a GIS[7]-tool and an EIS[8]-tool. At that time no software tool existed that combined these two ways of presenting data in a satisfactory way. The test was made with data that were partly real data and partly invented data.

The resulting prototype was a success - apart from one important point: it was not possible to integrate the two software tools, so you had to change software tool if you wanted to change from one way of looking at data to another. The incompatibility problems were so critical that the two parts of the prototype had to be presented with the use of different types of hardware: one on a PC, the other on a terminal.

For this reason it was decided to try another tactic: to develop a software tool that combined the two ways of presenting data. This process was described in chapter 7.

It was important when launching the MIDAS project to have a method of ensuring that the process was iterative. This was done partly by making pilot-projects for some of the most important component elements of the MIDAS report. And partly by having an evaluation of the strategy after a period of one year.

This led to an adjustment of the strategy with a slightly different focus. Problems in the implementation process had been discovered that made it necessary to introduce counter-measures if success was to be ensured.

Pilot projects and other projects.

An important point of the MIDAS report was to improve the co-operation with other organisations in the area of environmental data.

One of the most important partners for co-operation was NERI, the National Environmental Research Institute. Together with the counties and GEUS (the Geological Survey of Denmark and Greenland), NERI is probably *the* most important deliverer of data to the Danish EPA and an important user of data *from* the EPA. But

[7] GIS means geographical Information System and is a way of analysing and presenting data on maps.
[8] EIS means Executive Information System and is a way of presenting data - typically data on trade, production and sales - using graphics.

the process of accessing and using data from NERI and vice versa was not always easy. This was regarded as an important impediment to data work in the two institutions.

For this reason it was decided to carry out a pilot project to uncover prospects for and impediments to using each other's data. The idea was to use the experience and know-how gained on other areas at a later stage.

The pilot project confirmed the experience gained from the MIDAS analysis: that organisational impediments are often more important in data work than purely technical problems.

The first thematic analysis was also carried out at this time. The process and outcome is described in chapter 5.

The key data system and the concept of data organised in levels took its early start as described in chapters 3, 6 and 7. The development processes were prolonged several times. Both because the amount of staff dedicated to these tasks was small. But also because especially in the case of the key data system innovative thinking was required - and this takes time.

The evaluation report and its results.

The evaluation report was issued about a year after the publication of the original MIDAS report. The idea was to assess the methods and results after a year and after the completion of the pilot projects mentioned above.

The first part of the evaluation report was a recapitulation of the scope of the MIDAS project. This was necessary because myths had been forming in the period since the first MIDAS report. It was especially important to emphasise what the MIDAS project was not and what things were not the responsibility of the MIDAS task force. It was important to avoid the belief that the MIDAS project was some sort of magic wand that could supply data, databases, data-presentations and reports on the spot. Hard work was needed, and even more important: hard work was necessary also *outside* the MIDAS task force.

The report also contained an assessment of the success of each of the MIDAS component elements: the key data system, the idea for structuring data, the problems of obtaining data, the thematic analyses, etc.

For each component element a set of recommendations was presented, and the report finally introduced a revised set of recommendations for the future organisation of data work in the Danish EPA.

Together with recommending the continuation of the thematic analyses and the key data system, important proposals were:

- fast decisions on software tools for thematic databases and key database

- better co-ordination between legislative / advisory work and data work to ensure that the collection of data needed for e.g. monitoring of the results of legislation can be sanctioned in e.g. legislation
- start of project for creating a catalogue of databases
- a special budget for data projects to make sure that the funds are available when needed
- improvement of standard contracts for data projects
- postponement of several projects for resource-reasons
- continuation of the principles of central storage of databases and common concepts for design of databases and user interfaces

Much later …

Especially for resource related reasons several of the recommendations of the original MIDAS report were not implemented until much later. This goes for the appointment of a data manager whose primary task was to provide a full overview of the databases of the Danish EPA and to establish a framework for maintaining this survey. It also applies to the appointment of an extra database development co-ordinator.

An important vehicle for data strategic development was the Data Co-ordinating Committee of the Ministry of Environment and Energy. This group had been given relatively low priority for a long period, and existed as a fairly informal working group. In the early spring of 1995 it was re-formed under the chairmanship of the Danish EPA. Some of the tasks taken up were closely related to the ideas of the MIDAS report: having a catalogue of databases (at present this is made part of an Internet Homepage). Assessing and restructuring the organisational structure for co-operation on data. And making a formal agreement on how to access and use data across institutional borders, cf. the pilot project mentioned above.

An element of the original MIDAS report that has not yet been implemented was the idea of arranging seminars or training sessions for staff in the Danish EPA working with environmental data.

To summarise, the establishment and use of a common pool of high-quality environmental data is an important strategic element in an institution such as the Danish EPA. The process of defining and implementing the MIDAS strategy has nevertheless demonstrated how difficult it is to make this idea part of the organisational identity.

To fully integrate data work it is necessary to envisage data as part of the working projects of the organisation in general - and not only as a sort of cumbersome effort or extra task to be accomplished after having finished the 'real' work. Confusing data work with pure computer technical matters is a common mistake. The use of computers and software as tools in the work with data is of course of utmost importance. But the tools should not be confused with the tasks.

Changing dogmas such as these is part of an educational process which should not be underestimated.

9. Using experience from other organisations.

In this chapter differences and parallels between the EEA and the Danish EPA will be briefly reflected on before discussing the way parts of the environmental administrative system in the United States has worked strategically with data. Lastly some preconditions for working strategically with data will be summed up.

Differences and parallels.

Using experience from other organisations is not always as simple as it might seem at the face of it. Trying directly to transfer experience from one organisation to another will often lead to difficulties. Organisations work in different ways, they function in different environments, they have different set-ups, objectives etc.

Therefore it is important to get an overview of the differences and parallels between the relevant organisations.

There are some important differences between the Danish EPA and the EEA, some of which have been briefly mentioned in previous chapters[9].

One important difference is the fact that while the collection and presentation of environmental data is so far the main task of the EEA, it is only one among many tasks of the Danish EPA. This means that it is natural for the EEA to put a very large part of its resources into data work and some of these into long-term data strategic work.

Nevertheless, the resources available for long-term strategic data work seem at present to be relatively larger in the EPA than in the EEA. This has to do with several facts. Firstly the EEA is still a new organisation that has to use many resources on capacity building, establishing work routines etc. Secondly, many of the resources available to the EEA are scattered throughout the extremely decentralised EIONET-organisation. These resources are an important basis for the work of the EEA, but they are not readily available for the EEA in the same way that the staff in the Copenhagen headquarters is. Thirdly, the central EEA in Copenhagen has a staff of only sixty, and of these only few are in functions that are closely related to overall data co-ordination, standardising etc.

Another difference is the apparent need of the EEA to produce noticeable outputs. This again has to do with the fact that the EEA is a new organisation with a great need for demonstrating its usefulness. Long-term, strategic data work does not quickly generate spectacular products and is therefore likely to loose in the contest for resources in any organisation that gives very high priority to such issues.

One last important difference is that the EEA does not have any means of enforcement of its own when it comes to making the member countries follow strategies, collect data or apply standards. The standard means of enforcement of the EU are directives, but the EEA does not have any power to issue directives. Instead the EEA has to rely on the strength of the argument, on the idea of common interests and on the competitive aspect - the fact that it would be embarrassing for many countries not to be able to deliver the necessary data and not be mentioned in the different pan-European surveys.

[9] In chapter 2, cf. also 'STANDAT - a standardised format for exchange of environmental data', report for the European Environment Agency. Danish EPA, 1996 - especially chapter 11.

There are of course also important parallels between the two organisations. Perhaps the most important parallel is that both the EEA and the Danish EPA collect data for use in the administrative and political decision processes. Data are collected for the use of decision makers and for the use of the public, so that the state and the development of the environment can be assessed, results can be compared to objectives, problem areas can be pinpointed etc.

To sum up, the most important differences between the two organisations are that the EEA has a more scattered organisation in its EIONET structure; that the EEA has fewer means of enforcement; and that the EEA has a more focused task. The most important similarity is the way that data are used in the two organisations.

Environmental data in the United States.

In the following some main points and projects related to the work on environmental data in the United States are described. The United States are interesting because of the parallels in scale and because of some relevant individual projects.

The federal EPA has an Information Resource Manager function, and over time there have been several attempts to standardise data collection and presentation. But these initiatives have mainly focused on separate environmental issues (typically a single-media approach), not attempting to integrate information across subject areas.

Furthermore, the degree of success of these projects has been low. For example the strategy of developing and providing common software for registration of data has generally had limited success. The reason is that at state level facilities of this kind have either already been available or the individual states have preferred to develop solutions of their own. The differentiation is increased by the fact that focus on and resources for environmental management varies greatly from state to state.

Despite these problems, attempts at standardising data registration continues. A re-engineered version of the so called STORET system is under development. STORET was originally developed back in the 1960s to store monitoring data on water quality. Many data have been collected over time, but the quality of these data has generally been uncertain.

A budget of 2-3 million $ has now been allocated to try to cope with this problem, and also to move the STORET application from a mainframe to a client-server application. The strategy is to expand the registration part of the system with facilities for registering meta data such as the purpose of data collection; organisational aspects (associated people and projects); and quality control standards applied when collecting data.

A widespread use of a system such as the new STORET at state level would of course improve the quality of data considerably, also at federal level. But it is not possible to tell whether the federal task force working with the project will succeed in getting their system generally adopted.

The only project concerning integration of environmental information at federal level that we actually met during our stay at the United States was the ENVIROFACTS system. ENVIROFACTS is a collection of nation-wide data concerning many different environmental issues, related to specific facilities/sites. The idea of ENVIROFACTS is to standardise and consolidate basic identification information (key identifiers) on the

regulated facilities/sites, so that one may enter the database via these identifiers. Entries may be e.g. permits, chemicals (emissions), facility identification numbers or postal codes.

The concept of the system is that of a data warehouse: provide the user with a meta data description of the data available and a toolbox of routines for searching, combining and outputting the relevant data, based on the user's selection of a specific set of meta data values. The success of this approach depends both on the range and quality of data available in the system, and on how far is has been possible to actually 'clean' data. In the data warehousing terminology this means that you make it possible to combine data by using a standardised set of identifiers for all your data. This is not a simple task, especially not when the initial collection and quality of data is not well-known and well-described.

ENVIROFACTS is available at the WWW-home page of the US EPA (http:\\www.epa.gov/enviro/html/ef_home.html).

Initiatives such as STORET and ENVIROFACTS are important, but still they can not be labelled as general data strategies. More to the point is a set of recommendations for IRM (Information Resource Management) that the EPA developed some years ago[10]. The main points are that EPA must:

- develop, immediately implement and enforce data standards
- develop data integration policies and tools
- define data requirements and identify gaps in the data inventory
- reduce the burden on providers of information.

As a consequence of these recommendations EPA established a Key Identifiers Initiative in early 1995, to identify common data elements (termed key identifiers) widely used throughout the Agency and by State partners in the project. A guiding principle of this initiative is to be able to locate all environmental data related to the same place. A report on this project has been launched in May 1996, and it is this approach which has been used in connection with the ENVIROFACTS system.

So, although the long-term perspective is clear, there is still not a fully elaborated data strategy at federal level. Maybe these are easier to find at state level, possibly because of the smaller scale. We have been made aware of relevant initiatives in the states of Washington, Massachusetts, Texas and Oregon.

Looking a bit deeper into the efforts of Washington, there has recently been developed a 5 year Information Strategy Plan. The goals of initialising such a planning process were in short to

- meet current and emerging information needs
- examine the overall approach to data collection and management
- develop a plan for improving the existing information infrastructure and information systems.

The four main approaches identified during the planning process were

- multi-media information integration (across program areas)

[10] 'Using Information Strategically to Protect Human Health and the Environment', Report of the IRM Strategic Planning Task Force, August 1994. The task force is a subcommittee of the National Advisory Council for Environmental Policy and Technology, which included representatives of all major groups concerned with EPA policy, from industry to States and local governments.

- cross-functional integration of information (e.g. between enforcement and release data)
- linking expenditures to activities which again are linked to environmental conditions and results
- geographic-based analysis.

The plan furthermore comprises a schedule for the first five years of business area analysis projects.

So far, a general facilities database of hazardous waste sites including basic information on latitude, longitude and regulatory contracts has been developed, and facility information on wastewater discharge permits are being added. The system is developed with ArcView as an end-user tool.

The creation of the integrated information system is estimated to cost at least $7 million.

In at least one important way the organisational set-up of the EEA is very similar to the set-up of the American environmental administration: both have a central institution (the EEA / the US EPA) that is responsible for overall co-ordination in an organisational structure that is decentralised to a great extent, and at the same time huge in scale.

It was a general impression from a brief visit to different institutions in the American environmental administration that it is quite difficult with this organisational set-up to have any large scale strategic projects that cover the whole country.

We have tried to sum-up some main points related to the IRM project and the MIDAS project in the following table. The idea is not to make a systematic comparison, or to make an evaluation, but to highlight some main aspects of the two projects.

	MIDAS (Denmark)	**Recommendations for Comprehensive IRM**
Responsible agency	Danish EPA	US EPA
Scope	Danish EPA and the national data that are the responsibility of the EPA. Especially production, organisation and presentation of data.	Nation-wide
Objective(s)	High-quality data to fulfil the needs of the organisation with a minimum of resources	Support of a comprehensive approach to environmental protection
Approach	Problem analysis + valuable experience -> objectives + tool box + strategy. Implementation of overall strategy combined with thematic analyses for specific areas.	Focus on integration of environmental data across the traditional single-media approach
Important component elements / tools	• Conceptual framework • Data in levels • Key data system • Thematic analyses	General recommendations on data standards, data integration, data inventory and reduction of the burden of information providers
Special (e.g. software) tools	Key data system	ENVIROFACTS
In work since ...	1992	Recommendations launched in August 1994

Table 9.1: Some main aspects of the IRM project and the MIDAS project.

Preconditions and rules of thumb for working strategically with environmental data.

To round off this chapter we would like to try and generalise on some of the preconditions that are necessary for working strategically with environmental data. This is not only based on the MIDAS project, but also on what we have learned from looking at other projects.

First of all a realisation of the situation and of the need to act is of course necessary. In the MIDAS case this was facilitated by a new organisational set-up that included a department with the clearly defined task of looking into the strategic questions of environmental data. Important in this context was also the willingness of all relevant members of staff in the many different departments to co-operate towards the objective of analysing the situation and setting up a strategy.

Secondly adequate resources are an absolutely necessary precondition. It is not just a question of quantity but also of quality: the resource base should be qualified not just in the area of computer science, but also in the area of environmental science (biology, geology, chemistry etc.) and organisational issues. These three aspects are all vital for the success of the strategic work. Furthermore, it is essential to have the necessary resources at both the central level but also in the other relevant units of the organisation.

An institutional anchoring for the strategy is important, preferably via some kind of written statement. This might e.g. be in a work programme, where a special unit should be assigned to the task and where it should be clearly communicated that the task is vital to the organisation and that it will need resources and commitment.

The commitment of the management of the organisation is extremely important. Their support is material not only to ensure staffing and resources, but also to make sure that there is a general appreciation in the organisation of the importance of the project.

Focus in the whole organisation is necessary because a task force might be able to set up a strategy without assistance (though a less qualified strategy in that case) - but it would not be possible to implement the strategy without the support and commitment of larger segments of the organisation.

A group of dedicated supporters for the strategy and its implementation is also vital. Most important is of course the core group or task force that is responsible for the set-up and implementation of the strategy. But it is almost equally important to have supporters outside the task force - people that believe in the strategy and are able to promote the ideas *in* the organisation.

The necessary hardware and software platform must of course be available. It must be well-functioning, reliable and easy to use and supply the necessary range of user-friendly software tools. It is also important that a well-functioning 'intra-net' and preferably access to Internet facilities are available.

The time factor is important - the project must not loose momentum if enthusiasm is not to disappear. To keep up the feeling of success it is important to have a range of individual milestones and to reach a couple of these per year.

The organisational side of the question should not be underestimated. Surprisingly often the problems that have to be solved are in their essence not technical but organisational (e.g. the problem of having a clear division of competence, the problem of allocations of resources, the problem of setting up procedures etc.) Another important factor is the question of attitudes to e.g. sharing data and using time for environmental data projects - this is often even more difficult to change than the other organisational aspects.

Organisationally it was an advantage that the implementation of the MIDAS strategy was the responsibility of a department that was also responsible in the Danish EPA for indicators, overall environmental strategies and general reporting on development in the state of the environment and the pressures on it. This provided possibilities for synergetic effects and for links and interplay between the different kinds of strategic work. Furthermore a common problem was avoided: when data-strategic work is placed in the same department as tasks related to software and hardware it often becomes difficult to maintain the resources for the long-term data strategic tasks.

Making the process iterative is the way to make sure that you have a mechanism for providing the necessary adjustments through the implementation process. This can be done through evaluations of results and reformulating of action plans etc. on the basis of these evaluations. In the same way prototyping is a good way of establishing a constructive dialogue with the potential users of a system in the software development related to implementation of a strategy. Here it is important to be aware that if too many resources are used for prototyping, there is a tendency to make the prototype the final system.

It is important to decide on a method. The MIDAS method has been to try and work along the lines of a traditional planning method: analysing problems, setting down objectives, setting up a tool-box, setting up an action plan - while still putting special attention to organisational issues and hindrances. In other organisations it might work to use other, less structured, more bottom-up methods. The important point is to match the method to the organisation and make sure that the general objectives are clear as well as the way to reach them.

Whatever method is applied it is a good idea to try to learn from the experience of others. This was an important aspect of the first MIDAS strategy report and supplied important inspiration for both objectives, tools and implementation.

Counter-productive conditions.

Finally we would like to mention some of the things that can be counter-productive to attempts at working strategically with environmental data. We will not go into detail with the circumstances that are negations of the preconditions just mentioned. They are:

- lack of resources,
- no institutional anchoring,
- no management commitment,
- no organisational focus,
- no dedicated task-force,
- no adequate hard-ware and soft-ware
- no attempts at using the experience of others
- no awareness of method.

One important organisational condition that can be difficult to combine with attempts at strategic work is too much focus on immediate results and spectacular products. Strategic work need not stop all short-term product-oriented work. On the other hand if

all resources are employed in short-term tasks it will be difficult to find time for the more long-term work, that often has few immediate results.

To overcome this problem management realisation of the problem and management dedication also to long-term projects is material.

Another important barrier to attempts at working strategically is organisational resistance to attempts at co-ordination and standardisation - such resistance can be almost ideological in its form.

The best way to overcome this is probably to try and make sure that the long-term efforts are combined with short-term projects that are valuable to key segments of the organisation. It may however be necessary to combine this strategy with management support to make relevant persons participate in the necessary projects.

Too large organisational scope can be difficult to handle because there will be more details, more stakeholders, more interests and more needs for projects to take into account. The MIDAS idea of having an overall strategy and supplement it with thematic analyses for specific parts of the organisation might be a solution for this.

Main points concerning preconditions and counter-productive conditions are summed up in this table:

PRECONDITIONS	COUNTER-PRODUCTIVE CONDITIONS
Adequate resources	Too scarce resources / wrong kind of resources
Institutional anchoring	Lack of institutional anchoring
Management commitment	Lack of management commitment
Focus in the organisation	Lack of focus in organisation
Dedicated supporters	No support
Adequate software and hardware platform available	No adequate software and hardware platform
An adequate method	No coherent method
Use of the experience of others	No attempts at using the experience of others
Long term perspective is accepted	Too much focus on immediate results and products
Awareness of organisational aspects	No awareness of organisational aspects
	'Psychological' resistance to attempts at co-ordination
	Too large organisational scope

Table 9.2: Helpers and hindrances in data strategic work.

10. Ideas for further development - and some different approaches.

This chapter focuses on the future work on environmental data both in the Danish EPA and the EEA. Important questions are: based on the experience described in part one of the report, what further or revised elements might be added to the MIDAS-toolbox? And what approaches might it be relevant for the EEA to apply in its data work ?

MIDAS II ?.

At the time being there are no plans for revising the MIDAS strategy: focus is on implementing the ideas and projects described in the original report. But if we were to start all over again, the experience we have made would prompt us to take some new elements into consideration. The most important of these are discussed in the following paragraphs.

Visibility.

Visibility is one of the key words in this context. After the first period of enthusiasm about the project in the organisation there is a tendency towards declining awareness of and interest in the implementation process.

To avoid or merely diminish this, any strategy should comprise a specific set of actions to be taken regularly in order to communicate the progress of the process. This could e.g. have the form of describing progress via articles or newsletters for internal information. Or via demos showing the latest milestones reached in software development

Deciding on how to keep people committed to the cause one should however be very careful not to overdo the information effort, and not to announce a successful achievement before it has actually been attained.

Motivation and resources.

Another aspect which is very important, but also very difficult to cope with is the question of how to convince your expert colleagues of the benefits of joining and contributing to the implementation of a long-term strategy. Often they will feel that they have no spare-time available for new actions to be taken.

In this situation of scarce resources there is a natural tendency to always try to deal with the most acute problems and tasks at first. People often realise the long-term perspectives in a top-down approach, but do not feel that they have the time for dealing with it. And even though the top management agrees on the objectives etc. of a strategy, it can also for them be a problem to allocate the necessary man-power.

One way to deal with this organisational problem is of course to make the management force people to co-operate on the implementation process. But the use of force is seldom an appropriate or effective solution.

The best solution is to convince people that there are also short-term advantages of participating in the development and implementation process. E.g. that acquisition of data needed in their daily work will become much easier and take less time. Or that the possibilities for producing more valuable and convincing presentations of data in the form of maps or graphics will be much better. But again it is necessary to be able to satisfy such expectations once they have been nurtured.

A way of trying to include this element in a strategy might be to carry out some pilot projects, where a small group of persons get special support in their work with data. Although some resources are in this way withdrawn from the overall implementation process, the effect of having small successes along the way may prove to be very valuable.

Software tools.

Another human resource related issue to be taken into account is the very varying preconditions among the staff for using information technology based tools. The importance of offering a broad selection of tools is quite evident. For example few persons in the Danish EPA will be able to fully use the facilities of a full-scale GIS-tool such as ArcInfo for analysing purposes etc. A larger group would be able to use the presentation tool ArcView. But most people will - at least in the beginning - be satisfied with a much simpler and more dedicated tool for presenting data on maps.

The success of the tool-oriented part of a data strategy depends on the ability to offer a sufficient selection of ways of accessing, selecting and producing presentations of data.

The outside world.

One last point is that it is vital to include strategy elements dealing with the world outside your own organisation. This is obviously relevant when speaking of data collection: satisfying your data needs are rarely done be merely integrating data already existing within the organisation. So the formulation of procedures for achieving and updating data from external sources is extremely important. This includes making agreements on the questions of costs and time schedules for updating.

Another important fact to be included in a strategy is the growing demand for making data accessible to the public. This includes both the public in a broad sense, but also other institutions, private enterprises, international organisations etc. Both at national and at EU level the right of public access to environmental data collected by public institutions have been legally stated.

This indicates that considerations concerning presentation of data on e.g. an existing Internet WWW home page for the organisation should be included as an important data strategic element. Updating procedures and development of an appropriate user interface are important issues in this context.

The rôle of the EEA

As described in part one of this report, it is crucial to be precise on the objectives and output requirements of an organisation when planning to make a data strategy. - What are the objectives, which products are expected and how are the success criteria for the organisation defined?

It is not the task of this report in detail to answer these questions concerning the EEA. But in order to be able to discuss some potential directions of development, it is necessary to outline some general considerations.

According to the Regulation 1210/90 on the establishment of the EEA some of the main tasks of the EEA are (according to Article 2)

- to provide the Community and the Member States with the objective information at European level necessary for framing and implementing sound and effective environmental policies
- to record, collate and assess data on the state of the environment, to draw up expert reports on the quality, sensitivity and pressures on the environment within the territory of the Community, to provide uniform assessment criteria for environmental data to be applied in all Member Countries
- to help ensure that environmental data at European level are compatible and, if necessary, to encourage by appropriate means improved harmonisation of methods of measurement.

Output requirements include a report on the state of the environment every three years.

Until now some of the main outputs from the EEA have been the publication of the Dobrís report (1995) and a review of the Fifth Environmental Action Programme ('Environment in the European Union', 1995). These publications are to be followed in 1998 by the so called 'Aarhus report' and the first ordinary state of the environment report.

Input data for this reporting are collected from many different sources, a. o. from member countries, via the ETCs and from Eurostat and the OECD.

It is obvious that success/failure of the EEA and the EIONET to a large extent depends on the ability to collect, harmonise, analyse and present the relevant set of environmental data at European level.

An important question related to data work in the EIONET system concerns to what extent environmental data are to be transferred to, managed and used by the EEA itself.

One possible development could be that only the ETCs collect, store and manage data, and that the EEA in Copenhagen acts merely as an overall co-ordinator and editor of textual input from the ETCs and other contractors when producing state of the environment reports etc.

In this case there will be a need for supporting editorial functions at the EEA level by establishing procedures and software support for e.g. document handling. Furthermore

it will be relevant for the EEA to offer some general guidelines on data work for the ETCs. These should include a minor set of standards for registration of data (uniform identifiers, code lists) and meta data (where, how, for what purpose, by whom, when were data collected etc.) in order to ensure a certain level of comparability and common quality description.

If it on the other hand is decided that the EEA shall maintain a collection of environmental data of its own, the question of how to select, collect, store, update and access these data becomes an important issue.

In the following it is assumed that the EEA decides to establish a data collection of its own. If the most decentralised model is chosen instead, some relevant recommendations on how to cope with data standardisation may be found in a formerly published report[11].

Some approaches for the data work of the EEA

Considering the pressure on the EEA concerning output expectations it is realistic to assume that focus in the organisation will be on meeting these demands. That implies a. o. tasks that much effort will be put in producing the expected reports on e.g. the state of the environment of Europe.

Taking into account the very limited resources available for the more strategic data work at the EEA, a possible consequence might be that data collection and analysis are closely tied to the individual reporting processes. That is, data requirements are defined and data are collected and stored according to the specific preconditions and needs of e.g. producing the next state of the environment report.

In cases where data work is very closely tied to the repeated publishing of reports there are generally speaking three or four possible directions for development. One is the ultimate **ad hoc-solution**, where data work starts from the beginning for each reporting process. A possible consequence of this approach would be that the resulting collections of data would become 'islands'. That is, re-use of data and combination of data over time or across the various thematic entries would become difficult - or in the worst case: impossible. This way of dealing with data should only be chosen in the case where it is obvious that data demands vary so much over time and thematic entries, that e.g. maintaining time series is of no use.

If it is recognised, however, that the thematic scope of data needed to produce the relevant reports varies only to a certain degree from time to time, it might be preferable to choose a **report-oriented approach.** This implies that data needs are identified by making a more general analysis of the expected contents of the reporting in question, and that data are collected and stored according to the results of this analysis. With this approach it becomes possible to establish and maintain time series on core data in a more continuous way. And although it requires some initial resources to generalise the data analysis and standardise data collection and storage, it will usually be proved that less resources are required in the long run.

[11] 'STANDAT - a standardised format for exchange of environmental data', report for the European Environment Agency, Danish EPA, 1996.

A further step towards a general approach would be to go through a report-oriented analysis for the main output-requirements of the organisation, and combine the resulting data models where possible and feasible. That is, if e.g. data on emissions to air are required in several contexts, differing only in e.g. the level of detail regarding the sources of pollution, it would be more effective to collect these data at the lowest level of detail and make the necessary aggregations yourself, if possible. Furthermore this strategy should minimise the risk of having inconsistent data sets on the same subject. This approach is **a generalised output-driven approach.**

The last step towards generalisation is to combine this bottom-up approach (based on output requirements) with a top-down analysis, resulting in a more **global data model**. Speaking in the terms of general data analysis, it is a question of identifying the relevant 'business areas' of the organisation, and by step-wise refinement modelling the data requirements of these areas in more and more detail, without loosing the global view. Having defined this general framework, it should be possible to organise your data in a comprehensive and consistent way which is robust enough to handle the addition of new types of data.

Still, there are other aspects of data strategic work, and no matter which approach the EEA decides to base its data work on, the following questions should be considered:

- how can data be collected and stored in a standardised way ?
- how are the responsibilities of the different participants to be defined ?
- which tools should be supplied for accessing and working on data at different levels of complexity and integration ?

Answers and solutions will vary in their degree of generality, depending both on resources available and on organisational culture. The MIDAS approach describes one way of answering these questions; as it has already been pointed out any attempts at strategic data work should be carefully adjusted to the organisation in question.

In any case it is recommendable to think carefully about how to organise the work connected with environmental data. Otherwise many resources may be spent on coping with day-to-day requirements and ad hoc-solutions, missing the long-term perspective of establishing a sound and adequate basis for the work of the EEA.

11. Conclusions and recommendations.

In this chapter we would like to present our conclusions and some recommendations for the future data strategic work of the EEA.

The most important conclusions of the data strategic work of the Danish EPA can be related to the four component elements that were presented in chapter three - organisation, data content, human resources and computer and database aspects. But there are also some conclusions that have a more general scope.

The recommendations for the data work of the EEA is presented in boxes by the end of the five first sections of this chapter.

General conclusions.

One obvious question when presented with an environmental data strategy like MIDAS is whether it is really worthwhile to work with data in this way ?

The answer is yes. It is worthwhile for several reasons, the most important ones of which are that it provides a necessary overview of the whole field of your data work; it gives you the opportunity to pinpoint important problems and find the reasons behind them; it ensures that you have a long-term perspective in your data-work; it guarantees that your perspective is not lost in the minor day-to-day problems; it forces you to clarify your objectives; it gives you a heightened awareness of the means available (and it forces you to define them !); it gives you an opportunity to involve important decision makers at management level in the data work of the organisation, and it can be a tool to ensure that projects are defined also for areas where data work is ailing for staff-related reasons or the like.

But it is also important to keep in mind that experience from one organisation should not be used undiscriminatingly in other organisations. The EEA already working strategically and on a long-term basis with its data in many ways. Nevertheless it would probably be worthwhile for the agency to consider doing it also on a larger scale. This could be done both by using the MIDAS methodology and in a more ad-hoc way, as described in the box below and by the end of this chapter.

It has not been part of the terms of reference for this report to make any detailed analyses of the needs for data strategic work of the EEA. In general, such needs can be estimated by considering the answers to questions such as these: are all the necessary data available to the organisation ? Are data easily accessible to all users ? Is the out-put of the data work of the organisation satisfactory, i.e. are data published and used in reports in an adequate way ? Is the organisation of data work adequate, i.e. is the division of responsibility clear to all parties involved, is the work co-ordinated satisfactorily and are there no organisational barriers to data work ?

If the answer to one or more of these questions is ‘no’, it would be worthwhile for the organisation to take a closer look at its data work.

The EEA should consider working on a larger scale with data strategic issues. Depending on this decision, it should first of all be settled whether the EEA wants a proper data strategy or to work on a more ad-hoc basis. Depending on this decision, either

- *define a project that will lead to an environmental data strategy in the MIDAS terminology (problem analysis, use of experience from elsewhere, objectives, tool-box and action plan), put it in the work programme and make sure to get management support* ***or***
- *define a range of individual projects based on a quick assessment of problem areas. These projects should all be able to contribute to data strategic objectives. The range of projects would of course depend on the resources that the organisation is willing to use, but on the basis of the experience of the authors and their knowledge of the EEA at least these aspects should be taken into consideration:*

    - *presentation of data for management (and general public) purposes in an integrated system*
    - *common standards, guidelines and procedures for data work, including a common view of the world (cf. the ongoing thesaurus work) and a model for all data related to the work of the EEA (cf. below)*
    - *organisational aspects including strengthening of co-ordinating procedures*

Conclusions related to computer and database aspects.

There are two important conclusions here: that it is useful to use resources on a system for integrating and presenting your data. Apart from the obvious effects - that you get a better structure and a better way of presenting your data - you will get many other beneficial side-effects. The different parts of the organisation are obliged to work together on the presentation system and this co-operation often leads to a synergy effect. The areas with no data are made visible to everybody in the organisation. The work process often leads to valuable discussions on objectives and methods in data work. Furthermore, the process and the product provides focus on the data work in the organisation.

The second important conclusion is that it can be valuable to define an overall structure for all databases of the organisation. In this way the hierarchy of data is made clear and the way that all the different databases are interrelated is made explicit.

The EEA should consider whether it would be relevant to develop a system for structuring and presenting the most important of its data for the use of decision makers and especially for the public. Made available on the Internet home page of the EEA it would be a very useful way to present key data and make them easily accessible.

The EEA should also consider trying to define an overall structure for the environmental databases in the EEA and in the EIONET structure.

Conclusions related to human resources.

The most important conclusion based on the experience of the MIDAS project is that having enough resources and the right resources for data strategic work is absolutely essential. This might sound banal, but is often underestimated. Strategic data work needs many resources, and they are often difficult to get because the results of this work are long-termed and sometimes do not take the form of one specific product.

Another point is that the data strategic work should lead to the development of human resources that are capable of working strategically with data in the organisation: people that have the background and experience related to e.g. designing a data model for an organisation and providing guidelines for database structuring.

If the EEA wants to work strategically with its data it is extremely important to allocate the necessary resources and the right resources. It is also important to work determinedly with human resource development.

Conclusions related to organisation.

Perhaps the most important overall point related to organisation is that this aspect must not be underestimated. It is often tempting to concentrate your energy on computer technical issues, software systems, technical aspects of monitoring and reporting, but without the formal and informal organisation to handle these aspects, you will not achieve much.

With any fairly scattered organisational set-up, some kind of co-ordination becomes important. Not co-ordination in the form of a large bureaucratic organism. But procedures for co-ordination that ensure the necessary consistency in the organisation. This becomes especially relevant in an organisation of which the most important output is data, and data that it should be possible to combine and link in many ways.

Co-ordination can take many forms: in can be taken care of via formal committees; it can happen in more informal and ad hoc ways; it can be done through specific projects that involve several parts of the organisation and it can be done through common views of the world. Usually some kind of combination of different methods of co-ordination is the most adequate.

For the EEA with the very dispersed EIONET set-up co-ordination is an important issue that needs close consideration. Today different formal bodies exist for this purpose (i.e. the ITTAG-group and the National Focal Point group). That this work is efficient is important and it should be subject to a continuos informal evaluation and adjustment if necessary.

But apart from this other tools for co-ordination should be applied, e.g. common guidelines and formats.

It is also important to consider if the responsibility of all involved in the EIONET organisation is clear and explicit. And the role of the EEA itself in this context should be considered carefully. There is no other unit in the network that is naturally obliged to take care of overall co-ordination, common guidelines etc. Therefore it is important that the EEA takes the responsibility for such tasks despite the drain of resources that this might lead to. The effect of taking care of these tasks are long-term - and so are the effects of not doing it.

Lastly, it might be useful to consider the internal organisation of data-strategic work in the EEA, cf. chapter 9.

Conclusions related to data content.

There are two important points here: working with MIDAS has demonstrated that it is useful to define an overall structure and picture of the world for all your data. This is relevant in order to get an overview, to be able to pinpoint data needs and to make the way that data are interrelated explicit. It is also valuable as a way of unifying the data work in a large and diversified organisation - by working along the lines of some kind of common view of the world, some level of unity is obtained.

Another point from the MIDAS project is that it is valuable to have some kind of mechanism to ensure that there is a systematic method for evaluating the available data in detail and pinpoint needs and lacunas. In the implementation of the MIDAS strategy this is done by 'thematic analyses' on a rotation basis, looking at one subject area at a time.

The agency should consider the importance of having a common view of the world for its data to unify the data work in the very large organisational set-up that surrounds the agency.

Lines of action.

It is probably not possible to define one course of action that is ideal for **all** organisations. Never the less the method of the MIDAS project can be summed up in something close to a recipe that can be adjusted according to the needs of the users:

1.	Preparations ! This is vital for your chances of succeeding. Make sure to have the necessary resources and the necessary time, ensure the necessary institutional anchoring (e.g. make sure it gets into your work programme), ensure management back-up.
2.	Set up your task force, agree on the course of action and a precise set of terms of reference.
3.	Problem analysis. Pinpoint the symptoms of problems, and analyse the problems behind the symptoms. Do not be content with a mere identification of symptoms. Involve all relevant departments of your organisation through a series of interviews. Look for needs, for ideas, for objectives and for ideas for tools in your talks with colleagues.
4.	Analyse the experience of other organisations and pick out the ideas that are relevant to your organisation and to the mending of the problems you have identified
5.	Define your tool box on the basis of 4 and 5. Make sure that you have tools that will cover all the relevant problem areas
6.	Define your objectives. These can usually be identified on the basis of the general functions and objectives of the organisation and on the basis of the problems identified. Involve relevant departments of your organisation, remember the management.
7.	Set up the strategy - a report or paper where you describe the problems, objectives and tools in their context.
8.	Set up an action plan, preferably incorporated into the strategy. The action plan is very important as it defines how the implementation process is to be carried out
9.	Make sure that you have some mechanisms to ensure that the process is iterative and new requirements can be incorporated into the framework of the strategy - e.g. evaluations and adjustments
10.	Now the trouble starts: you have to implement the strategy. Make sure that the resources do not disappear, hold on to the institutional anchoring and the back-up of the management. You have to concentrate on each of the different elements of the strategy, but you also have to keep an eye on the context. And you have to involve large parts of your organisation.

Please note that the order of the phases is not totally rigid. It can e.g. be debated at what stage of the process it is most adequate to define the objectives of the strategy.

There are of course a number of short-cuts that can be made. These are especially useful and relevant if you decide to define a couple of individual data strategic projects rather than having a comprehensive data strategy. The most recommendable short-cut is to shorten the analysis phase by having a one-day or two-day seminar or workshop with key persons from all the relevant segments of the organisation. The idea is to comprise the phases three to eight into one short process. There are several well-tried methods to use in such a seminar. One of these is the Logical Framework Analysis method that is distinguished by including problem analysis, objectives, outputs, activities and an assessment of resources needed in one coherent and logical analytic process.

Furthermore this method is very suitable for group-oriented processes i.e. at a seminar with important decision-makers and stockholders.

Whatever is determined it is important from the outset to decide on a method and not try to go through the process in a more haphazard way.

Whether the EEA wishes to follow the path described here - or to follow part of it - is up to the organisation itself to decide. No matter what decision is made, it is important not to forget the long-term, strategic aspects of data work.

12. Executive summary.

This chapter provides a quick overview of main points from the whole report. The figures in the left column refer to chapters, pages and figures in the report where the relevant information is elaborated and explained in more detail.

What is MIDAS ?

Chapter 1, p.1

The name 'MIDAS' is used by the Danish EPA as an acronym for its environmental data strategy. This strategy was initiated in 1991 and is now under continual implementation. A data strategy in the MIDAS concept of the word requires a problem analysis; an analysis of valuable experience made elsewhere; the set-up of a range of objectives; a tool-box with a set of tools for achieving these objectives; and a strategy combining the tools and the objectives in an action plan.

Chapter 2, p.5

Objectives of the report.

Chapter 1, p.1

The present report is part of a package of project launched by the Danish Ministry of Environment and Energy for the support of the European Environment Agency (EEA). The main objective is to transfer knowledge and experience of the MIDAS project to the EEA. The idea is not the adoption of the MIDAS strategy by the EEA, but to enable the EEA to use the MIDAS project as an inspiration in its data strategic work.

The starting point.

The starting point of the MIDAS project was a problem analysis - an attempt to pinpoint not just the immediate problems, but the reasons behind them. Five major problem areas were identified:

Chapter 3, p.10f

1. Problems related to internal organisation of data work in the Danish EPA - there was decentralisation *without* co-ordination where it should be co-ordinated decentralisation
2. Problems in relation to the co-operation with other bodies outside the EPA mainly in the collection of environmental data
3. There was not enough demand for data and focus on data from the top level of the organisation and from the outside world
4. There was a lack of practical training - not in the use of specific software tools but in the general production and use of environmental data
5. Resources for environmental data work were scarce.

Figure 3.1, chapter 3, p.9

In establishing objectives, tool-box and strategy focus was on four aspects of environmental data work: organisation, data content, human resources and database aspects.

The tool-box.

After describing the background and problem analysis of the original MIDAS report, the present report looks into the tool-box of the MIDAS project. Some of

the most important tools are presented in more detail, among them:

Chapter 4

The conceptual framework - which is a tool for defining the main categories of data relevant when describing and analysing any field of environmental work. The objective is to ensure that the available data are comprehensive. The conceptual framework can be put into a form and in this way work as a kind of checklist (see table below). Data on environmental problems are of course relevant, and sectors in society are important, as they are the target groups for most environmental policy. Other important aspects are data on the state of the environment; data on regulation; and data on environmental economy.

State of the Environment		**Env. Problem**	**Sources of pollution**		**Regulation**		
State	Pressure	Location and extent	Structural/ behavioural aspects	Contribution to environmental problem	Objec-tives	Measures to be taken	Time limits/ expenditure

Chapter 5

Thematic analyses - which is a way of dealing with a large subject area by dividing it into smaller bits. In the original MIDAS report it was not possible to go into any detail with the problems and data needs related to the many different areas of work of the Danish EPA. Therefore it was decided to go through the different areas one by one with the double aim of pinpointing problems and providing strategies for improvement. A set of rules for this work was defined, and the conceptual framework was used for the definition of data gaps and data needs.

Chapter 6

Organisation of data - another idea of the original MIDAS report was to have data in different levels to make it easier to combine data and use them in more than one context. This involved a hierarchy of data according to their level of detail and to the way they were to be presented. The levels were expert data (the most detailed level); thematic data combining data from the different expert databases that were relevant to the theme in question (presented in a GIS-system); and keydata. This was completed by the idea of having a computer based catalogue of data to supply overview and the idea of having a database of common data (data used in more than one database).

Chapter 7

The key data system - the idea of the key data system was to have a tool for structuring, combining and presenting environmental data at the highest level of aggregation to decision makers. The system was supposed to combine graphic presentations and map-based presentations, and a special tool was later developed for this purpose. In the actual implementation process the distinction between key data, thematic data and expert data was dissolved so that the key data system ended up including data down to a fairly high level of detail.

Chapter 4, p.14 ff.

Some of the other tools recommended in the original MIDAS strategy are: Guidelines and procedures for environmental data projects; clear definitions of responsibilities related to data work; standard agreement with data suppliers; specialised training courses; strengthening of the data co-ordinating group in the Danish Ministry of Environment and Energy.

The implementation of the MIDAS strategy.

Chapter 8

In the implementation process pilot projects and proto-typing were important methods. At the overall level, the whole MIDAS strategy was subject to an evaluation and reformulating after a period of a year. This was done to make sure that the strategy was up-dated and experience made useful.

Using experience from other countries and agencies.

Chapter 9

To broaden the perspective of the report a little, experience from the United States is discussed. Main points are summed up in table 9.1.

Preconditions etc. are summed up in table 9.2, p.53

An important point when discussing experience is the preconditions for initiating data strategic projects and carrying them out. Important is also the discussion of counter-productive conditions. When starting and implementing data strategies it is vital to be aware of these conditions and to try to neutralise them.

Conclusions and recommendations.

Chapter 10

Another way of summing up your experience is by discussing what you would change in your approach if you had the chance. In the MIDAS context, more focus would have been put on visibility and user-oriented intermediary products to ensure continuous involvement by the whole organisation. Also more focus would be put on the range of software tools available and on aspects concerning the outside world, e.g. making data available to the public.

When your data work is very closely tied to the production of specific reports there is a span of approaches to collection, storage and retrieval of data ranging from an ad-hoc-model approach to a global data model approach.

Chapter 11

When you are going to decide whether data strategic work is relevant for your organisation, there are some questions that can be used as guidelines, e.g. are all the necessary data available to the organisation ? Are data easily accessible to all users ? Is the out-put of the data work of the organisation satisfactory ? Is the organisation of data work adequate, i.e. are there no organisational barriers to data work ? If the answer to one or more of these questions is ‘no’, it is worthwhile to take a closer look at the data work of the organisation.

The MIDAS method is summarised in the table at the very end of chapter 11.

If a need for data strategic work is recognised there are basically two ways of doing it: the MIDAS method, comprising a comprehensive data strategy, or a more ad-hoc way. Basically it is a question of resources and time that decides which approach is most adequate. In the report it is recommended that the EEA considers its need for data strategic work. If it is agreed that there is such a need the EEA could either define a project that will lead to an environmental data strategy **or** define a range of individual projects based on a quick assessment of problem areas. These projects should all be able to contribute to data strategic objectives. The range of projects would of course depend on the resources that the organisation is willing to use, but at least these aspects should be taken into consideration:

A suggestion for a method for initiating

a more ad-hoc set of projects is presented at the very end of chapter 11.

- presentation of data for management (and general public) purposes in an integrated system
- common standards, guidelines and procedures for data work, including a common view of the world (cf. the ongoing thesaurus work) and a model for all data related to the work of the EEA
- organisational aspects including strengthening of co-ordinating procedures

Other recommendations concern:

- development of a system for structuring and presenting key data.
- allocation of the necessary resources and human resource development.
- co-ordination within the EIONET - apart from formalised co-ordinating bodies e.g. common guidelines and formats can be used as mechanisms for co-ordination.
- organisation and especially division of responsibilities and the role of the EEA itself in relation to overall guidelines etc.
- a common view of the world for data to unify the data work in the very large organisational set-up that surrounds the agency.