Water Quality R&D - Awareness and Implementation

Technical Report
P324

Water Quality R&D - Awareness and Implementation

Environment Agency Workshop

R&D Technical Report P324

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Research Contractor:
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EXECUTIVE SUMMARY

The Water Quality Function of the Environment Agency hosted a workshop to discuss issues related to the awareness and implementation of Water Quality R&D. The workshop revealed that there are differing levels of awareness of Water Quality R&D throughout the Agency; to some extent it was felt this problem is linked with Agency structure and organisation. However, those Agency staff present were also of the opinion that the R&D programme does deliver demonstrable benefits to the Agency. A number of issues were highlighted where improvement could lead to the enhanced uptake and implementation of the results of R&D:

- **Communication and awareness**. The general awareness of R&D overall and the benefits it can add appears to be particularly poor at an Area level, although many Area staff could list individual R&D outputs that had proved to be effective. Communication needs to be improved both in terms of increasing awareness of R&D amongst Agency staff in order to gain feedback on implementation, and to identify R&D needs at an operational level.

- **Ownership**. In order to be effective the R&D programme and its outputs must be supported and owned at all levels throughout the Agency. It was felt that for R&D implementation to be effective it is critical to have support at both Director and operational level. More support needs to be given to Project Managers from line management to enable involvement in R&D to become accepted as part of the day job.

- **Implementation.** It was clear that the implementation of R&D outputs should be considered in more detail at an earlier stage in the project. In addition, it was highlighted that the R&D Project Manager who makes the recommendations for the implementation of the results of R&D does not generally have the responsibility to see the recommendations through.

Finally, it was illustrated that the Agency allows projects to run to completion, even when it has been recognised that the work is no longer required or will not be useful to the business. A system of **project reviews** is required to allow such projects to be identified and terminated. However, a change in culture is also required in order to ensure that Project Managers are not discredited for taking such measures and that project termination for the reasons above is not seen to be a failure.

KEY WORDS

R&D Implementation, R&D Management, Communications, Workshop

1. INTRODUCTION AND AIMS

The Water Quality Function of the Environment Agency hosted a two-day workshop (29-30 March 1999) at Regent's College, London, to discuss issues related to Water Quality Research and Development (R&D).

The overall aims of the workshop presented to participants were:

1. To raise awareness internally within the Agency of current and recently completed R&D undertaken by the Water Quality Function.

2. To identify how to achieve better communication and lines of responsibility during the R&D process.

3. To review the processes involved in the successful implementation of R&D and to compare and contrast these with experiences from external organisations.

The first day of the workshop was for Agency staff only and provided an opportunity for Water Quality R&D Topic Leaders (or their delegates) to:

- describe the business need and opportunity of their R&D Topic Area;
- give an outline of the research, the results, conclusions and recommendations;
- describe the benefits / added value to the Agency; and describe
- implementation issues and challenges.

The second day involved invited external participants and specifically addressed the issue of the implementation and uptake of R&D.

In addition to presentations, both days included group 'brainstorming' discussion events.

Detailed objectives and discussion questions and summaries for both days are presented in Appendix A. The participants for the workshop are presented in Appendix B with the programme in Appendix C and presentations given and the points arising from them in Appendix D.

1.1 Structure of the Report

This report:

- presents the issues raised and discussed during the brainstorming sessions on each day (Section 2); and

- puts forward a list of actions which the Water Quality Function and the Environment Agency as a whole could take forward to address some of the issues raised (Section 3).

1.2 Overview of Water Quality Function Business and R&D Topic Areas

The overall business aim of the Water Quality Function is to achieve a continuing and overall improvement in the quality of controlled waters through the prevention and control of pollution. The Water Quality Function (and the Agency) needs effective R&D to underpin development of policy, ensure improvements in efficiency, make advances in regulatory control together with advancing scientific understanding of the water environment and the impacts which occur upon it. The Water Quality R&D Programme (P2) comprises five Topic Areas with the following objectives:

P2A – Ecotoxicology and Hazardous Substances Topic Area - Jim Wharfe.

- To provide a sound scientific understanding of hazardous substances and mixtures in the environment and to support the development of associated strategies and policies.

- To provide underpinning information for the derivation of environmental standards and to assist in the formulation and implementation of use related water quality objectives.

P2B – Consenting and Discharge Impact Topic Area - Gerard Morris.

- To provide methodologies and techniques for assessing the impact of discharges to controlled waters and to develop new methods for controlling pollution arising from such sources.

P2C – Rural Land Use Topic Area - Bob Huggins.

- To provide information and introduce best practice for assessing and controlling diffuse pollution from agricultural activities and forestry practices.

P2D – Groundwater Pollution Topic Area - Bob Harris.

- To provide methods for, wherever possible, preventing pollution, assessing the extent of, and subsequently controlling the pollution of groundwater.

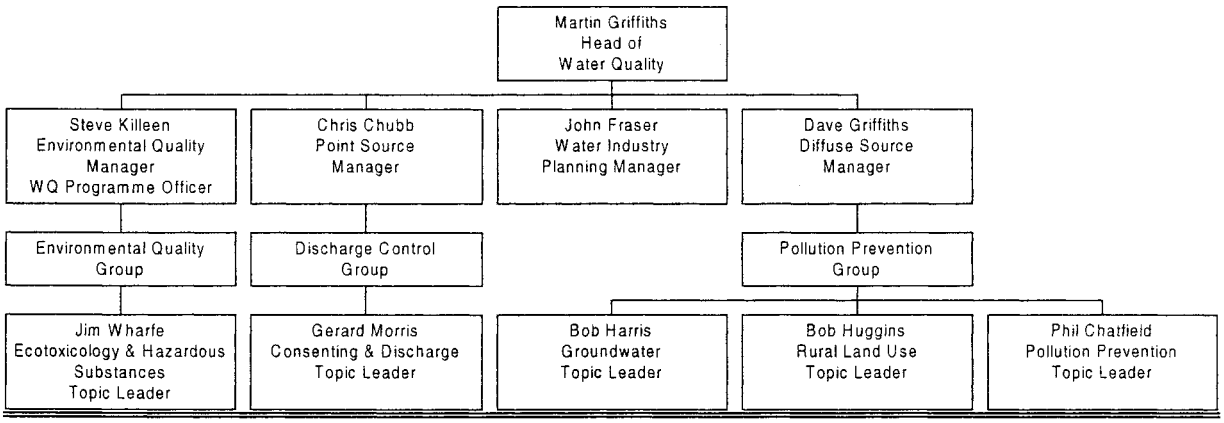
P2E – Pollution Prevention Topic Area - Phil Chatfield.

- To develop and introduce new techniques for preventing and controlling pollution from road run-off, firewater and other accidental and deliberate unauthorised spillages.

The above Topic Areas support the overall business of the Water Quality Function but are allied to specific business groups (see Figure 1).

The generation of R&D in the Water Quality Function is interactive. The business groups represent top-down customer groups where the R&D requirement is largely policy driven. There is also a bottom up approach in the form of proposals from Topic Leaders, project managers, and others in the Function and elsewhere. All proposals have to be considered by the Water Quality Function Group, Environmental Protection Directorate and finally the R&D Programme Board to set the prioritised Water Quality R&D Programme for the forthcoming year.

Figure 1.1 Water Quality Function



2. MAIN POINTS ARISING FROM THE WORKSHOP

Throughout the workshop the issues being discussed centred on four main themes:

- communication and awareness;
- ownership;
- implementation; and
- project management.

The main points arising from the discussions are presented below.

2.1 Communication and awareness

Many of the perceived problems relating to internal communication and awareness, with respect to R&D, spread beyond the Water Quality Function and are Agency-wide. Although Area staff could list specific R&D outputs when questioned, the general awareness of R&D and the overall value it can add to the Agency's business is particularly poor. Area staff appear not to know what R&D is ongoing or what outputs are produced. It was felt that the organisational systems in place to proactively seek information concerning R&D had deteriorated since the transition from NRA to Agency, and that recent restructuring and recruitment had also contributed to the lack of awareness. However, these points are currently being addressed with an electronic catalogue of R&D outputs available on CD-ROM, and with comprehensive information on the National R&D Programme now available both on the internal bulletin board and Agency website.

Improved communications between the Function and Areas would ensure an understanding within the Areas of the reasons why the Agency should conduct strategic and policy driven R&D, together with an appreciation of what R&D can offer. A number of initiatives that could achieve this were identified including:

- roadshows to present R&D and its results and formal training sessions on the R&D process and programme;
- holding seminars and workshops to create awareness and facilitate implementation, both prior to project start up and at completion;
- the development of "Area champions" to promote R&D within Areas and to support Project Managers in delivering the technical aspects of the project;
- improved responsibility by Topic Leaders to take R&D back to Regions and Areas and seek feedback; and
- the identification of direct channels between Areas and Head Office to allow improved communication of ideas, feedback and the results of R&D. This could

include R&D management support officers (MSOs) and Topic Leaders making themselves better known to Area staff.

In addition to communication and awareness of R&D within the Agency, it was felt that the public perception of the Agency as an organisation which promotes and participates in R&D and which stands for sound science could be improved, and that effective external dissemination of results of R&D is required. In order for this to be effective, simple summary reports should be produced that can easily be understood by the public. Where appropriate, research results should also be disseminated within other governmental organisations and industry. Providing that the research is sound, this may help to supplement and improve the Agency's influence over decision making within such bodies.

2.2 Ownership

For effective development, management, implementation and use, R&D must be supported at all levels within the Agency. It was felt that this support is lacking in some sections of the Agency.

The lack of ownership of R&D is apparent at the Area operations level. It was felt that there is little influence on the R&D process from the development of the programme through to involvement in projects and the implementation of results. To a large extent this problem could be addressed through improved communications. Training or awareness sessions could be instigated in order to equip Agency staff at all levels to identify research needs for the Agency and to inform them how to feed such ideas into the R&D planning process.

The failure to accept responsibility for implementation was a major reason cited for projects failing to achieve an impact. Clearly, a careful delineation of responsibilities between the project manager and the sponsoring business group is required once the R&D stage has been completed.

It is perceived that R&D is not always supported as much as it could be by the Agency Board as some past policy decisions seem to have been made solely for political reasons and bear little relation to the supporting R&D that may have been conducted by the Agency.

2.3 Implementation

It was generally agreed that effective implementation of R&D throughout the Agency does not always occur. The following reasons were identified during the workshop:

- lack of involvement of the end-users or other key Agency staff (e.g. Corporate Information Systems (CIS)) in the project leading to an output that is difficult or impossible to implement, or which doesn't comply with existing Agency specifications.

- failure of long-term projects to evolve with changes in business drivers, leading to an output that no longer meets the Agency's business needs;

- poor contractors failing to deliver the work;

- poor initial specification of a project;
- project timeliness:
  - projects being commissioned too early with the subject that they are covering not yet being of importance to the Agency; or
  - projects taking too long to deliver their output such that the problem which they address has already been dealt with by other means.

The implementation of R&D outputs should be recognised to be as important as the research itself, and as such it must be supported from the highest levels within the Agency with mechanisms put in place to facilitate this stage of the work. It was suggested that an improved, and publicised, commitment from internal decision makers to R&D and its implementation would improve this position.

In order to facilitate the implementation of projects, it was suggested that user-orientated outputs be made standard where appropriate. More effort should be devoted to identifying the likely uptake route, end user and end user requirements of a project before it is commissioned. This should ensure that the final output is user-orientated and that the likely implementation costs are taken into account at an early stage. The effectiveness of implementation of an R&D output could be tested through the use of pilot projects.

2.4 Programme and Project Management.

It was suggested that the Agency should carry out a "gap analysis" on its R&D programme, comparing the priorities of the Agency, as laid down in its various strategies and business plans, with the R&D programme it has developed. This should ensure that the programme is sufficiently comprehensive and linked to the business needs of the Agency. It was also pointed out that the Agency could gain access to more research through increased association with other research organisations and by increased participation in collaborative research projects. Such opportunities include the EU Fifth Framework Programme of Research and Development, several areas of which are relevant to the Agency.

As outlined in Section 2.2, ownership of R&D is seen to be lacking. It must be ensured that Area and Regional staff have sufficient opportunity to contribute to the Agency's R&D programme. It was felt that the current methods used to develop the programme can stifle innovative ideas.

With respect to project management, it was made quite clear that there is perceived to be a general lack of internal support for project managers. It was felt that R&D project management is an added extra for which sufficient time is often not allowed in work schedules. It was also made clear that in a number of cases project management was also not recognised by line managers as a potential for personal development. Such factors have led to a general lack of willingness of individuals to become project managers and therefore needs to be addressed throughout Agency from the top down.

3. CONCLUSION AND ACTION LIST

Conclusion:

R&D plays a crucial role in ensuring that the Agency can function effectively and hence maintain its reputation as a credible regulator whose activities are underpinned with sound science. The Agency cannot, however, simply increase its R&D spend to meet the myriad of challenges with which it is faced – in fact the current trend is that the R&D budget is declining in real terms. The Agency must spend its R&D budget more effectively; that is strategically and efficiently.

The workshop presented an opportunity to highlight the topics of concern and initiate discussion and exchange of ideas in this area. A clear message came from the discussion and brainstorming sessions held during the two day workshop; R&D is not fully integrated or owned by the business it is there to serve. Traditionally, R&D in the Agency has been regarded as an exclusive process with specialised planning and management practice and cycles that are neither aligned to functional or corporate business. There have been significant steps over the past few years to integrate R&D into the business. R&D should now be accepted as an inclusive practice that is incorporated into general organisational endeavour in order to provide a more effective service to the business and for the optimal utilisation of limited resources.

The goal for the Water Quality Function, with respect to R&D, is to produce an R&D programme that is complete with respect to business need and integrated to its business strategies. The workshop reported here represents Water Quality's commitment to moving toward this goal and will make a valuable contribution to the on-going debate on R&D management in the Agency.

Water Quality Function Actions:

- Undertake a critical evaluation of the Water Quality R&D Programme to recommend guidance and improved procedures;
- Ensure that the Water Quality Programme is aligned to business need;
- Ensure that sponsoring business groups recognise the importance of their role in implementation;
- Host an annual R&D workshop to:
    - Increase communication with Areas;
    - Promote the outputs of the Water Quality R&D Programme, both internally and externally;
- Ensure that project managers have line management sign up;
- Terminate projects that are no longer required by the business.

Water Quality Function recommendations to the R&D Unit:

- Area R&D roadshow to increase the profile of the R&D Programme and its management;
- Investigate the possibility of setting up Area champions for R&D.

APPENDIX A GROUP ACTIVITY DISCUSSIONS

A.1 SUMMARY OF DAY 1 DISCUSSIONS

The objectives for the brainstorming activity on day 1 were:

1. To assess the perception that R&D was generally failing (or failing to be recognised) to deliver the anticipated benefits.

2. To review successfully implemented Water Quality R&D outputs and the reasons for this.

3. To review the reasons for Water Quality R&D outputs failing (or failing to be recognised) to deliver the business benefits and to recommend best practice and practical solutions.

To assist with meeting these objectives the following specific questions were asked:

1. How aware are the audience of Water Quality R&D?

2. How does Water Quality R&D provide value to the business?

3. Why do some Water Quality R&D outputs fail (or are perceived to fail) to deliver the benefits?

4. What are the opportunities to improve:

   - fitness for purpose?
   - implementation processes?
   - R&D recognition?

Q1 How aware are the audience of Water Quality R&D?

The level of awareness throughout the groups was linked to the individuals' previous level of involvement in the R&D process. Awareness at the Area level was less than at a Regional level and this was less than that at a National level.

Concerns/criticisms/suggestions that were put forward included:

- lack of knowledge of what R&D is producing;
- there is currently no proactive opportunity to seek information on R&D;
- a source of information on what R&D has been completed/is ongoing is required; and
- the organisational systems appear to have deteriorated in the transition from NRA to Environment Agency.

Q2 How does WQ R&D provide value to the business?

Despite the perceived lack of awareness of R&D amongst some members of the groups, all groups could define benefits that R&D provides to the Environment Agency's business, including:

- making the business more efficient, effective and consistent;
- supporting the main business aim of achieving environmental improvement;
- developing sound science on which to base the Agency's decisions and operations;
- improving staff development (if involved in R&D);
- offering concrete outputs, both in the shape of tools to be put into direct use, or by laying the foundations to increase the knowledge base and enable the Agency to influence future direction and decision making;
- influencing people outside the EA by providing the opportunity to increase PR;
- enhancing the Agency's reputation and credibility; and
- presenting commercial opportunities in selling outputs.

One group discussed the balance between research and development. It was felt that the Agency was at the leading edge when it came to development but often did not take the lead with research projects. Overall the Agency was seen to undertake more development than research projects.

Q3 Why do some R&D outputs fail (or perceive to fail) to deliver the benefits?

One group felt that there should not be an expectation that all R&D should deliver a benefit. However, failure to deliver was not seen to be acceptable where it was the result of poor management or a poor contractor.

Reasons for failure included:

- lack of understanding of the importance of R&D and therefore a lack of commitment to R&D in some sections of the Agency. There was also felt to be a lack of support internally for project managers with organisational commitments and time pressure of the 'day job' having to take priority and R&D involvement not included in personal development plan;
- the output of R&D is not relevant or only partially relevant by the end of the project due to failure of some long-term projects to change alongside evolving business needs;
- Area staff felt that R&D outputs have not been generally accessible to them due to a lack of awareness of R&D outputs and how to obtain them;

- there is seen to be a lack of support for the R&D programme and for the implementation of R&D at a Director level;

- decision making with respect to the implementation of R&D, and with respect to other Agency policies, is seen to be political and to have no relation to the actual results of R&D;

- there is felt to be a lack of ownership, within operations, of the R&D process, from influencing the development of the R&D programme, through involvement in projects to the implementation of the results of R&D;

- the lack of involvement of those who will be involved in the implementation of the results of R&D at an early stage (e.g. those who have the power and budgets to authorise the implementation and those who will have to implement the results on the ground) leads to R&D not being implemented as effectively as it might, if at all;

- there is lack of awareness of R&D procedures and outputs within Areas due to recent restructuring and number of new personnel;

- poor contractors - need for performance assessment;

- poor definition of specifications for projects;

- the current way the R&D programme is developed does not allow the opportunity for innovation amongst Agency staff;

- frequently the output of R&D is not timely - either too early (the issue with which it deals has not yet arisen) or too late (the issue has been dealt with by other means) - this leads to missed opportunities;

- guidance is required to enable Agency staff to identify R&D needs and to know how to feed those ideas into the R&D planning process.

Q4 What are the opportunities to improve fitness for purpose, implementation processes and R&D recognition?

A number of improvements to address the reasons for failure identified above were proposed by those present at the workshop. These included:

- better communications to improve:
  - understanding by operational staff of the need for strategic research;
  - understanding by operational staff of the benefits R&D can offer;
  - awareness of and access to information sources.
- This could include:
  - roadshows and formal training;

  - holding seminars and workshops at the end of projects to create awareness;
  - the development of "Area champions" to promote R&D within Areas and to support Project Managers in delivering the technical aspects of the project;
  - improved responsibility by Topic Leaders to take R&D back to Regions and Areas and seek feedback;
  - clearly identifying the costs and benefits of outcomes where possible in order to gain Area support;
- inclusion of R&D in personal performance objectives in order to recognise involvement in R&D as part of the day job - it should not be seen as an added extra;
- consideration of the implementation of R&D at an early stage including any likely resources required and the involvement of CIS, this could be achieved by the use of user implementation panels;
- R&D staff making themselves better known to Area staff;
- the encouragement of innovation within Agency and the instigation of more in-house R&D, i.e. contract less R&D;
- publicising the output of R&D so that the source (i.e. R&D) is clearly identified;
- the clarification of the end-user and the appropriate implementation pathway;
- the more effective participation of business groups in the development and implementation of R&D;
- the extension of the role of R&D management support officers (MSOs) to process champions should be considered in order to involve more staff within Agency in the R&D process.

A.2 SUMMARY OF DAY 2 DISCUSSIONS

The objective for the brainstorming on day 2 of the workshop was:

- To evaluate current Agency R&D implementation practice against generic strategies and those used in key external organisations in order to devise more effective future mechanisms/Best Practice to address the problems identified on day 1.

To assist with meeting these objectives the following specific questions were asked:

1. How is the success of R&D monitored in the Environment Agency and external organisations and what indicators are used?
2. What measures could the Environment Agency adopt to improve the uptake and implementation of R&D?

- an improved commitment from internal decision makers to R&D and the importance of innovation;

- a "gap analysis" should be carried out on the Agency's R&D profile, comparing the needs and strategies of the Agency to the R&D programme, to ensure that the programme is sufficiently comprehensive;

- draw more on the R&D success of others - capitalise on the UK SET base and contribute to more collaborative projects;

- develop business plans to clearly link R&D to the business.

APPENDIX B PARTICIPANTS

R&D Meeting, Monday 29 March 1999

Attendees - Day 1

D Bird
A Bramwell
G Brighty
M Charnock
P Chatfield
C Chubb
J Coombe
A Croxford
B Edmunds
A Ferguson
M Forshaw
D Foster
S France (WRc)
J Goddard
D Griffiths
M Griffiths
B Harbott
A Hart
D Hogan
P Hogan
D Keeling
M Kibblewhite
S Killeen
R Knight
P Leinster
J McEvoy
G McKissock
G Morris
M Morris
N Morris
B Pailor
D Palmer
A Picken
L Pope
L Powell
N Reader
N Smith
K Thomas
C Tidridge
J Tinsley
M Walton
T Warn
G Wealthall
J Wharfe
P Whalley (WRc)
A Wilkinson
A Wither
A Wood
L Woodburn
B Zaba

R&D Meeting, Tuesday 30 March 1999

Attendees - Day 2

D Ainsworth (FWR)
D Bird
M Bramley
A Bramwell
A Brown (HSE)
P Chatfield
C Chubb
I Clifforde (WRc)
C Corbishley
J Edwards
M Forshaw
K Fox
S France (WRc)
D Griffiths
M Griffiths
B Harbott
A Hart
A Jenkins (NERC)
S Killeen
D King (EPSRC)
S Lambert (WS Atkins)
G Leeks (Ext)
D Leggett (CIRIA)
G McKissock
J McTiernan (SEPA)
B Merriman
G Morris
L Powell
R Reeves
P Saunders (DETR)
L Scholes
D Taylor (Brixham Env. Zeneca)
G Wealthall
J West (UKWIR)
J Wharfe
P Whalley (WRc)
B Wilkinson (NERC)
A Wood
B Zaba

APPENDIX C WORKSHOP PROGRAMME

Water Quality R&D
Monday 29 March 1999

(Environment Agency only)

Programme

Chairman: Steve Killeen

1000	Registration, Coffee	
1030	Introduction to Workshop	Paul Leinster
1045	Overview of Water Quality Programme	Steve Killeen
	Presentations from Topic Leaders:	
1100	Groundwater Pollution	Alwyn Hart
1130	Ecotoxicology and Hazardous Substances	Jim Wharfe
1200	Rural Land Use	Richard Smith
1230	Buffet Lunch and Poster Session	
1400	Consenting and Discharge Impact	Gerard Morris
1430	Pollution Prevention	Phil Chatfield
1500	Tea	
1515	Discussion Group Activity Introduction	Paul Leinster/Martin Griffiths
1645	Report Key Issues from Discussion Groups	
1700	Close	

WATER QUALITY R&D
Tuesday 30 March 1999

Programme

Chairman: Mervyn Bramley

0930	Registration, Coffee	
1000	Introduction	Mervyn Bramley/Steve Killeen
1015	Environment Agency R&D Procedures and Experience	Bogus Zaba
1100	The Role of the Environmental Protection National Service in R&D	Dave Bird
1115	Coffee	
1130	An Industrial View - Zeneca	David Taylor
1200	Health and Safety Executive View	Alan Brown
1230	Cranfield University R&D Management Centre View	Richard Reeves
1300	Buffet Lunch and Poster Session	
1400	Discussion Group Activity Introduction	Steve Killeen
1530	Tea	
1545	Report Key Issues from Discussion Groups	
1630	Summary and Next Steps	Mervyn Bramley/Steve Killeen
1700	Close	

Q1 How is the success of R&D monitored in the Agency and external organisations and what indicators are used?

This question seemed to raise more questions than answers. In particular:

- should implementation be measured as an indicator of R&D success? R&D projects do not always require implementation;
- the audience for each R&D project differs and therefore the criteria for the measurement of success of each R&D project will be different:
- there will be different indicators of success for different types of research (e.g. strategic R&D may feed into policy development whilst operational R&D may result in the development of a tool);
- there are two points for measurement of success - R&D delivery and R&D uptake.

However, it was possible to identify some criteria for the measurement of the success of R&D.

NERC success criteria include:

- publications (at least 2 per year per project) - these are seen as key criteria to the success of a project;
- repeat work for the same customer or others;
- patents;
- spin-out companies;
- inclusion of results on data bases of research on in specific areas compiled by other organisations;
- products taken to market; and
- review on completion.

Criteria identified by Agency staff included:

- how much influence over governmental or industrial decision making does Agency derive from the results of research;
- effective dissemination of the results within Agency and externally;
- the Agency's ability to provide answers to external queries;
- media coverage and general public interest in the results of R&D, number of press releases issued, column inches, radio/TV minutes;

- have the objectives and expected benefits of the R&D been achieved - in order for this to be assessed they should be set out clearly at the beginning of the project;

- have the 'lives' of the end-users improved as a result of the R&D - is the tool which has been developed effective in its use?

- has the stewardship of the environment improved as a result of the R&D?

Q2 What measures could the EA adopt to improve the uptake and implementation of R&D?

The brainstorming groups on Day 2 had more success in identifying measures that the EA could adopt. These were as follows:

- improved communication, including:
  - continual re-assessment of customers' needs - the procedure needs to be more formal than at present;
  - the production of simple summary reports - readable by a 'Sun' editor;
  - the identification of clear implementation channels between Regions, Areas, National Centres and Head Office which would make R&D implementation more effective;
  - improved marketing of ideas;
  - encouraging peer reviewed publications by Environment Agency specialists to promote awareness internally and externally;
  - improve the public perception so that it is made clear that the Agency stands for sound science;
  - the creation of "Area Champions" to act as liaison points between functions and Areas, to provide feedback to functions on Area R&D needs and to promote the results of R&D within Areas;
- giving ownership and empowerment to individuals throughout the entire project from inception to implementation;
- placing accountability of the implementation of R&D at the Director level;
- improving recognition throughout the Agency of what R&D has delivered and what it has the potential to deliver;
- developing user orientated outputs;
- use of pilot projects to test implementation concepts;
- need for 'assurance' - giving customers confidence in the work;

APPENDIX D PRESENTATIONS

D.1 OVERVIEW OF WATER QUALITY R&D

D.1.1 Presentations

ENVIRONMENT AGENCY

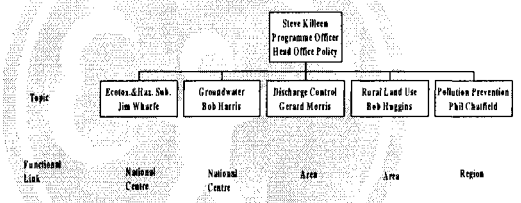
Overview of Water Quality R&D Programme

Steve Killeen

Water Quality R&D Programme
1998/1999

- **Large programme - 107 projects (£2m approx.)**
  - **69 on-going**
  - **34 new starts**
  - **4 technical services**
- **Excellent support from Functional Business Groups.**
- **Effective programme management structure.**

Programme Structure



- **Good distribution of project managers across the Agency**

Water Quality R&D Programme Key Objectives

- **Consolidate and develop science base**
- **Formulation of water quality objectives and standards**
- **Improved regulatory control**
- **Introduction of best practice for assessing and controlling diffuse pollution**
- **Pollution Prevention**

Key Activities

- **Responding to a range of pressures**
  - **Project ceiling limits**; support to project managers to complete projects. Phasing of new starts
  - **Financial management**; effective management to ensure full productive use of budget
  - **Implementation and delivery**; successful national training courses organised and delivered. Secondee to support programme implementation and training.
- **Demonstrate benefits of programme**

Water Quality R&D Programme 1999/2000

- **Approximately £1 million for new starts**
- **Total of 18 proposals**
- **Important to maximise synergies across the EP Directorate**

Examples of links with key research issues

ENVIRONMENT AGENCY

- **Stresses and Strains**
  - **Chemical Strategy**; to understand and describe the full range of direct and indirect pressures from chemicals on the environment
- **Integrated River Basin Management**
  - **Enteric viruses in natural waters**; to improve our understanding of the impact of human activities and pollution on water quality
- **Managing Water Resources**
  - **Natural attenuation of pollutants in groundwater**; to further our understanding of point and diffuse impacts on groundwater in relation to water usage

Water Quality R&D Workshop Objectives

ENVIRONMENT AGENCY

- To raise awareness internally within the Agency of current and recently completed R&D within the Water Quality Function.
- To identify how to achieve better communication and lines of responsibility during the R&D process.
- To review the processes involved in the successful implementation and to compare and contrast these with experiences from external organisations.

Groundwater Quality

Alwyn Hart

(Bob Harris is in Borneo)

Groundwater protection, pollution and remediation

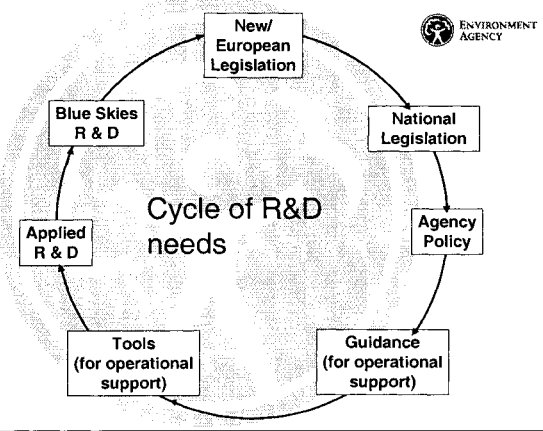
- Managing Water Resources
- Integrated River-Basin Management
- Conserving the Land

Groundwater protection, pollution and remediation

- Protecting groundwater
- Remediating polluted groundwater
- Monitoring groundwater
- Diffuse pollution
- Groundwater and surface water interface

Defining our agenda for R&D

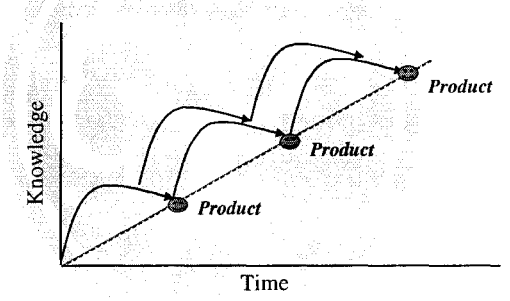
- Need to underpin regulatory decision making - *"sound science"*
- Need to take a strategic view, longer timescales than just one year
- Sub-surface is technically complex, little data, limited technical skill base



Legislative drivers

- Groundwater Regulations 1998
- Regulation15 Waste Management Licensing 1994
- Water Resources Act 1991 S161Works Notices
- Part IIA Environmental Protection Act 1990 (contaminated land regime)
- EU Water Framework Directive

Delivering progress



"The dirt on clean fuel" Water Comes Clean

America's most vexing environmental problem

most serious groundwater pollution crisis

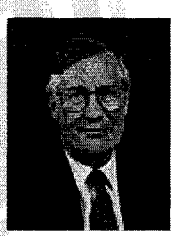
NewScientist PLANET SCIENCE

R&D Technical Report P11

- Completed 1996 = 18 months "in advance"
  - –commercial use and market for MTBE
  - –differences between US and UK
  - –fate and transport
    - slow (bio)degradation
- Projections for future use
- Recommendations for future monitoring

Outcomes & benefits from P11

- Targeted monitoring for MTBE based on sound science
- Informs further work
- Internal DETR briefing
- Happy customer



Bioremediation of nitrate in aquifer systems P2-101

- Feasibility study
- Collaboration (47% Agency) with
  - Severn Trent Water & WRc
- Impact of nitrate on potable abstractions
- MAC = 50 mg l^{-1} as NO_3
- Blending, ion exchange, reverse osmosis, electro-dialysis

P2-101 Conclusions

- It is possible to stimulate in-situ denitrification
- Addition of carbon source through injection borehole ring
- Biochemical transport model to optimise nutrient delivery
- Attractive cost-benefit analysis
- Demonstrated the potential viability of a real world treatment

Outcomes, benefits and implementation from P2-101

- Technical reports, biochemical model
- Dissemination seminar
- Next stage industry only pilot scale
- ***Drive the research agenda***
- ***Cost effective and sustainable water management***
- ***Familiarity and confidence in future technology***

CONSIM P2-007

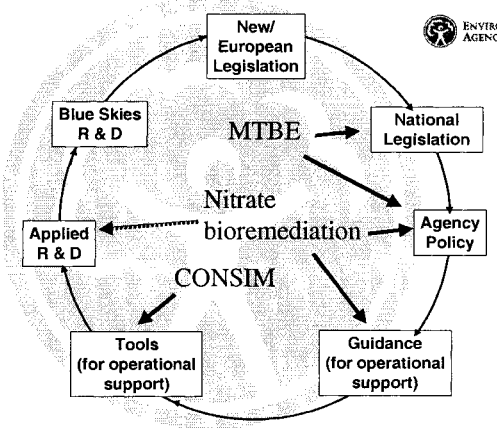
- Builds on the previous LANDSIM model
- Aims to assess risk to groundwater from land contamination
- Models contaminant mobility and transport using site investigation data
  - –assess plausible pollutant linkages for Part IIA
  - –assess need for further SI data
  - – assess extent of remediation needed and compare remedial options

Outcomes, benefits...

- Help ensure water environment is properly considered in site assessment
- Help ensure risk assessments are consistent with UK policy and legislation
- Improves consistency between industry and Agency approaches

... and implementation from P2-007

- Roll out training to Area staff (complete)
- CIS compliance testing (now)
- Marketing as a commercial product (Golder's)



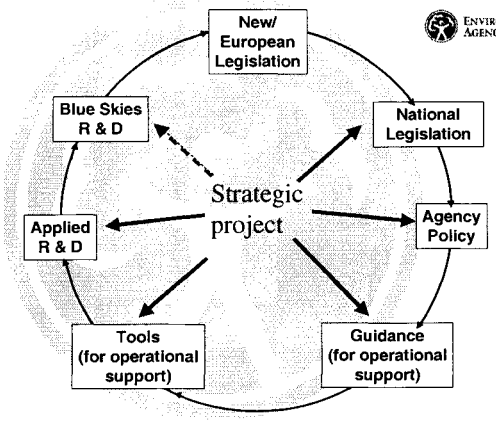
Strategic R&D - fate, transport and natural attenuation of pollutants

- £850k over 3 years
- To provide underpinning science for risk based regulatory decisions (Groundwater Regs, Water Resources Act (works notices), Part IIA, Reg 15)
- To verify natural attenuation
- To drive the wider UK and EU R&D agenda (more for our money)

- Microbial contaminants - Cryptosporidiosis
- Fate and transport - pesticides, industrial chemicals in gw
- Fellowship in natural attenuation studies
- Site specific study

Outcomes and benefits P2D(99)01

- 50+ staff recent NA course
- New Ops staff - 37 GW Regs, 16 Part IIA
  - £2M investment
- Key issue for UK plc (£350M contingent liability SKB)
- Better regulation - reduced risk of litigation and negative PR



ENVIRONMENT AGENCY

Ecotoxicology and Hazardous Substances

Jim Wharfe

National Centres

- Separate business units, distinct from Areas, Regions and Head Office
- Provide centralised scientific & technical expertise & support within the Agency
- Provide specialist knowledge externally to UK Government and EU Commission
- Fully accountable to a Customer Board

National Centre - Ecotoxicology & Hazardous Substances

- Provide a focus of expertise and strategic direction for the assessment & control of chemicals in the environment
  - –maintain a high level of current awareness
  - –identify & prioritise substances of concern
  - –promote international harmonisation
  - –prepare & manage a research strategy
  - –provide authoritative advice & guidance

National Centre - Ecotoxicology & Hazardous Substances

- Multi-media
- Key work areas
  - –Notification of New Chemicals
  - –Existing Substances Regulation
  - –Pesticides/Biocides
  - –Endocrine Disrupting Chemicals
  - –Nutrients & Eutrophication
  - –EQSs & Complex Mixtures

EHS Research & Development

- Inherited a large portfolio (30+) of research projects
- Established a topic area for ecotoxicology & hazardous substances
- Prioritised immediate future needs - (4 planned new starts and 18 completed projects by April 1999)

EHS R&D Strategy - Next Steps

- Longer-term programme to meet Agency business needs and strategic requirements
- Smaller number of larger projects and long-term initiatives
- Focus on deliverables, uptake and benefit success measures
- Integrated initiatives with UK Government & Industry
- Wider understanding of cross media issues

Current Research Deliverables

ENVIRONMENT AGENCY

- POPPIE
  - –pesticide prediction model to assist the targeting of monitoring programmes
- Endocrine Disrupting Chemicals
  - –enhancing our knowledge and fulfilling the Agency Strategy

ENVIRONMENT AGENCY

Prediction of Pesticide Pollution In the Environment (POPPIE)

Andy Croxford

ENVIRONMENT AGENCY

Agency's Pesticide Monitoring

- 167 pesticides
- 3183 sites
- 350,000 determinations
- £4m analytical costs

ENVIRONMENT AGENCY

Business Need

- Guidance for monitoring programmes
- In-house system to replace Farmstat
- Improved targeting of existing monitoring
- Identification of new monitoring needs
- Assistance for advice on approvals & policy

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Datasets

- Pesticide Usage
- Pesticide Properties
- Cropping
- Soil maps and properties
- Rainfall
- Catchment boundaries

ENVIRONMENT AGENCY

POPPIE delivers

- Predicted levels in surface waters
- Suggested monitoring suites
- "What if" scenarios
- Pesticide usage patterns
- Cropping patterns
- Monitoring data
- Trends

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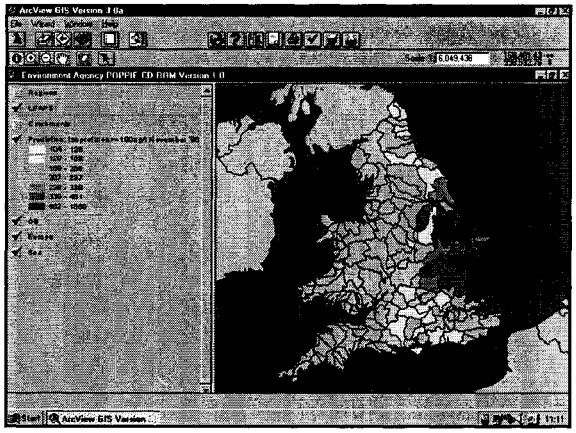
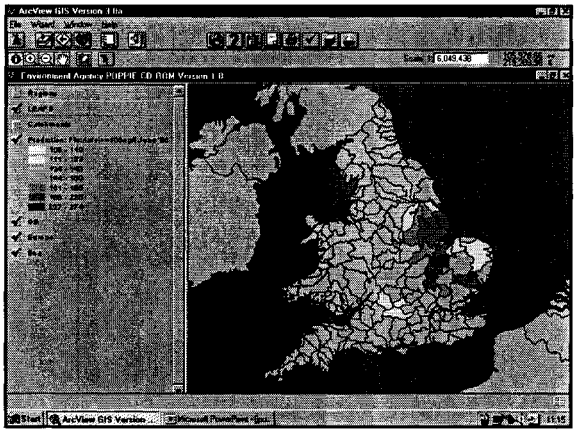
Output forms

- Maps
- Statistics
- Comparisons with standards
- Graphs
- Catchment, LEAP & National scales





ENVIRONMENT AGENCY

Possible Future Developments

- Groundwater predictions
- Sheep dip
- Amenity pesticides
- Trace organics
- Antifoulants
- Other agricultural pollution e.g. nutrients
- Scotland & N Ireland

ENVIRONMENT AGENCY

Implementation

- National desktop for area/regional use
- Training
- Direct external marketing
- Internet
- Paper-based products

Research into Oestrogenic Endocrine Disruption - Causes and Effects

Dr Geoff Brighty

Environment Agency

Presentation

- Overview of endocrine disruption
- Focus on two WQ funded projects
  - identifying causal substances
  - identifying biological effects
- Deliverables and implementation

What is endocrine disruption ?

- Interference with normal hormone (endocrine) function, leading to adverse effects.
- Examples:
  - Imposex in marine molluscs caused by tributyltin (TBT)
  - egg-shell thinning caused by organochlorine chemicals

R&D Project 490: Oestrogenic substances in STW effluents

Background - DoE Research

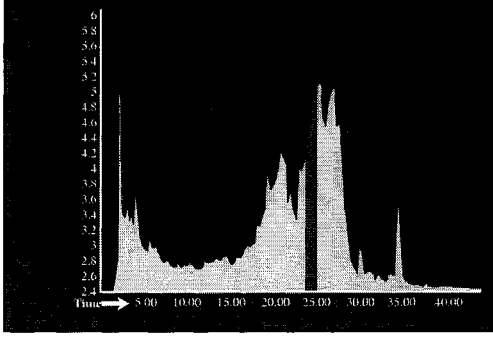
- Effluents shown to induce feminising effects in caged male fish

What are the causal substances ?

Which ones should be controlled ?

- Investigate sewage effluents

LC Fractionation of the Mid-Polar Organics Fraction



Deliverables and Implementation

- Knowledge - oestrogenic substances
  - steroids - *new* class of pollutant
  - AP/APEs - high levels locally
  - viewpoint - informed strategy
- Tools and techniques
  - analytical / TIE methods
  - EQSs for APs/APEs
- Environmental benefit
  - reduction in AP/APEs

R&D Project 636: effects in fish

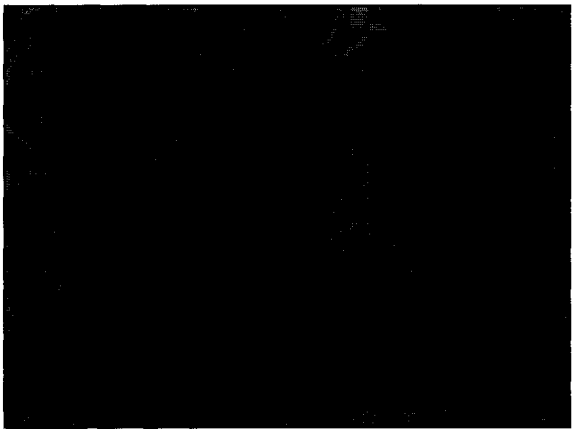
Background

- Oestrogenic effluents discharged to rivers/estuaries

What are the biological effects ?

How do the effects vary with WQ ?

- Examine native fish populations



Deliverables

Knowledge

Confirmed oestrogenic effects
- high incidence and severity
- correlates to effluent proportion

Informed need for strategy

R&D priorities
- Prove cause and effect
- Establish population consequence
  - set environmental targets

Implementation

Strategy presents policy case for control of endocrine disruption
- Relevant environmental targets
  - WQ: Fisheries; water re-use
- Prioritise locations
- Driver for effluent controls
- Driver for product controls ?

Recommendations for WQ

- Value strategic programmes that develop knowledge / understanding
  - lead to sound policy
  - establish relevant priorities
  - accept, in time, will lead to applied guidance and tools for operational staff
- Cost effective / collaborative

ENVIRONMENT AGENCY

Rural Land Use

Rural Land Use
- The issues

ENVIRONMENT AGENCY

- Pollution incidents
- Nutrients
- Pesticides
- Soil sediment
- Pathogens

Rural Land Use
- The tools

ENVIRONMENT AGENCY

- Legislation
- Campaigns
- Advice
- Financial incentives

Rural Land Use
- R&D subject areas

ENVIRONMENT AGENCY

- Manures
- Pesticides
- Sheep dip
- Soils
- Buffer zones / wetlands
- Outdoor pigs
- Maize
- Integrated Farming Systems
- Forestry
- CAP reform
- Quality assurance schemes

Rural Land Use
- Implementation

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- Internal guidance
- External guidance (leaflets, manuals, videos)
- Demonstration (farm events, agricultural shows)

ENVIRONMENT AGENCY

Best Management Practices

P2C(97)02 - Development of a booklet for field staff

P2C(97)10 - Development and piloting of a BMP manual for farmers

Best management practices - The need

- To raise awareness
- To provide guidance

Best management practices - Methodology

Booklet for field staff

- Review of information
- Field visits within the UK, United States and New Zealand
- Publication

Manual for farmers

- Farmers steering group
- Technical advisers
- Piloting
- Publication

Best management practices - Contents

- Soil management
- Manure management
- Livestock management
- Crop management
- Pesticide management
- Water management
- Habitat management

Best management practices - Implementation

- Agency champions
- Awareness day
- Training
- Dissemination to other organisations
- Campaigns

ENVIRONMENT AGENCY

Consenting & Discharge Impact

Gerard Morris
Topic Leader

Topic Objective

To provide methodologies and techniques for assessing the impact of discharges to controlled waters and to develop new methods for controlling pollution

Budget

- Agency £410k
- Collaboration £2,220k

Themes

- Integrated River Basin Management
  - Urban Pollution Management
  - Water Quality Modelling
  - Impact of new legislation

Impact of new legislation

- Impact of nitrate removal technology
- Recovery and disposal of sewage sludge in the 21st century
- Efficiency of wastewater disinfection
- Enteric viruses
- Bioremediation for oil spillages

Urban Pollution Management

- Urban Pollution Management Manual
- UPM & Wastewater Treatment Help Desk
- Integrated Waste Water Technology Demonstration project
- Risk based decision making for waste water planning

Water Quality Modelling

- Urban Water Environment - review
- National compilation of time of travel data
- Real time water quality modelling forecasting and control system
- Modelling the rehabilitation of urban rivers
- GREAT-ER
- URGENT

R&D Projects

Two Examples

- Urban Pollution Management Manual
- GREAT-ER

Urban Pollution Management Manual

Objective

"To review and update the UPM Manual to be the agreed basis for AMP3 implementation and regulation in England and Wales and to present state-of-the-art technology for wastewater planning for use elsewhere"

Urban Pollution Management Manual 2nd Edition

- Sponsored by Environment Agency, UKWIR, SNIFFER, Ofwat and FWR
- Coordination by FWR
- Contractor - WRc

UPM History

1970 Technical Committee Report on Storm Overflows HMSO

1984 River Basin Management Group established

1992 Royal Commission on Environmental Pollution 16th Report

1993 Urban Waste Water Treatment Directive Guidelines produced

1994 UPM Manual produced

1998 UPM II Manual produced

Concept of Urban Pollution Management

The management of wastewater discharges from sewer and sewage treatment systems under wet weather conditions such that the requirements of the receiving water are met in a cost-effective way.

"The failure to relate overflow to river needs.... puts at hazard the attainment of target quality for the river system and distorts the correct pattern of investment in the sewerage system".

– Royal Commission on Environmental Pollution 16th Report 1992

What is UPM?

- Planning approach
- Outcome is a detailed emission specification for all significant wastewater discharges
- Outline form of engineering solution

Benefits of UPM

- Environmentally based solutions
- Options for:
  - Procedure for authorisation
  - Cost savings
  - Consistent approach
  - Best practice UWWTD

UK Government Priorities

- To achieve EU mandatory standards
- To achieve Guidelines Standards for Bathing and Shellfish waters
- To secure improvements in river water quality
- To address aesthetic problems, minimise release of persistent substances and public complaints

CSO Improvement Programme in England & Wales

No. of unsatisfactory CSOs

1994	5726
1996	5200
2000 predicted	4000

Following Government's guidance 22 September

2005	1333

Implementation Issues & Challenges

- Dissemination of Manual
- Endorsement by DETR, Agency and Water Companies
- Help Desk and User Support
- Training needs and implementation
- Develop programmes for improvement of CSOs
- Monitoring and report on performance

UPM II Dissemination

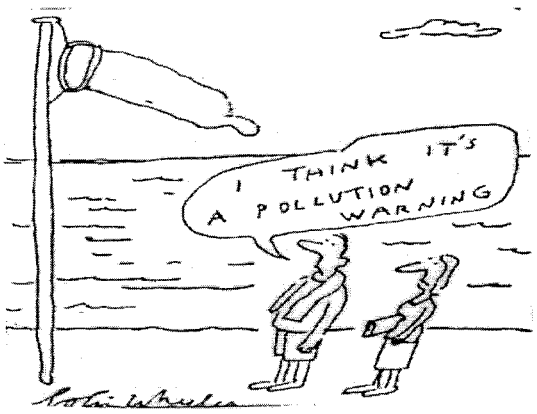
- Agency/SEPA/Northern Ireland
- Water Companies/Scottish Water Authorities
- Consultants/Suppliers
- Educational Sector
- Europe and Elsewhere

E.A. Regulatory Policy

- "The EA has fully accepted and approved the UPM Manual and endorses the adoption of the UPM procedure in developing solutions to sewerage and sewage treatment problems"
- "It is intended to gradually substitute current methodologies for consent calculation by UPM methods"

UPM II Training

- Policy aspects for investment planners and consent setters
- Impact assessments for environmental scientist
- Model building and development for scientists and engineers



Concerns inhibiting update of UPM 1

- Complexity
- Reliability
- Costs
  - data collection
  - modelling
- Timescales
- Conservatism

Lessons learned

- UPM works!
  - Solutions are cost effective
  - Solutions are environmentally sound
  - UPM does not always save money
- UPM is not a fixed/rigid process
  - Methodology has to be "tuned" to suit circumstances
- UPM does not have to be complex
  - Not always detailed modelling and/or data collection programmes

Pan-European Development of GREAT-ER

Geography-referenced **R**egional **E**xposure **A**ssessment **T**ool for **E**uropean **R**ivers

WHAT ?

ENVIRONMENT AGENCY

- Support tool for Environmental Management and Risk Assessment
- PC model that predicts chemical concentrations in rivers across Europe
- Designed for post screening level assessment
- GIS will produce simple and clear visualization of chemical concentration and water quality
- Calibrated prototype will be validated by using monitoring datasets from the UK, Italy and Germany

ENVIRONMENT AGENCY

- Project Duration: 3 years

Starting Date:	February 1st 1996
Kick-Off Workshop:	March 15/16th 1996
1st Annual Workshop:	February 28/29th 1997
2nd Annual Workshop:	February 1998
Deliverables:	March 1999

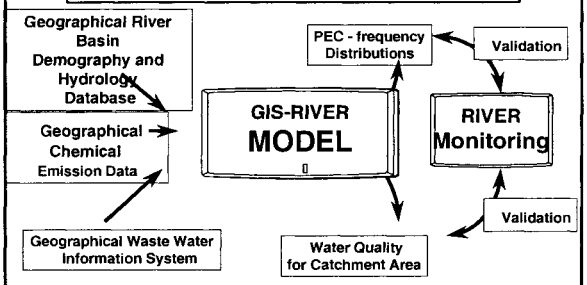
- Budget: ± 1,200,000 ECU

Environmental Risk Assessment Steering Committee (ERASM) of the Association Internationale de la Savonnerie, de la Détergence et des Produits d'Entretien (A.I.S.E.) and the Comité Européen de Agents de Surface et Intermédiares Organiques (CESIO) and the UK Environment Agency

- Project Management

European Centre for Ecotoxicology and Toxicology of Chemicals (ECETOC)

GREAT-ER Project



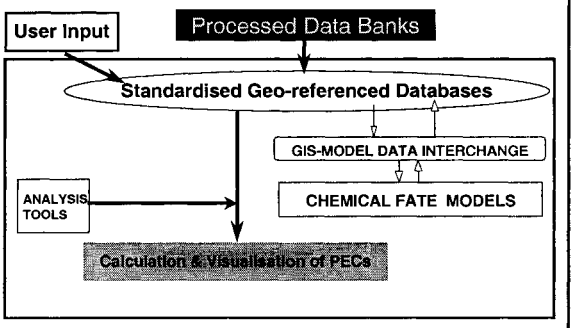
ENVIRONMENT AGENCY

Project Description

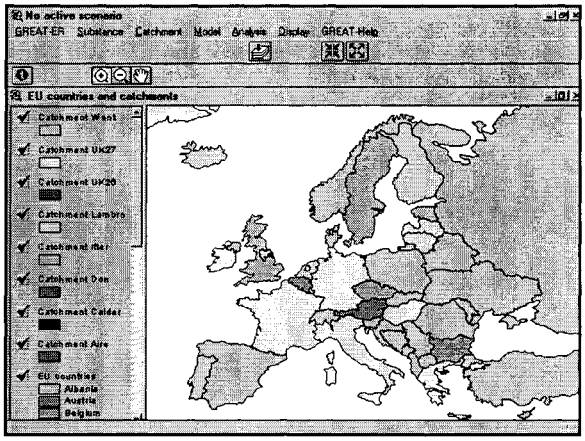
Modular Approach

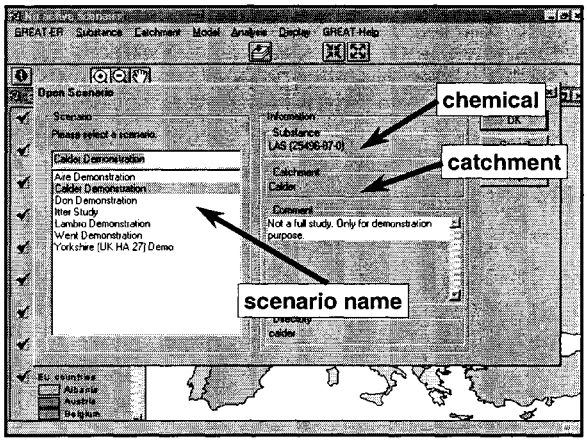
- **Hydrology**
- **Chemical Fate Modelling**
- **Geographical Data Methodology**
- **GIS / Model Integration**
- **Monitoring**

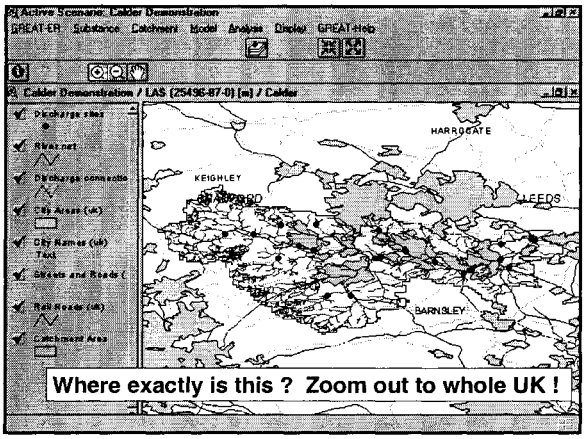
GIS / Model Integration

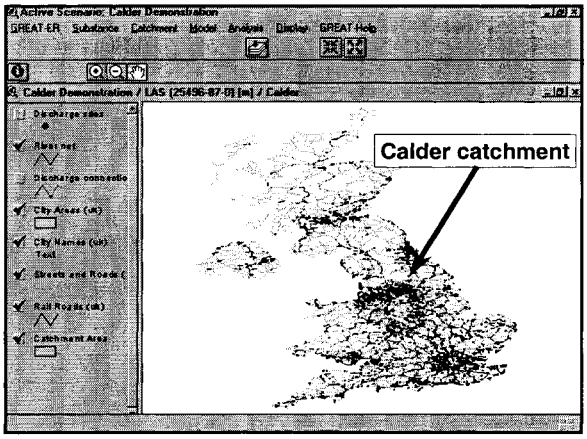


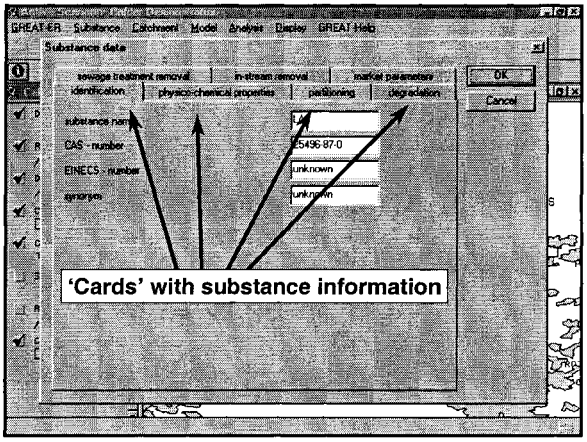
ArcView GIS

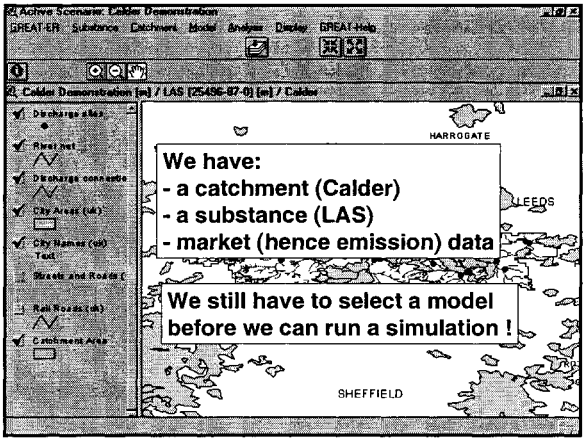

No active scenario
GREAT-ER Substance Catchment Model Analysis Display GREAT-Help
EU countries and catchments

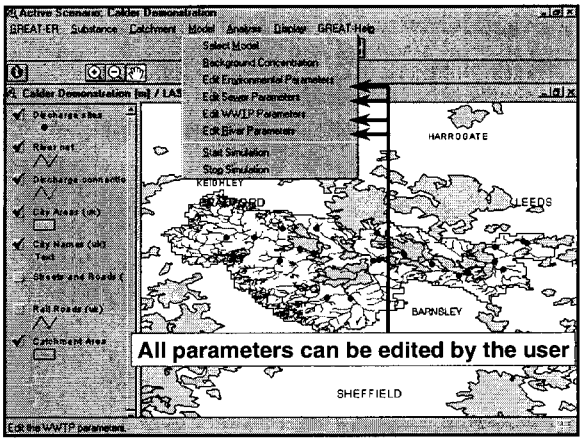

chemical
catchment
scenario name

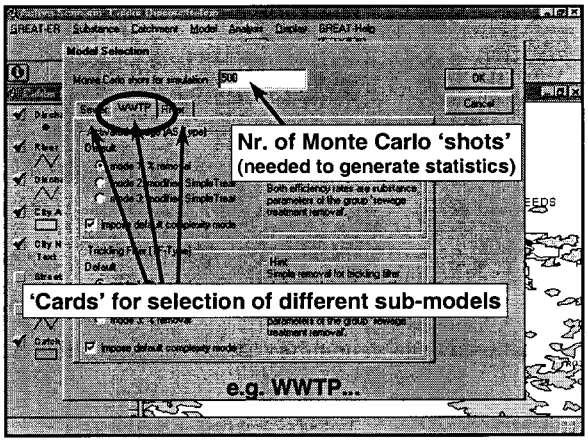

Active Scenario: Calder Demonstration
HARROGATE
KEIGHLEY
LEEDS
BARNSLEY
Where exactly is this ? Zoom out to whole UK !

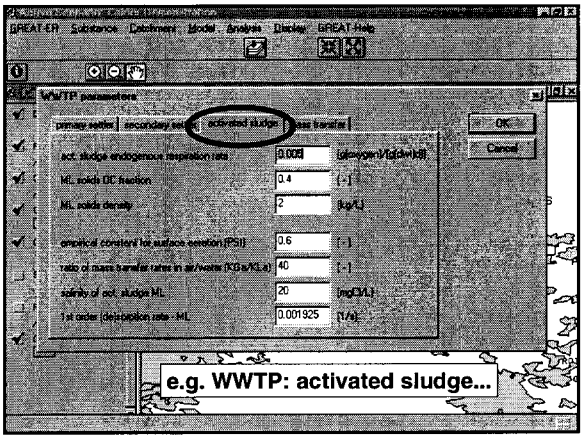

Calder catchment

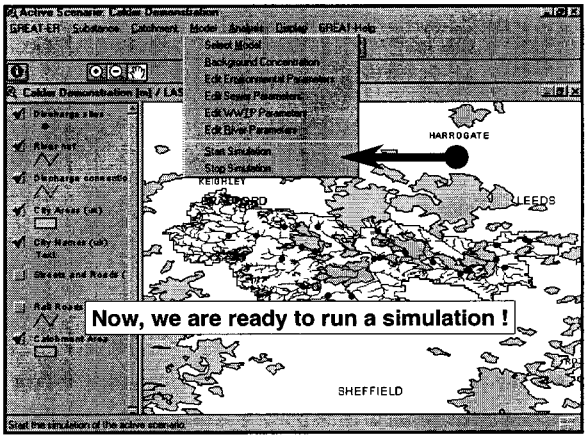

Substance data
'Cards' with substance information

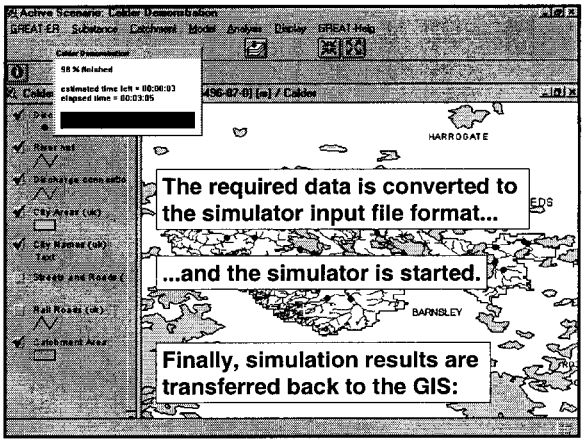

We have:
- a catchment (Calder)
- a substance (LAS)
- market (hence emission) data
We still have to select a model before we can run a simulation !
HARROGATE
LEEDS
SHEFFIELD

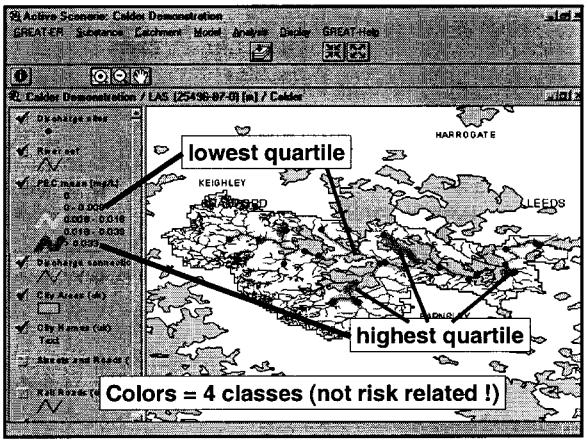

All parameters can be edited by the user

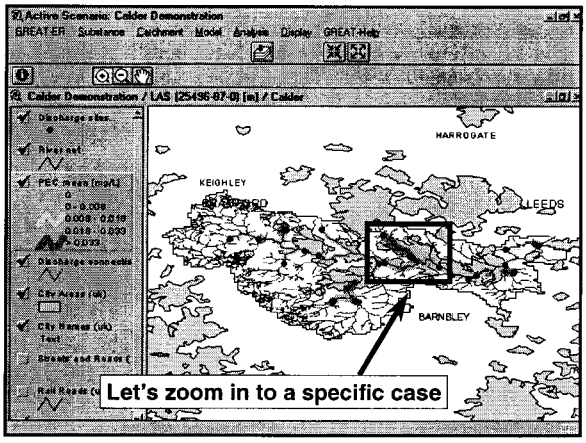

Nr. of Monte Carlo 'shots'
(needed to generate statistics)
'Cards' for selection of different sub-models
e.g. WWTP...

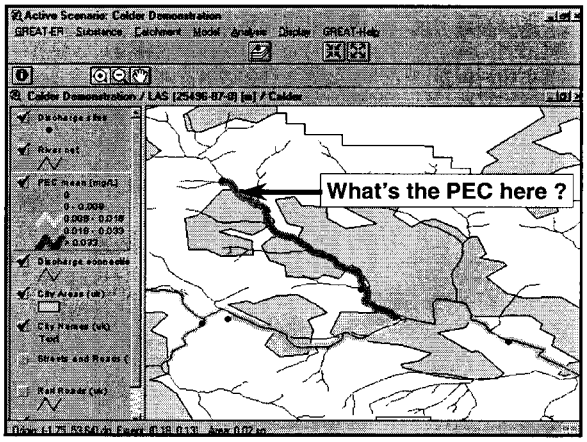

e.g. WWTP: activated sludge...

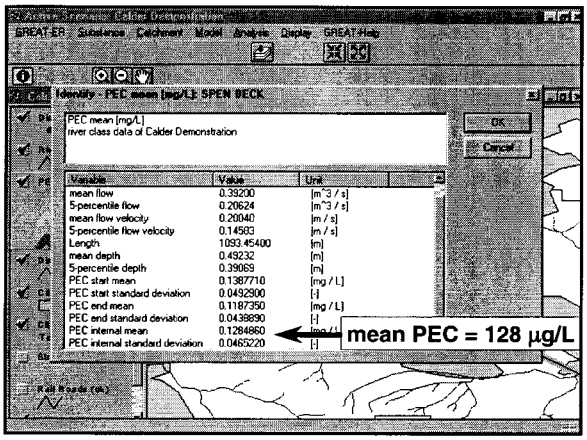

Now, we are ready to run a simulation !

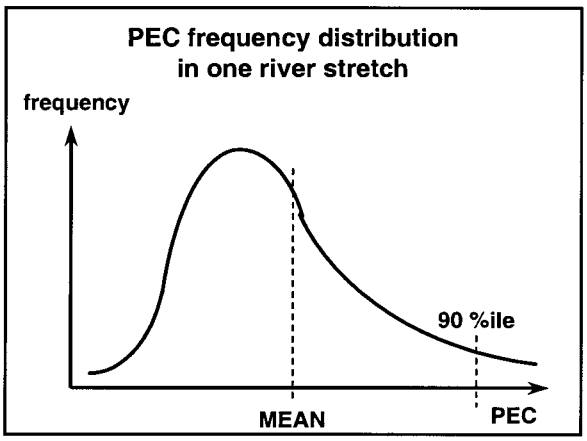

The required data is converted to the simulator input file format...
...and the simulator is started.
Finally, simulation results are transferred back to the GIS:

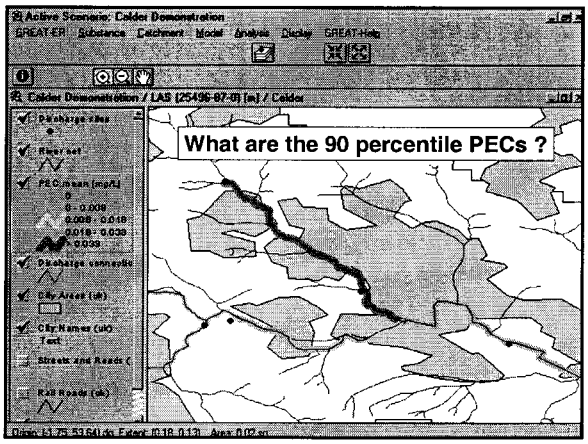

lowest quartile
highest quartile
Colors = 4 classes (not risk related !)

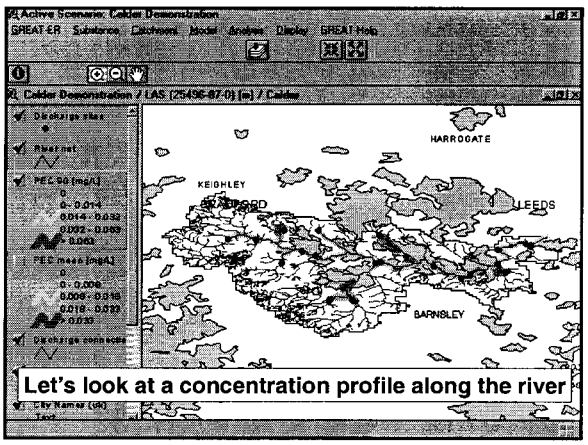

HARROGATE
KEIGHLEY
LEEDS
BARNSLEY
Let's zoom in to a specific case

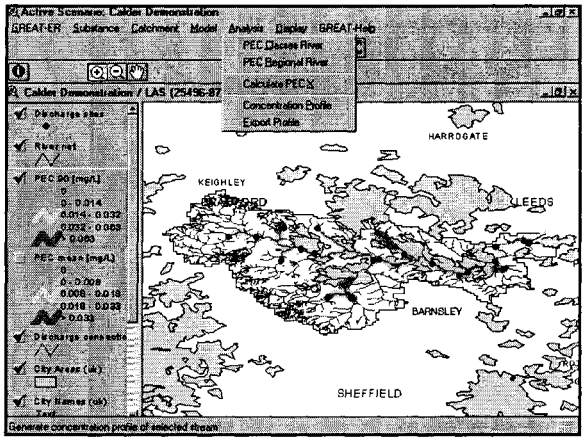

What's the PEC here ?

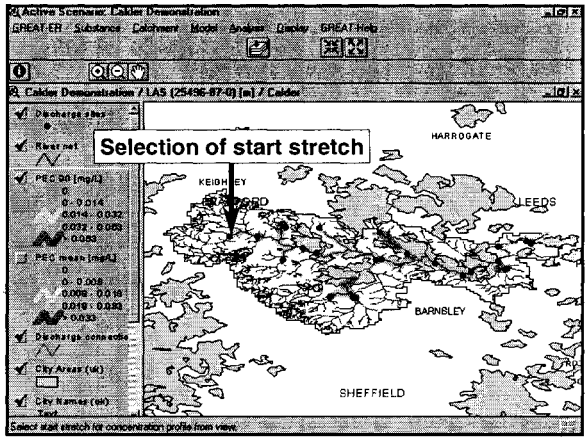

mean PEC = 128 µg/L


PEC frequency distribution
in one river stretch
frequency
90 %ile
MEAN
PEC


What are the 90 percentile PECs ?


HARROGATE
KEIGHLEY
LEEDS
BARNSLEY
Let's look at a concentration profile along the river

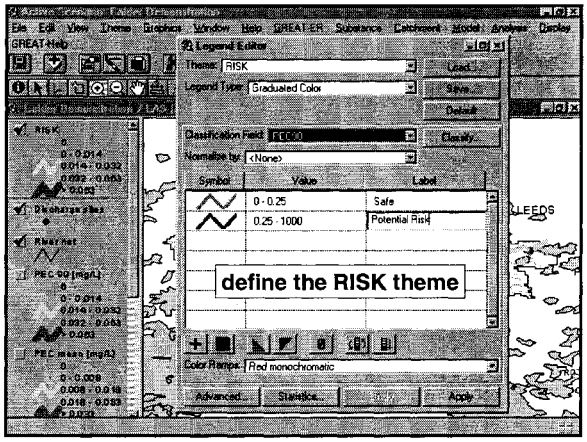


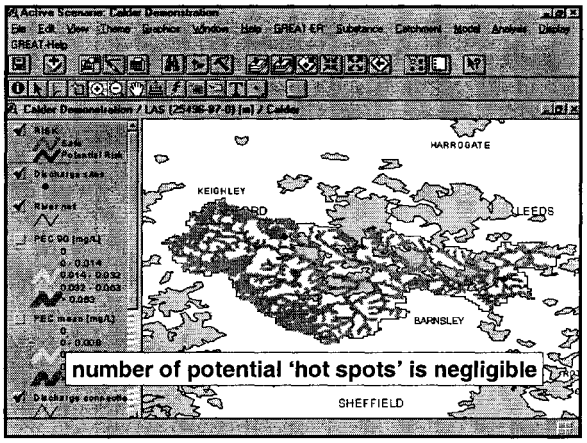


Application Example:

Risk Visualisation

- using the expert mode, a new theme 'Risk' is defined
- 'Risk' has 2 classes:
  - –PEC 90%ile < PNEC = safe
  - –PEC 90%ile > PNEC = potential risk



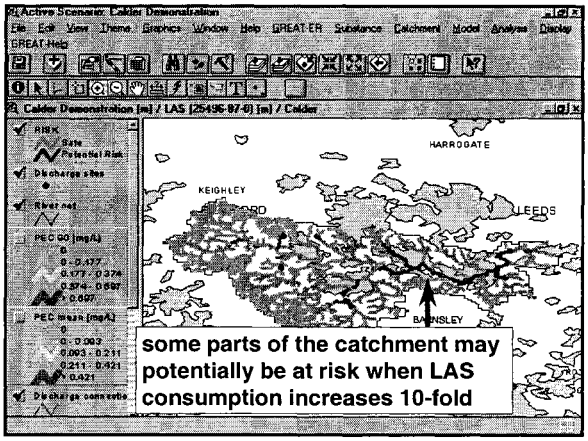


ENVIRONMENT AGENCY

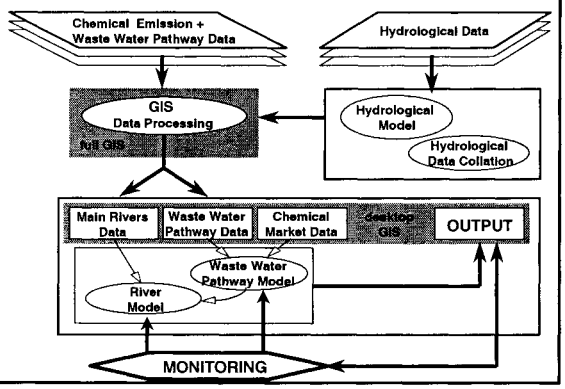
Application Example:

What-If Scenario

What would happen with the risk zones when LAS consumption would be increased 10-fold ?



Calibration/Validation

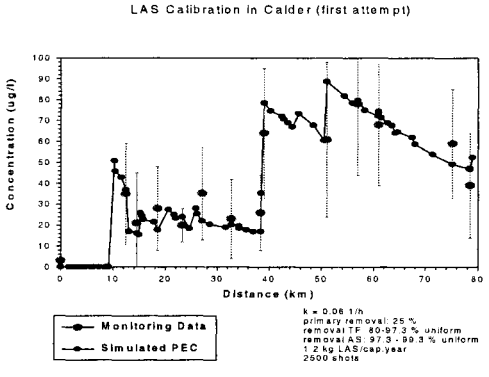


Monitoring

- **UK** - Aire, Calder, Went, Rother
  - Environment Agency
  - Yorkshire Water Plc
- **Italy** - Lambro
  - University of Milan
  - National Water Research
  - University of Venice
  - Water Authorities
- **Germany** - Itter
  - BRW (local water authority)

CALIBRATION/VALIDATION

- Calibration settings
  - LAS usage = 3.28 g/cap/day ;
  - Boron usage = 0.22 g/cap/day
  - LAS half life = 0.06 d-1
  - Removals through Activated Sludge type works (98-99.5%)
  - Removals through Trickling Filter type works (94-98%)
  - Assume no in sewer removal
- Simulated PEC mean is within one STD from the mean measured concentrations



IN CONCLUSION

GREAT-ER offers:

- **refinement of local and regional exposure and risk**
- **insights in risk management and control options**
- **insight in spatial and temporal variability**
- **allows accurate predictions for new chemicals, endocrine modulators, pharmaceuticals and others which can't be detected**

GREAT-ER offers the opportunity to expand to :

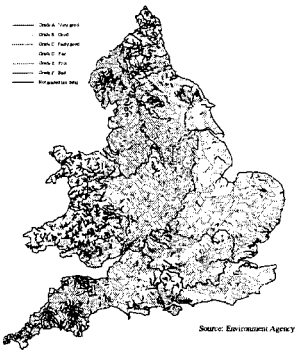
- **other areas**
- **other industrial applications**
- **other compartments**

WHY DO WE NEED GREAT-ER?

ENVIRONMENT AGENCY

- Planning for improvement of discharges and river quality
- Analysis of impact of new legislation eg. UWWT, Water Framework
- Assessment of the impact of chemicals on the water environment
- Forecasting future changes and "what if" scenarios
- Reporting of data and dissemination of environmental information

General Quality Assessment for chemical river quality 1993 to 1995

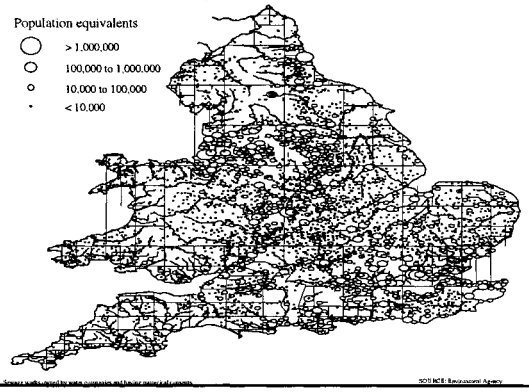


Benefits of GREAT-ER Approach

ENVIRONMENT AGENCY

- Integration of databases
- Integration of modelling tools
- Integration of user requirements

Location of sewage treatment works and size of population served



Future Developments in the UK

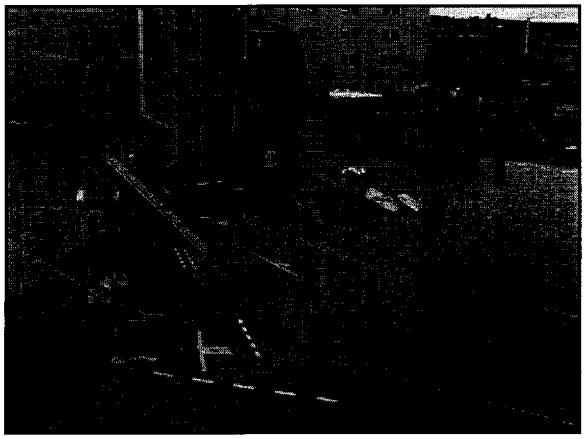
ENVIRONMENT AGENCY

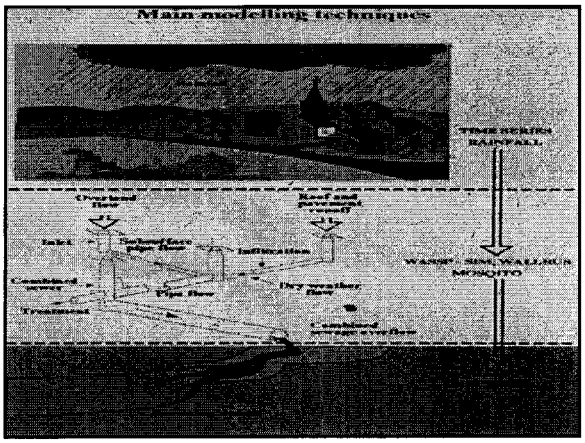
- UK Scoping Study
- Dissemination of GREAT-ER
- Agreement on future GREAT-ER developments
- Collation of databases
- Consider, sediments, pathways, key chemicals and diffuse pollution

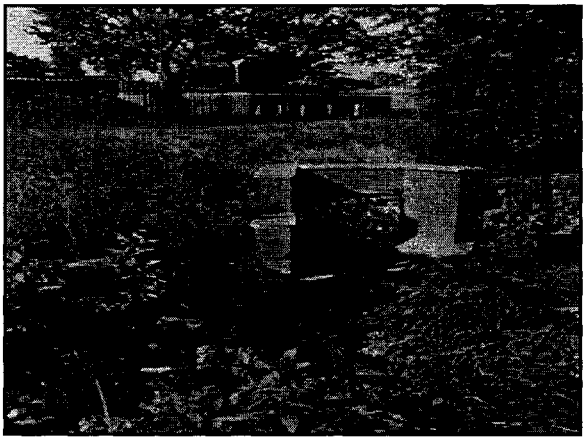
Suggestions for future European Development

ENVIRONMENT AGENCY

- Dissemination and user support
- Selective representative basins in Europe
- High level application across member states
- Acceptance by regulatory authorities







ENVIRONMENT AGENCY

Pollution Prevention

Phil Chatfield

Pollution Prevention

- Diffuse Pollution
- Non-regulated sectors
- Urban/industrial sectors
- Client is PPSG
- Projects are mostly collaborative

Diffuse Pollution

- Urban surface water run-off
- Oil Pollution
- Construction sites
- Mine water discharges
- Road accidents and fires

Project Selection

- Use of incident data
- Ideas canvassed from Area staff
- Proposals from SEPA/CIRIA
- Proposals from universities etc.
- Area/PPSG prioritisation

Principal Themes

- Sustainable urban drainage systems
- Preventing and managing oil pollution
- Improved construction management and practice
- Mine waters
- Operational guidance

Overall Approach

- To investigate and quantify the problem e.g. highways drainage
- To identify best practice or new solutions e.g. management of gully pots
- To disseminate results e.g. oil storage guidance
- To evaluate the solutions e.g. effectiveness of pollution prevention awareness campaigns

Sustainable Urban Drainage Systems (SUDS)

- Highways run-off (with Highways Agency)
  - evaluation of the problem
- Constructed wetlands for treatment
  - trial of solution
- Dissemination of results
  - links with CIRIA SSS
- Evaluation of techniques
  - studentships

Operational Techniques

- GMO's as pollution tracers
- Review of pollution control equipment
- Controlled burn
- Chemical techniques
- Coastal protection

Mine waters

- Biological remediation of acid mine waters
  - identification of acidophillic bacteria
- Mine water treatment and monitoring
  - R. Pelenna

Oil Pollution

- Public attitudes survey
- Oil breakdown in separators
- Oil storage
  - bunding
  - internally bunded tanks
- Evaluation of effectiveness of approach
  - studentship study into Oil Care Campaign

Construction Industry Background

- Major, un-regulated cause of industrial pollution
- Need to improve standards - prosecution is too late
- Problems with silt, oil, concrete and cement
- Underlying problems relating to perception and management

Construction Industry The Approach

- Working with industry - CIRIA
- Training tools - building a cleaner future
- On-site treatment of construction discharges
- Environmental good practice on site handbook
- Environmental Management Systems

Dissemination External

- Seminars
- Free guidance
- Published/priced materials
- Web-sites

Dissemination Internal

- R&D training seminars
- Pollution Prevention Manual
- Distribution of publications
- Guidance

Barriers to Success

- Procurement
- Emphasis on major projects
- Lack of empowerment for small variations or projects
- Good project leaders

Conclusion

- Area ownership
- Focus on real operational problems
- Strategic and short-term
- Strong collaborative theme
  - –theme
  - –improve dissemination
- Staff development opportunity

ENVIRONMENT AGENCY

Agency Procedures & Experience

Bogus Zaba, R&D National Service

Handover of R&D to Originator

- Well recognised generic problem in R&D
- Types of problem we encounter:
  - "That's not the answer we wanted"
  - "I don't remember asking that question"
  - "Not interested in that anymore"
  - "Couldn't you just answer a few other questions while you're at it?"

Types of Project Outputs to be handed over

- Strategic
  - Usually widely disseminated but not expected to have immediate operational impact
- Policy Development
  - Not always widely disseminated; immediacy of impact varies
- Operational
  - Should have wide dissemination and impact

Poor Implementation?

- Not all projects outputs are destined for implementation by the operational side of the business
- Resources will not always be available for immediate implementation of good R&D results
- Depending on results of R&D further development / piloting / demonstration might be needed prior to operational implementation

Fantasy Project

- Commissioning function clear about objectives and outputs required.
- Practitioners (contractors) understand function's needs
- Work proceeds to planned budget and timescale
- Function takes up outputs and implements them
- Pigs fly

Nightmare Project

- Idea not owned and understood by function - originates from outside?
- Idea not clearly understood and interpreted by practitioner (contractor)
- Timescales and budgets not adhered to
- Products not recognised or used by function
- Stagnation at end of Project

Procedures - Project Initiation

- Functional Committees vet and prioritise proposals for R&D
- Project managers appointed from within the function - project not passed on to R&D
- Co-ordination across functions and with external bodies through R&D Unit
- R&D Project Assessment Board vets detailed Project Plans

Procedures - Project Management

- Agency Project Management, Scheme of Delegation and Procurement Manuals apply
- R&D Service assist Project Managers in understanding and following these
  - Handy checklists
  - R&D PM Handbook (coming soon)
- R&D Management Information System used to track and report on Projects and Programmes

Procedures - Dissemination (1)

- R&D Service helps Project Managers compile dissemination lists
- WRc (dissemination contractors) prepare outputs in standard formats and disseminate according to lists
- 1-2 page Technical Summaries produced
- National Bulletin Board / Mailback (R&DINFO) Service used to provide rapid penetration

Procedures - Dissemination (2)

- Main outputs (Publications, Technical Report, Project Records etc) disseminated and **catalogued** by WRc
- High Profile outputs - additional publicity promoted
  - National Press Releases
  - Articles in Specialist Journals
  - Internal publicity

Procedures - Implementation (1)

- The End of Research Stage Evaluation (ERSE) process
  - Draft Outputs
  - Implementation Plan / Statement
  - Technical Summary
  - Contractor Assessment
  - Formal Sign-off

Procedures Implementation (2)

- Business Impact Statement (BIS)
  - Produced at Project Approval Stage
  - Revisited at project closure
- Product Description
  - Produced at Project Approval Stage
  - Revisited at closure

Procedures - Problems

ENVIRONMENT AGENCY

- Communications between Function / R&D / Contractors / National Centres can be poor
- Procedures perceived as bureaucratic and "imposed" by the R&D system
- Time-consuming - Project Managers and other functional staff mainly devote only 10-20% of their time to R&D work
- Those asked to write implementation plans are not empowered to commit resources

Stepwise or Big Bang towards Implementation?

ENVIRONMENT AGENCY

- Big Bang
  - Identify all stages (and estimate costs) up front
  - Obtain approval for large project, including all development, pilot, demonstration and implementation stages
- Stepwise
  - Stages of R&D
  - Functional / Regional Projects to pilot etc

ENVIRONMENT AGENCY

The Role of the Environmental Protection National Service in R&D

EPNS

- Agency EP Functions
  - Waste Regulation and Management
  - Water Quality
  - Radioactive Substances Regulation
  - Process Industries' Regulation
  - Land Quality
- Approaches piecemeal and different in the past
- Integrated approach to EP
  - Regulatory Processes
  - Prevention and Minimisation
  - Technical Guidance

Role in R&D

- Integrated approach
- Screening of R&D proposals
- Implementation of selected R&D
  - Strategic
  - Policy
  - Operational

EPNS Screening

- Avoids duplication of effort
- Multidisciplinary approach
- EPNS can fill gaps with proposals
- Role in implementation

IMPLEMENTATION

Objective

To achieve better implementation of R&D outputs within EP in cases where this can not be done effectively by the Functions

Types of Project

- NOT involved in all EP Projects
- Suitable projects
  - cross cutting topics
  - precursors to technical guidance
  - unexpected outputs
- Trend to fewer, larger projects

Identifying Projects

ENVIRONMENT AGENCY

- **Strategic approach**
  - preferred method
  - cross cutting topic
  - EPNS screening
- **Reactive approach**
  - exceptions reports
  - less important through time?!
- **Retrospective approach**
  - weak implementation

Types Of Implementation

ENVIRONMENT AGENCY

- **Fit-for-purpose outputs**
- **Link with relevant activities**
- **Delivery by seminar or training**
- **Publicise benefits**
- **Develop policy guidance**
- **Co-ordinate pilot/demonstration stage**

Monitoring & Reporting

ENVIRONMENT AGENCY

- **Priority status**
- **Type of implementation**
- **Funding**
- **Time scales**
- **EP Research Group**

D.2 EXTERNAL PRESENTATIONS

D.1.1 Presentations

Water Quality R&D Awareness & Implementation Workshop

An Industrial View

David Taylor
Brixham Environmental Laboratory
Zeneca Ltd

BEL Research Interests

Major themes

- Ecotoxicology
- Ecosystem Dynamics
- Risk Assessment
- Biomonitoring
- Waste treatment
- Bioremediation
- Soil & Groundwater Contamination

Exploratory Research

- Analytical science
- Ecology
- + other major themes

Brixham Environmental Laboratory
Major projects in progress (1999)

• M R Evans	Biodegradation kinetics	Yr 4 of 3
• R W J Aldington	Biotreatment of wastes (COMBAT)	Yr 4 of 4
• T D Williams	Effluent Biomonitoring (Phase II)	Yr 3 of 3
• T H Hutchinson	Endocrine modulation	Yr 3 of 5
• M H I Comber	Bioavailability (BRACE)	Yr 2 of 4
• M R Evans	Ecosystem Dynamics	Inception
•		

Core Research Programme
PURPOSE

- To have the knowledge to be able to deal with the major environmental problems encountered in 3 - 5 yr. time by the programme sponsors.
- To influence the science underpinning the regulation of products and manufacturing processes in order to improve their cost effectiveness.

BEL Research Strategy

- Customer focussed
- Collaborative
  - Internal & external partnership
  - Optimised leverage
- Peer reviewed science
- 3-5 year planning horizon

Project Selection Criteria

- Client relevance
- Urgency
- Originality
- Client spread
- Cost / benefit
- Leverage
  - Financial & Intellectual
- Realism

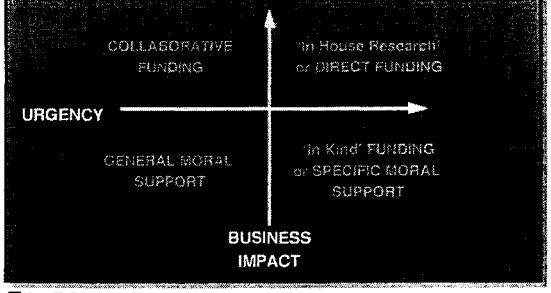
Core Research Programme
Approval Process

- Individual Customer Discussions
- Annual Business Review Meetings
- External Peer Review Process
  - 1996 Prof J Krebs (NERC)
  - 1999 Sir Crispin Tickell & Dr G Boulnois
- BELAC

Our objective is to maximixe intellectual & financial leverage

No one should be reinventing wheels !

Industrial Support Matrix



Collaborating Institutes
1998 Research Programme

Brunel University	University of Leeds
Moscow State University	University of Luton
Oregon State University	University of Newcastle
University of Aberdeen	University of Northumbria
University of Cambridge	University of Oxford Brookes
University of Dundee	University of Plymouth
University of Exeter	University of Reading
University of Kent	University of Stockholm
University of Lancaster	University of Strathclyde
University of Liverpool	University of Wales (Bangor)

Collaborating Bodies
1999 Research Programme

- CCMS Plymouth
- Dti LINK Programme
- Environet Foundation
- Institute of Terrestrial Ecology
- Royal Society of Chemistry
- UK Environment Agency
- UK MAFF (Burnham)
- USA EPA (Duluth)
- BP Amoco
- CEFIC (EMSG)
- ICI
- North West Water
- Novartis
- Shell
- UKWIR
- Yorkshire Water

Core Research Programme
Communication Process

- Customer Discussions
- Brixham Reports
- Research & Development Bulletins
- Biannual Research Review
- Annual Research Seminar
- External Publication

RESEARCH

- Statutory Requirement on HSC/E
- Nature of involvement set down in S&T Mission Statement, ie
  - Supports HSC/E Mission Statement
  - No free standing S&T objectives
  - Supports policy, operational, regulatory and standards setting functions
  - Continued success dependent on demand from HSE's intelligent customer base

S&T MISSION STATEMENT

- The Health and Safety Commission and Executive aim to develop and apply a practical, scientific understanding of risks to people's health and safety from work-related activities, based on a continually updated store of hazard experience, in order to ensure that these risks are properly controlled.

PORTFOLIO RESEARCH GROUPS

- **Occupational Health**
- **Major Hazards and Risk Assessment**
- **Engineering**
- **Behavioural and Social Sciences**
- Advisory/Non-Executive
- Provide coverage of all HSE research
- Fora for topic based strategies
- Focus for use of portfolio evaluation
- Facilitate information exchange

COLLABORATION TARGET

- That 30% of new projects in 1998/99 will be in collaboration with others, with industrial partners for 25%

GUIDELINES FOR RESEARCH

- Link expenditure on research to HSE aims
- Issues rather than projects

MAINSTREAM RESEARCH MARKET BOOK

- Current interests
- Planned projects
- Competition for Ideas
- Distributed free
- Internet

NEW DISSEMINATION MODEL

- Dissemination plan at outset
- Responsibility rests with the Project Officer
- Reports published free and in full on the Internet
- Priced hard copies available print on demand
- Publicity through press releases and newsletters

INTELLECTUAL PROPERTY RIGHTS

- Published IPR Policy and Exploitation Plan
- HSE/HSL Concordat on commercial exploitation

EXAMPLES OF PRACTICAL OUTCOMES

- Hillsborough Incident Investigation
- King's Cross Fire Investigation
- Slam Doors on Trains
- Supermarket Check-out Operators
- Mark 1 Rolling Stock

RISK COMMUNICATION GUIDELINES - EXAMPLE

- First Stage - to establish issues
- Collaborative approach through ILGRA
- External contractors working with OGDs to elicit good practice
- Depts to benchmark practices against best practice.

CRITERIA FOR WHEN TO PURSUE COLLABORATION

- where HSE wishes to persuade/convince industry that a problem exists. This opens for example the possibility for a two phase approach, ie HSE funds a small initial project with further work jointly funded or industry funded;
- the availability of realistic collaborators. HSE needs to avoid pursuing collaboration as an end in itself, eg with industries which are small or fragmented;
- where HSE identifies potential health and safety benefits which collaboration will help to realise;
- where the research is of reasonable total value (not the HSE contribution) such that the value for money justifies the resources required to manage collaboration;

CONT.

- where industry can derive economic benefits such as loss prevention from involvement with HSE;
- where the work is research HSE would, in any event, have carried out but collaboration can bring enhancements in terms of access to expertise, networks and potentially better outcomes;
- where greater ownership of results by industry and/or end-user would be encouraged;
- where HSE can retain open publication rights to ensure the full and early availability of results in accordance with good scientific practice;
- where there are not specific conflicts of interest with partners such as the difficulties of near market investment;
- where collaboration promotes the 'transparency' of the scientific basis for HSE policy and operational decisions.

HSE
Health & Safety Executive

TYPES OF COLLABORATIVE RESEARCH

- **Shared Funded Projects**
  HSE plus co-sponsors fund research project;
- **Multi-Sponsor Joint Project**
  Programme funded by group of sponsors eg Joint Industry Projects in OSD (typically in size range £300k - £600k) may or may not be managed by HSE;
- **Managed Collaborative Projects**
  Managing agent appointed to sign up sponsors, manage programmes and let contracts via tender;
- **Annual Fee Projects**
  Group of sponsors each agree to pay annual fee and agree a programme of work each year;
- **Club Networks**
  Large number of sponsors each paying small fee; newsletters; common technical theme (can be opportunity to identify other JIPs).

Dissemination and uptake of R&D

Dr Richard Reeves
The R&D Management Centre, School of Mechanical Engineering, Cranfield University, Bedford MK43 0AL, UK.

The Environment Agency 30th March 1999

The problem of research results not being taken up is not at all unique to the environment agency.

European Research

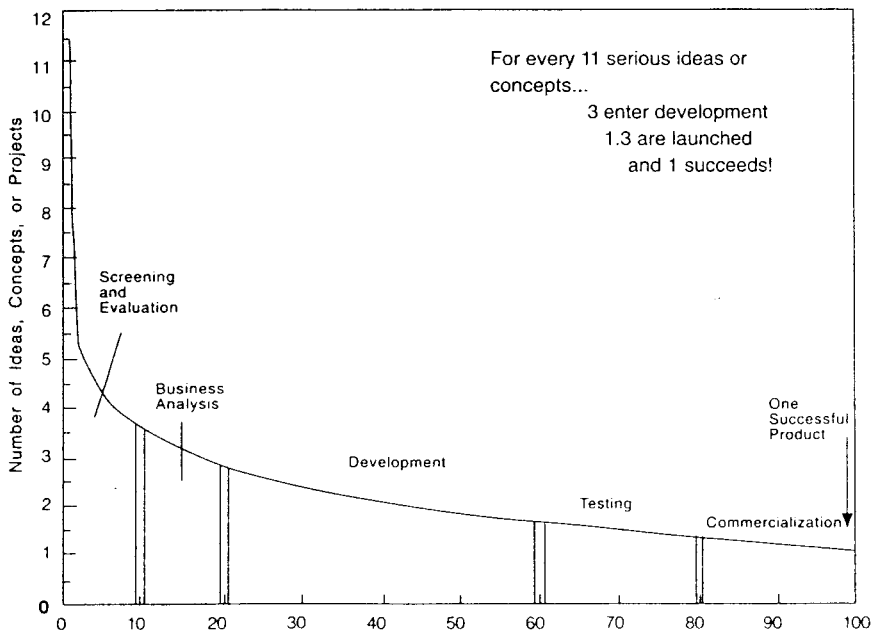
Under the Framework Programme 4, £10bn was spent over 5 years. Previous Framework Programmes had achieved poor implementation of research outputs, so in FP4, applicants were required to include a dissemination and exploitation plan in their proposals. This was not notably effective, and under the new FP5 the commission no longer sets out to define research objectives – it defines social and economic problems and calls for proposals for reset to tackle them. The new philosophy is to specify that the proposing consortia must include organisations with the means to implement solutions, i.e. manufacturers, distributors and regulators as appropriate are required as well as technology generators.

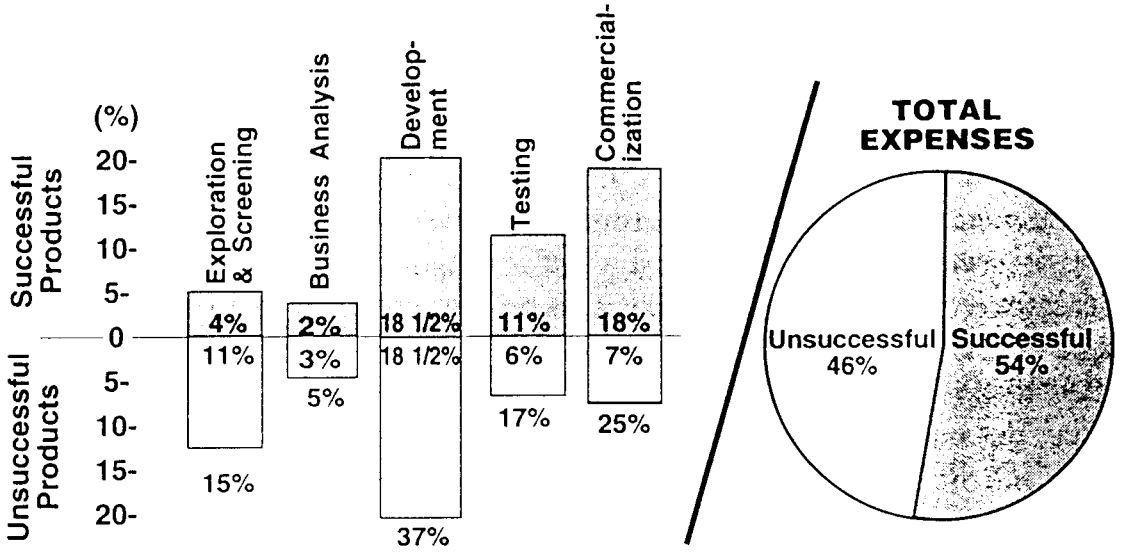
NHS Research

Medics love doing research, and publishing in *The Lancet*. There is no channel from there to clinical practice. It is all provider push, not market pull. One reason users are resistant is that they have not been involved in procuring research, results just come to them.

Industry

It is not expected in informed companies that all R&D projects will be implemented, because projects are recognised to suffer a high infant mortality.





THIRD GENERATION R&D[1]

Views on how to manage R&D in companies have developed over the years, as follows.

First Generation (1940s and 50s)

"Strategy of hope."

Science is Good, and Creativity must not be stifled by planning. R&D decides what to work on, and the programme. The outcome of research cannot be foreseen. Transistors and Nylon are the sorts of outcomes expected.

Second generation R&D (1970s)

"R&D must be accountable"

The customer-contractor concept: R&D is judged on payback criteria.
R&D spending is a financial investment, and is considered on a project-by-project basis. An R&D project can only proceed if someone in the business is prepared to pay for it. Generally this is divisional management, wanting development projects where a defined return can be reasonably foreseen. Sometimes corporate management will pay for basic research.

The business is judgmental on R&D.

Third generation R&D (1990s)

"Partnership"

Managers and R&D work as partners to share and pool their insights in deciding what to do, why, and when. They balance the needs of each business and the corporation within a portfolio of R&D activities to achieve integrated business and R&D strategies across the company.
Third generation R&D is not a mechanistic model, it is a statement of the intention to achieve productive working relationships and shared insights between R&D and the

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[1] *Third Generation R&D,* Philip A Roussel, Kamal N Saad and Tamara J Erickson, of Arthur D Little Inc.. Harvard Business School Press, 1991. ISBN 0-87584-252-6

company. Achievement of this happy state requires establishment of a shared vocabulary and body of understanding between R&D and the company, as well as a methodology. All R&D is related to business objectives as well as technical objectives.

Classifying R&D under 3rd Generation R&D

It has been normal to classify R&D into pure research, applied research, development, and so on, but in order to be able to discuss R&D from a strategic point of view, the following classification is more useful.

a) **Incremental R&D .** *Small r, large D.*
Small advances in technology based on established science and engineering, aimed at business objectives (reducing costs, improving products, improving manufacture). Risks on each are low, and multiple incremental projects over time can lead to massive improvements in business position.

b) **Radical R&D.** *Large R and often large D.*
Undertaking new work with the specific purpose of applying the knowledge gained to a useful purpose. Radical R&D draws on a foundation of existing scientific and engineering knowledge which predicts a reasonable chance of success but which is insufficient so far to be applied. There is substantial risk, and 80% of radical projects fail. The 20% of successes must provide high margin new products or processes that distinguish the company from competitors.

c) **Fundamental R&D.** *Large R, no D.*
To uncover new knowledge and develop research competence in a field the company believes will have strategic impact. Also to prepare for commercial exploitation in these fields. The output is not products, it is strategically useful scientific or technological information, and capability.
Timescales are long (8-15 years). Scientific, social, governmental and competitive uncertainties seem to multiply over a similar period, 5-10 years, so there is serious doubt as to whether a company should undertake fundamental R&D. It is often difficult to hold on to the ownership of fundamental results, and spending on fundamental R&D dilutes company earnings during present management's tenure, for the uncertain promise of benefits during a future management's tenure.

It is also useful to define important fourth and fifth categories of work, which are not strategic but are often carried out by the R&D department:

d) **Customer service**
Supporting present operations. This work is important, but is of operational significance, not strategic. It is a cost of trading, like any other, not an investment.

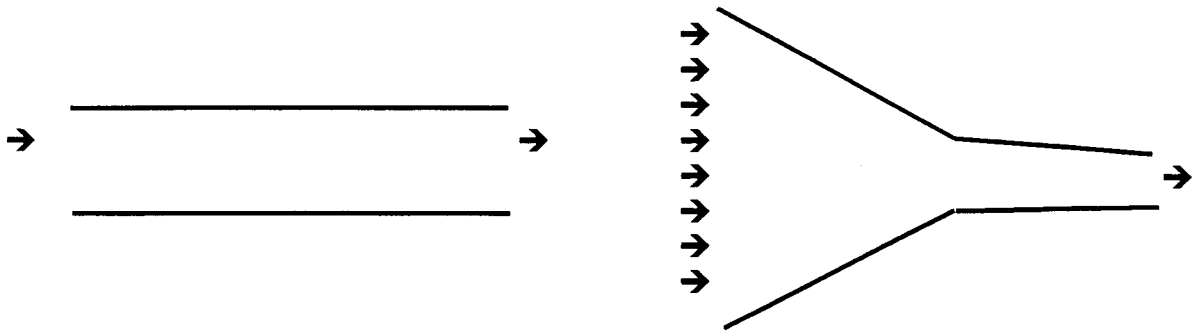
e) **Compliance work**
Finding responses to environmental legislation, health and safety requirements, etc that are imposed on the business and must be met as a condition of staying in business.

Under third generation R&D it is recognised that R&D must learn a language that is meaningful to the business, i.e. express R&D ideas in strategic terms.

STAGEGATE MANAGEMENT OF R&D PROJECTS

About 70% or R&D spending in many companies can be classified as New Product Development, or NPD.

Tunnels and funnels



Tunnel management is where management tries to pick a winning idea and put it into a project management process from which it expects a winning product to emerge.

Much more realistic is the recognition that because ideas suffer high infant mortality, you should use funnel management, where a large number of ideas are put into a funnel and are culled during the process of development by machinery in the funnel so that only winners emerge. Project management applies to the stages in the process.

In normal project management the objective is to succeed in achieving the original objectives. In StageGate® NPD[2] the whole idea is to control projects and kill them off when the news about them becomes bad. StageGate creates stages, each of which requires project management, and defines outcomes required for each stage.

The StageGate management system

This has been implemented by many major companies and others are thinking about it.

A critical feature of StageGate management is that it is a whole-company thing. There is a strong element of parallel working; work is required in each stage by production, marketing and finance as well as R&D.

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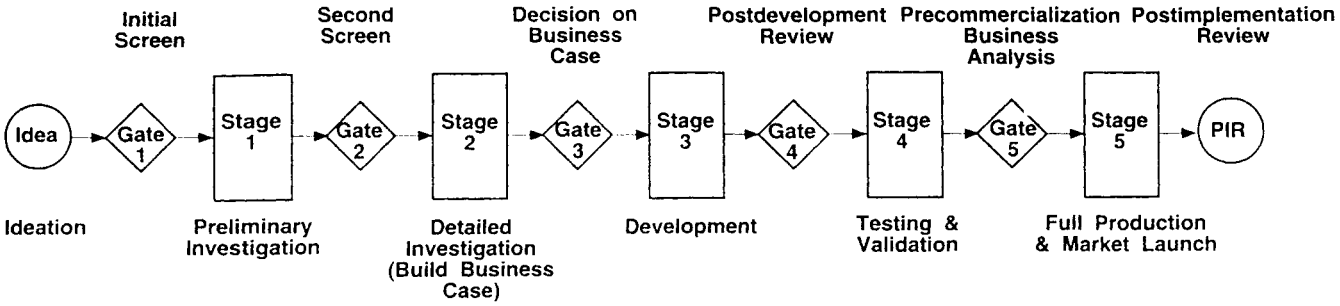
[2] StageGate is a registered trade mark belonging to Robert G Cooper



It is not allowed for a project to proceed to R&D completion and only then discover a marketing or operational reason why it is not going to work. Marketing, operational and financial things are appropriately assessed in each stage. Projects only receive funding for one stage at a time and the criteria for passing each gate are pre-determined. Gate committees are whole-company meetings, not just R&D matters.

TECHNOLOGY FORESIGHT

This is not forecasting. Foresight means bringing parties together before proposals are even formulated. Two things are supposed to happen

1. Systematic collation of best opinions available about likely technical and social developments and their effects
2. Establishment of social networks involving researchers and all parties likely to be involved downstream

Research Field Foresight

A study of the cardiovascular research field was carried out co-operatively among medical researchers, funders and practitioners in 1993-5 at the initiative of the funding agencies supporting research in this specific field. This was held to have been very successful as an experiment in enabling a strategic approach to be taken to the initiation of medical research for the first time.

Foresight has also been carried out within companies[3], within industries[4] and by the UK government.

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[3] Barker, D. & Smith, D.J.H. (1995) 'Technology Foresight Using Roadmaps', Long Range Planning, Vol. 28, 21-28.
A journal article which gives a good account of the BP exercise. This has also been called Technology Roadmapping

[4] CERAM Research (1996) 'Technology Foresight Study - A Report from the Council of CERAM Research', Stoke-on-Trent: CERAM Research.
The official report of the CERAM exercise.

D.1.2 Points arising

The key discussion points below summarise the major non-technical issues that were raised following the presentations. It was agreed at the start of the workshop that comments would not be attributed to individuals in this report.

- the level of "blue-sky" research should not be prescribed but is included in the Agency's R&D programme through researchships and fellowships and the European Communities fifth programme of research and technological development (FP5);

- the Agency's R&D programme should incorporate a variety of R&D types ranging from strategic to operational;

- planning and budgets are essential for the good management of R&D but should not be set in a tablet of stone - project managers who change either, as long as such changes are for good reasons, should not be stigmatised for doing so;

- It's not the customer's fault if they can't remember what they asked for; it is the project manager's fault for not having constantly reminded them, i.e. continuous communication is required between the project manager and the ultimate end-user/s to ensure that the results of the R&D project meet the end user's requirements and are what is expected;

- a collaborative approach to benchmarking best practice with respect to R&D programmes and management with other government departments has been found to be helpful to HSE;

- the Agency is good at initiating R&D projects and is charitable at letting them continue - where appropriate the termination of projects should become an acceptable option;

- it is difficult to find ownership for strategic research within the Agency. However, the Agency has a responsibility for preparing for the unknown;

- the stage-gate approach was put forward as a method for assessing which projects should be continued and which should be terminated. Concern were raised over the use of this approach with the Agency's tendency to move towards a small number of larger projects. It was thought that this could be addressed through the development of a balanced portfolio of small and large projects.