

# EUFRAM

Concerted action to develop a European Framework for probabilistic risk assessment of the environmental impacts of pesticides<sup>1</sup>

Work Package 2

## INTEGRATED RESEARCH STRATEGY VERSION 2<sup>2</sup>

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## 1 AIM

The aim of this work package is to

**“...develop an integrated research strategy document, by reviewing, integrating and prioritising research recommendations and achievements emerging from other work packages and from the EUPRA workshop and other past and ongoing initiatives relevant to probabilistic risk assessment for pesticides”.**

In order to accomplish this aim we need identify what research has already been carried out and what research needs to be done. Importantly, we also need to decide which of these research needs are key in the development of a European Framework for probabilistic risk assessment of the environmental impacts of pesticides.

This document was the basis for discussion at the first EUFRAM project meeting held in Wageningen on 12-14 May 2003. Questions posed for discussion at that meeting are outlined in red. At the end of this document (section 6) is a Table summarising comments that were made at that meeting and action points arising from it

## 2 RECOMMENDATIONS OF EUPRA

An obvious starting point is the European workshop on Probabilistic Risk Assessment for the Environmental Impacts of Plant Protection Products (EUPRA) held in The Netherlands in June 2001. More than 100 participants attended the conference including international experts on probabilistic methods from government, academia, industry and other stakeholder groups, largely from Europe but also from USA and Canada. As well as reviewing the state of the art in probabilistic risk assessment the participants were asked to identify which aspects of the environmental evaluation of plant protection under EU Directive 91/414 could be improved by using probabilistic methods. They were also asked to define priorities for further research, method development, data generation and other actions required to develop and implement these improvements.

The environment at risk was divided into 3 compartments, aquatic organisms, terrestrial vertebrates, and terrestrial invertebrates and plants. The usefulness of PRA was considered separately for each compartment by separately constituted discussion groups. Their recommendations are the starting point for this document.

It is clear from the EUPRA report that participants identified similar needs in all three environmental compartments. The most general of these crosscutting themes are at

the heart of the current EUFRAM project. The remainder are summarised under the general subject headings of “toxicity” and “exposure”. Table 1 indicates which of these research themes were explicitly raised by a particular discussion group. That a research need is missing from the a particular environmental compartment does not of course mean that it is irrelevant, though it may mean that it had relatively low priority for that group. For example issues about behaviour and natural history of non-target organisms may be more relevant to terrestrial vertebrates (which will be exposed principally through contaminated food), than to aquatic organisms (which will absorb pesticides through the body surface or gills). On the other hand some research needs such as the toxic effect of mixtures may apply equally to aquatic organisms, terrestrial vertebrates and invertebrates, but may not (yet) rank highly as a risk assessment concern in any of them.

**Table 1 PRA research needs identified at EUPRA conference**

Issues about Toxicity/Effects	Explicitly identified as a research need for given environmental compartment ?		
	Aquatic	Terr. Verts	Terr. Inverts & Plants
Extrapolation from individuals to populations	✓	✓	✓
Extrapolation from single species to communities	✓	✓	
Agreement on endpoints for different toxicity tests	✓		
Extrapolating from acute to chronic effects			✓
Toxicity of Mixtures	✓		
Extrapolation of toxicity from laboratory to field	✓		
Variation in sensitivity between species (SSDs)	✓	✓	✓
Variation in sensitivity within species/lifestages		✓	✓
<b>General Issues about toxicity/effects</b>			

Issues about Exposure/Fate			
Regional/Landscape/Spatial variation in exposure scenarios	✓	✓	✓
Extrapolation of exposure from laboratory to field	✓	✓	✓
Behaviour and natural history of non-target organisms		✓	✓
Spatial distribution of residues		✓	✓
Residues dynamics (dissipation, bioaccumulation, etc.)		✓	✓
Avoidance/attraction of contaminated food		✓	

Issues about Exposure/Fate			
Non-dietary routes of exposure (e.g. dermal exposure and inhalation)		✓	
<b>General Issues about exposure/fate</b>	✓		✓

Crosscutting issues to be addressed by EUFRAM			
(WP3) Role and outputs of probabilistic assessments	✓	✓	✓
(WP4) Methods of uncertainty analysis	✓	✓	✓
(WP5) Probabilistic approaches for use with small datasets	✓	✓	✓
(WP6) Guidance on reporting probabilistic assessments in the regulatory context	✓	✓	✓
(WP7) Communicating the results of probabilistic assessments	✓	✓	✓
(WP8) Case studies	✓	✓	✓
(WP9) Practical approaches for validation	✓	✓	✓
(WP10) Guidance on software and databases for probabilistic assessment	✓	✓	✓
(WP11) Pooling data for probabilistic approaches	✓	✓	✓

Although the EUPRA workshop was organised as far as possible to record the views of a knowledgeable and representative group of stakeholders, it is possible (likely?) that there are important research needs that were not identified by EUPRA or that the categorisation of research needs summarised from EUPRA could be better formulated.

*Questions for May 2003 Project Meeting.<sup>3</sup>*

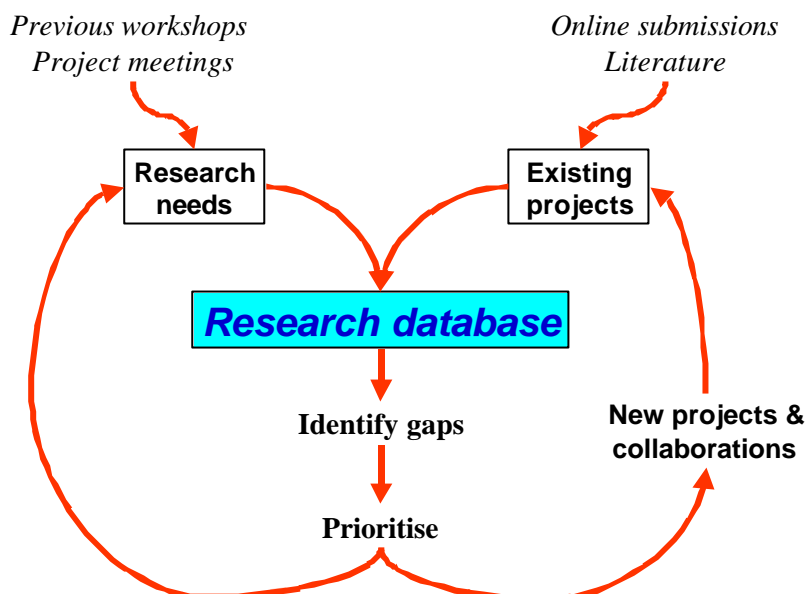
- 1. Are we happy with the environmental compartments? Should we split the third group into terrestrial invertebrates and terrestrial plants? Should we further split off soil organisms as a separate group?*
- 2. Are we happy with the research needs? Should we change the categorisation and/or add further needs?*

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<sup>3</sup> This document was the basis for discussion at the first EUFRAM project meeting held in Wageningen on 12-14 May 2003. Questions posed for discussion at that meeting are outlined in red. At the end of this document (section 6) is a Table summarising comments that were made at that meeting and action points arising from it

The process of identifying research needs is likely to be an iterative process being modified at subsequent meetings (Fig 1.)

**Figure 1. Schematic representation of development of the research database and research strategy**



### 3 PRIORITISATION

The more datasets there are available, the better our assessment methods and practices, and the better our understanding of mechanisms of toxicity and exposure then the better our risk assessments are likely to be. The wish-list of research projects we might hope to embark upon is likely to be very long. Clearly we need to sort them in order of importance.

Table 1 gives a sense of which research needs were considered most important for the three environmental compartments. But within any given compartment different stakeholders however, may have different concerns. For example, one pesticide *manufacturer* may be having a particular problem with a particular active substance in aquatic ecosystems, whereas another may be concerned about exposure to voles. Pesticide *regulators* may prefer to have improved data on toxicity of substances to important non-target species; whereas *academics* may be more interested in innovative, publishable models.

One way of arriving at an order of priority for research needs might to conduct an opinion poll of different stakeholder groups – the EUFRAM partners perhaps or some larger constituency. It would at least be interesting to know whether different interest groups showed consistently different priorities. It would be a democratic thing to do, but not necessarily the best scientific approach.

Ideally we want a technique that will enable an objective ranking of the key research needs. A possible candidate might be some form of sensitivity analysis. Where PRA case studies have been carried it should be possible to conduct sensitivity analyses to identify those parameters in the model that have the largest effect on the model outcome. If the uncertainty around such parameters can be reduced by further research and data collection then it would seem appropriate to promote this research need higher up the list. However, there are as yet relatively few PRA models that encompass the full range of toxicity and exposure parameters describing the full risk assessment. Where models are only partial then it will only be possible to compare their relative importance within a subset of the complete parameter list. Furthermore there may be important research needs and actions that lie outside the ambit of sensitivity analyses. For example many of the work packages within the EUFRAM project are not concerned with particular data needs but rather with generic needs that may help promote the use of PRA. Sensitivity analyses will not help us decide whether more effort should be spent on validating the results of PRA compared to finding ways of communicating the results of PRA to the general public.

Many of the research needs outlined by the participants at EUPRA are as important for deterministic risk assessments as they are for probabilistic assessments. For example refining methods for dealing with variation in toxicity between species (species sensitivity distributions) will be an important improvement to current regulatory risk assessments whether or not, probabilistic methods are adopted. The EUFRA report acknowledges this and argues that priority should be given to research that is important for current deterministic assessments as well as probabilistic assessments.

### *Questions for May Project Meeting.*

#### *How do we establish research priorities?*

- 3. Consider research priorities for the whole field of pesticide risk assessments (deterministic and probabilistic) or*
- 4. Consider research priorities within different environmental compartments, aquatics vs terrestrial vertebrates*
- 5. Consider research priorities for different stakeholder groups*
- 6. Consider research priorities as defined by sensitivity analyses conducted in case studies*
- 7. Some combination of the above*

## 4 RESEARCH DATABASE

At the core of the EUFRAM website will sit a research database.

**“This will be used to record information (including contact details) on current, past and future projects relevant to the network. Anyone will be able to contribute information for inclusion in the database, search the database, and use it to identify potential collaborators for new projects. The database will link each research project to the integrated research strategy**

The point of the database is to enable users to find out what work is being done to satisfy particular research needs within the field of probabilistic risk assessment. As yet these research needs have not been agreed and won't be before the first project meeting in May. Therefore it seems premature to begin any elaborate database construction now. The project meeting will also be a good opportunity to discuss what we want the database to look like and what we want it to do. We should consider:

### 4.1 Scope.

For example how comprehensive should the references section be? Do we want the potential to store many hundreds of bibliographical references relating to every aspect of pesticide risk assessment and its ecological and chemical foundations? Should they be included only if they refer to *probabilistic* risk assessment or only to the particular research projects considered by EUFRAM?

### 4.2 Functionality.

It is envisaged that the principal users of the database will also be the main contributors to it. As a minimum therefore the database will need to be able to display relevant projects and references and to allow users to add their own.

*Beyond this there is a range of possible options.*

- *It would be useful if references could be cross-referenced to the environmental compartments and research needs identified by EUPRA. It is simple enough to build in this functionality but a necessary consequence will be greater effort demanded of the user. Without any cross-referencing the user could perhaps be allowed to upload many references into the database as a single batch. But if we wish to link references to particular themes and projects then each reference will need to be appropriately cross-referenced or key-worded. A possible advantage (in addition to the added functionality) is that the extra effort will deter users from any indiscriminate uploading.*

- The usefulness of the database would be further enhanced if references were formally submitted in their constituent fields (Authors, Year, Title, Journal etc). Again one will need to balance the extra cost in entering data against the benefits obtained. The reference database available on [www.pfmodels.org](http://www.pfmodels.org), simply lists relevant references on pesticide fate modelling grouped by year. It does not offer any search facility. But as the purpose of the collection is to identify key papers, the number published in any one year will not be great and a simple listing may be all that is needed.
- In addition to being able to **add** new projects, references, contact details, should users also be allowed to **modify** or **delete** them? For example, contact details may have changed, or some references or projects may have been entered twice. Perhaps users should submit proposed changes or deletions to the database manager who will check them before implementing them.
- Ability to conduct more sophisticated queries (eg using key words) and download records from the database

To begin with it is probably wise to keep things simple. It may not be worthwhile building in too many bells and whistles before we are clear that the database is useful and popular. As a starting point it would seem sensible to present the user with a matrix of research needs and environmental compartments as in Figure 2.

**Figure 2. Suggested first screen for EUFRAM research database.** (In this example only research needs falling under the heading “Toxicity/Effects” are shown. In reality there will also be research needs grouped under “Exposure/Fate” and “Crosscutting themes”)

EUFRAM Research Database. (Initial outline)

View Projects	View References	View Web Sites	View Contacts
Add Projects	Add References	Add Web Sites	Add Contacts

<b>Issues about Toxicity/Effects</b>	<b>Aquatic Organisms</b>	<b>Terrestrial Vertebrates</b>	<b>Terrestrial Invertebrates and Plants</b>
<b>General issues about Toxicity/Effects</b>	<a href="#">look up</a>	<a href="#">look up</a>	<a href="#">look up</a>
Extrapolation from individuals to populations	<a href="#">look up</a>	<a href="#">look up</a>	<a href="#">look up</a>
Extrapolation from single species to communities	<a href="#">look up</a>	<a href="#">look up</a>	<a href="#">look up</a>
Agreement on endpoints for different toxicity tests	<a href="#">look up</a>	<a href="#">look up</a>	<a href="#">look up</a>
Extrapolating from acute to chronic effects	<a href="#">look up</a>	<a href="#">look up</a>	<a href="#">look up</a>
Toxicity of Mixtures	<a href="#">look up</a>	<a href="#">look up</a>	<a href="#">look up</a>
Extrapolation of toxicity from laboratory to field	<a href="#">look up</a>	<a href="#">look up</a>	<a href="#">look up</a>
Variation in sensitivity between species (SSDs)	<a href="#">look up</a>	<a href="#">look up</a>	<a href="#">look up</a>
Variation in sensitivity within species/lifestages	<a href="#">look up</a>	<a href="#">look up</a>	<a href="#">look up</a>

On selecting a particular combination of research need and environmental compartment the user will be taken to the next screen explaining in more detail how the research need relates to the deliberations of the EUPRA report. For example if the user was interested Species Sensitivity Distributions in relation to aquatic organisms they would see something like

**Figure 3. Screen 2 showing how research need relates to issue discussed at EUPRA**

View Projects
View References
View Web Sites
View Contacts

Add Projects
Add References
Add Web Sites
Add Contacts

Ecological compartment: 
Research Need:

**Issues raised at EUPRA Conference:**

Source of uncertainty	Could probabilistic methods help?	What methods or data would be needed?	What research is required to develop and implement them?	What other action is required to develop and implement them?
Interspecific variability in sensitivity.	Yes, because fixed application factors vary, but may no longer be required with probabilistic risk assessment.	Methods that concentrate on lower tail of distribution.	<p>When to use parametric models vs. distribution-free methods.</p> <p>Influence of data quantity (number of species), endpoint type, and segregation by mode of toxic action.</p> <p>Normalising test endpoints to population parameters (e.g. <math>r</math>, <math>\lambda</math>, risk of extinction).</p> <p>How precise are estimates in lower tail?</p> <p>Validation.</p>	Build and make available databases of existing data. Develop guidance for use of SSDs.

records: 1 of 1 (Filtered)

The user might then go on to look at what projects exist that might answer these research needs (Fig 4)  
 (The projects shown here are taken from the WP8 case studies.

**Figure 4. Projects related to research needs**

Add Projects		View Refs		View Contacts				
Proj Num	Title	Description	Probabilistic component (exposure/effects/ both)	Compartment considered (terrestrial/aquatic)	Compound(s) considered	Route(s) of exposure considered		
4	PRA for a fungicide using SSDs - Aquatic Ecosystem	Species Sensitivity Distributions for all aquatic groups	Effects	Aquatic (Surface Water)	Fungicide	Standard application to agricultural field spray drift		
5	DEFRA research project PN0932: Addressing interspecific	Species sensitivity distributions	Effects only			n/a		
6	DEFRA research project PN0933: UK case study on probabilistic risk	Monte Carlo for exposure, SSD for effects. Chlorpyrifos, Fish & Invertebrates, Spray drift	Exposure and effects	Aquatic (Surface Water)	Chlorpyrifos	Spray drift		
7	DEFRA research project PN0933: UK case study on probabilistic risk	Monte Carlo for exposure and for effects, Amphibians, Atrazine, spray drift and drainflow	Exposure and effects	Aquatic (Surface Water)	Atrazine	Spray drift + drainflow		
11	Higher-tiered aquatic risk assessment for Deltamethrin	Risk curves (joint probability curves, combination of exposure and effect distributions) to quantify the risk to aquatic organisms	Exposure and effects	Aquatic	Deltamethrin	spray drift (only relevant entry)		
12	Higher-tiered aquatic risk assessment for Endosulfan in	Geographical analysis of aquatic exposure (in combination with PRZM run-off modelling), deterministic risk assessment based on most sensitive species	Exposure and effects	Aquatic	Endosulfan	spray drift, run-off		
33	Probabilistic aquatic risk assessment of cotton pyrethroids	SSDs developed for different organism groups, compared to mesocosm/field endpoints. Spatial analysis of cotton landscape used to give landscape level exposure characterisation. 10th percentile effect concentrations were compared to exposure distribution	Both	Aquatic	Cypermethrin as a representative cotton pyrethroid	Drift and run-off		
34	Probabilistic aquatic risk assessment for	SSDs developed for different organism groups, also mesocosm and field endpoints. PRZM/EXAMS used to generate exposure concs also field monitoring used to give distribution of exposures (Solomon et al 1996)	Both	Aquatic	Atrazine	Drift and run-off		

Record: 1 of 8 (Filtered)

Similarly the user may wish to see the references associated with a particular research need or a particular project

**Figure 5. References screen**

Environmental Compartment	Research Need	Project Title	Reference	Add Refs
▶ Aquatic Organisms	Variation in sensitivity between species (SSDs)	PRA for a fungicide using SSDs - Aquatic Ecosystem	Full title not available currently as monograph is currently being peer reviewed by EU	
Aquatic Organisms	Variation in sensitivity between species (SSDs)	Probabilistic aquatic risk assessment of cotton pyrethroids	Hamer, M. ET & C vol 20 pages 652 - 692 (5 papers)	
Aquatic Organisms	Variation in sensitivity between species (SSDs)	Probabilistic aquatic risk assessment for atrazine	Solomon et al (1996) ET & C vol 15 pages 31 - 76. Updated with more exposure, approx 2000	

Or view the principal contact (s) associated with a project.

**Figure 6 Contacts screen**

ProjectNum:

Title:

Contacts

Surname	First Name	institution	email	Country	address
Luttik	Robert	RIVM	Robert.Luttik@RIVM.NL	Netherlands	Bilthoven,

Record:  of 2

### 4.3 Structure.

The main tables containing substantive data (as opposed to those describing relationships between tables) are as follows.

#### Projects

The fields and data for this table have been lifted from the Project Meeting Paper produced in Work Package 8 on Case Studies.

Name	Data Type	Example
ProjectNum	Long Integer	
Title	Text	Higher-tiered aquatic risk assessment for Deltamethrin
Description	Memo	Eg Risk curves (joint probability curves, combination of exposure and effect distributions) to quantify the risk to aquatic organisms
Probabilistic component (exposure/effects/both)	Text	Exposure and effects
Compartment considered (terrestrial/aquatic)	Text	Aquatic
Compound(s) considered	Text	Deltamethrin
Route(s) of exposure considered	Text	Spray drift
Exposure assessment (Modelling? Experimental data?)	Text	Ganzelmeier drift data
Probabilistic approach(es) for exposure	Text	Monte Carlo
Organism(s) considered	Text	Aquatic invertebrates
Assessment of effects (lab tests, microcosms, literature data)	Text	Lab studies
Probabilistic approach(es) for effects	Text	SSD
Endpoint(s) considered and number of datapoints	Text	Acute EC50 in lab studies (28 species),
Sector generating the case study (academia / government / industry)	Text	Industry
Start Date	Date/Time	
Finish Date	Date/Time	
Funded by	Text	Bayer CropScience
Availability	Text	Results published (see reference)
Documents	OLE Object	Eg Full MSWord document describing project rationale and goals
Fulfils Research Need?	Memo	Degree to which project fulfils research need(s)

Because these fields have been taken without any editing from WP8 on case studies we may want to consider whether all these fields are necessary or whether there are other fields we would like to add. The more fields we add, the more work will be required of users entering new projects onto the database.

### Publications

Name	Data Type	Example
PubNum	Long Integer	
WholeThing	Memo	Liess, M., and R. Schulz. 1999. Linking insecticide contamination and population response in an agricultural stream. Environmental Toxicology and Chemistry 18:1948-1955
Title	Text	Linking insecticide contamination and population response in an agricultural stream.
Authors	Text	Liess, M., and R. Schulz.
Journal	Text	Environmental Toxicology and Chemistry
Volume	Text	18
Year	Text	1999
pages	Text	1948-1955
Abstract	Memo	
Key Words	Text	SSD, Field monitoring, microcosm, aquatic invertebrates
Document	OLE Object	Eg Copy of unpublished paper or report in MSWord
Fulfils Research Need?	Memo	Degree to which reference fulfils research need(s)

To get the most benefit from the data it would be preferable to split them into smaller sub-fields and not left undifferentiated in the “whole thing” field. As well as linking with references with the Environmental Compartments and Research Needs it may also help searching if key words are included. Again, this requires more work from the user.

## Contacts

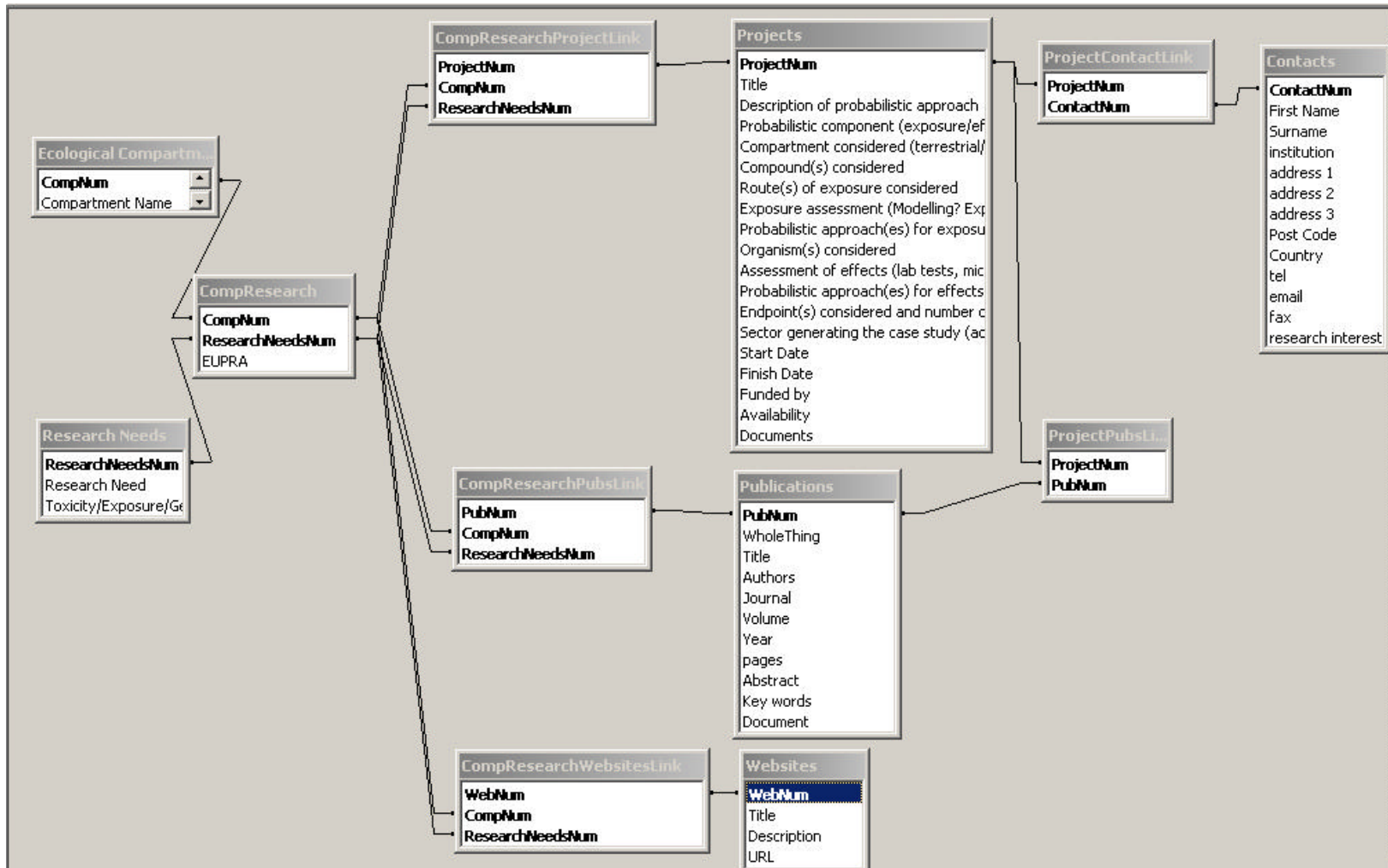
Name	Data Type	Example
First Name	Text	Andy
Surname	Text	Hart
institution	Text	CSL
address 1	Text	Sand Hutton
address 2	Text	York
address 3	Text	North Yorkshire
Post Code	Text	YO41 1LZ
Country	Text	UK
tel	Text	+44 (0) 1904 462053
email	Text	a.harts@csl.gov.uk
fax	Text	+44 (0) 1904 462211
research interests	Memo	International Telephone calls

## Web Sites

There is an increasing amount of material available from the web, therefore it seems appropriate to include links to relevant web sites.

Name	Data Type	Example
WebNum	Integer	
Title	Text	PFMODELS.org
Description	Text	A site dedicated to pesticide fate modelling
URL	Text	www.pfmodels.org

Figure 7. Proposed relationships between principal data tables and link tables are shown in the figure below



## Questions for May Project Meeting.

Ideas about the research database

8. Scope. Size, exhaustiveness
9. Functionality. What facilities would we like to see built in eg search and download capability
10. Structure. What level of detail do we want to record

## **5 REVIEWING PROGRESS**

So far this document has considered only the structure of an integrated research strategy. At some point, when the database has been populated by examples, we will need to consider content. At some point we will need to consider what projects have managed to achieve, what further gaps they have identified and how important they are to be filled. This implies that EUFRAM members will digest the literature and distil its findings and make conclusions.

## Questions for May Project Meeting.

11. Mechanisms by which EUFRAM database users will be able comment on project achievements and new or unmet research needs.

## 6 DETAILED PLAN OF ACTION

The above paper was circulated to EUFRAM Partners prior to the first Project Meeting (May 2003). Comments received before and during the meeting are discussed in Table 2 below. All actions points are the responsibility of the Work Package leader and are timetabled for completion before 31/12/2003.

**Table 2: Action Plan**

Qu No	Question	Conclusion of comments and discussion	Action required to progress issue
1	<p>Are we happy with the environmental compartments? Should we split the third group into terrestrial invertebrates and terrestrial plants? Should we further split off soil organisms as a separate group?</p>	<p>Several comments received before the project meeting made arguments for more refined splitting of the environmental compartments based on similar ecology, exposure, or toxicology. For example soil dwelling organisms will share similar exposure pattern compared to surface dwellers. Plants are more likely to be affected by herbicides than are invertebrates. One could continue with this logic and create 7 compartment, following EPPO or many more. The meeting felt that since one of the key purposes of the research database was as a repository of relevant references then it was less important how many environmental categories or research needs are specified in the matrix as long as one can search titles and abstracts. Nevertheless, the existence or absence of projects and references within the matrix of needs and environmental compartments may focus attention on those areas that are attracting the greatest research effort and those which are not</p>	<p>Leave the environment divided into 3 compartments for the time being.</p> <p>Ensure that user can search database for terms in reference title and abstract</p>

Qu No	Question	Conclusion of comments and discussion	Action required to progress issue
2	<p>Are we happy with the research needs? Should we change the categorisation and/or add further needs?</p>	<p>It was pointed out that the current list of research needs did not include issues about long term exposure.</p> <p>Refer to SCC report on harmonisation of risk assessment</p> <p>It was felt that the research needs identified at EUPRA were a reasonable starting point. But that further needs would become apparent during the course of EUFRAM, particularly during the case studies work (WP 8)</p>	<p>Add long-term exposure to research needs list</p> <p>Consult Scientific Steering Committee report to identify new research needs</p> <p>Revise research needs in the light of progress made in other work packages</p>
3-7	<p>How do we establish research priorities?</p>	<p>In comments submitted before the project meeting it was felt that environmental compartments should be given equal weighting but research needs ranked within them.</p> <p>Wide group of stakeholders should be encouraged to comment on which research needs should be given greatest priority, bearing in mind that the EUFRAM project was created with the needs of government regulators as paramount.</p> <p>Sensitivity analyses may help provide objective criteria for prioritisation but in many cases not all parameters will be available and not all research topics will be susceptible to sensitivity analysis.</p> <p>Again, in the course of conducting case studies the relative importance of research needs may be clarified. But this may also depend on the particular case studies chosen. Similarly, there is a danger that the research needs accorded greatest priority will be biased to those emerging from EUFRAM work packages</p> <p>Ultimately it will be necessary to elicit agreement from EUFRAM partners (and a wider constituency) about research priorities and recommendations. There are established procedures for doing this ranging from a simple balloting to a more systematic method eg (DELPHI)</p>	<p>Encourage other WP leaders to identify and prioritise research needs both within their own work area and outside it.</p> <p>WP leader to investigate alternative methods for ranking and propose approach. Consider doing a first “poll” as starting point by e-mail</p> <p>Provide mechanism on website for partners (and other users?) to suggest new research topics and prioritise them</p>

Qu No	Question	Conclusion of comments and discussion	Action required to progress issue
8	<i>Research Database: Scope</i>	Partners should be encouraged to upload only key papers with implications for Probabilistic Risk Assessment	A prototype database is running on the EUFRAM website with a sample dataset from WP8
9	<i>Research Database Functionality</i>	A basic search facility (of title and abstract fields) would be a minimum requirement., with the ability to upload and download references in a standard format.  Depending on demand by users, further web functions may be implemented	WP leader to organise web-enabled upload and download functions for literature references and project descriptions  To begin with all entries/modifications will be vetted by the web host. Consideration will be given later to the degree to which the process may automated
10	<i>Research Database Structure</i>	References should conform to standard database formats ( ie split into constituent fields eg author, date, journal etc).  Where possible abstracts of papers will be included and searchable	
11	<i>Reviewing progress in developing a research strategy</i>	Mechanisms by which EUFRAM database users will be able comment on project achievements and new or unmet research needs.	WP leader to add comment box to project and reference records which enables partners to express an opinion about the degree to which a project fulfils a given research need.  Mechanism is also required to allow users to submit new or unmet research needs.