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Analysis of Topics and Trends in Indoor Environment Research in Europe: Studies in Homes

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ABSTRACT
A database (IERIE) has been established that holds detailed information on indoor environment research projects across Europe, which is of potential value to both researchers and funders of research. This paper demonstrates how the database can be used to evaluate topic trends and patterns in indoor environment research, particularly focusing on homes. The illustrative analyses reveal, for example, the number of projects that involve investigations in the home and the types of study being performed. It is anticipated that as the database grows and develops it will be of increasing value to policy makers as well as to researchers and funding bodies.

KEYWORDS
Indoor environment, Web-based database, Europe, Air pollution, Research, Homes

INTRODUCTION
There has been considerable research into, and regulation of, occupational environments, but there are other indoor environments where health impacts have not been given adequate consideration. In particular, young people, as well as the elderly or sick, are potentially most vulnerable to the health effects of air pollution, and these groups tend to spend most of their time either in their own homes or indoors in places such as nurseries, schools, hospitals and day-care centres. Hence the environment inside homes and these other buildings is likely to be extremely important to the health and well being of individuals, and may have a significant overall impact on public health.

There are many factors in the indoor environment that may affect the quality of the air (and other aspects such as thermal comfort and noise levels) and thereby impact on an individual's health and well-being. These factors include: building design and maintenance, chemical and biological contaminants, ventilation, temperature, humidity and lighting.

In order to foster a wider appreciation of the many factors that may influence the indoor environment, and to promote research and discussion on this, the MRC Institute for Environment and Health (IEH) has developed IERIE (Inventory of European Research on the Indoor Environment).[1] This web-based database has been developed to provide ready access to information on current projects, to help identify research gaps and new advances in the field and assist in the efficient identification of future research needs. The data can be used to develop a picture of current and changing patterns of research in Europe regarding, for example, pollutants of greatest concern, new or popular areas of research, and patterns of collaboration. This paper presents some example applications of this resource, focusing on research on homes.

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[1] (http://wads.le.ac.uk/ieh/ierie/index.htm)

METHOD
Compiling the database
Information to populate the databases is obtained from questionnaires sent directly to researchers across Europe working in the indoor environment field. This includes individuals specialising in a variety of scientific disciplines, from ventilation system engineering through to molecular toxicology. Researchers are contacted via organisations such as government bodies, universities and research institutes, or via indirect means such as societies and committees, scientific journals, newsgroups, conference/workshop delegate lists and use of Internet search engines. The questionnaire is specifically designed to obtain information about the researcher's projects, the sources of funding, and the project collaborators.

Data is entered onto a Microsoft SQL Server 7 database through a Microsoft Access 2000 project interface. Details are checked to maintain accuracy and consistency through programming logic and manual inspection. The database is updated on a regular basis.

Projects are key-worded using a specially designated three level hierarchical thesaurus so as to allow a user to easily search the database using the predefined terminology (see Figure 1).
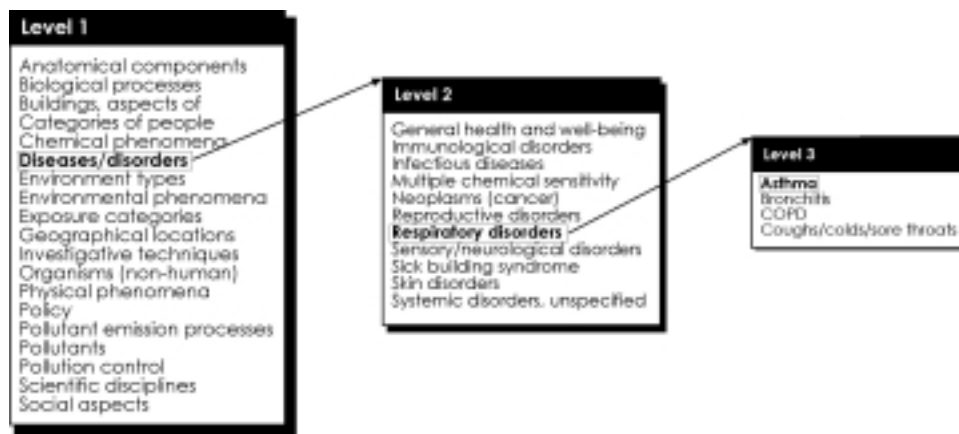
Figure 1. Example of thesaurus tree structure for term 'Asthma'

The IERIE website was created using Active Server Pages technology to allow free public access to the database. Users are able to browse details of researchers and their organisations and their projects. Interrogating the database is conducted either using the thesaurus or by entering terms in a search tool based on the project keywords, title and abstract.

Analysing the data
This paper illustrates the capability of IERIE by analysing some extracted data on the following four topics:
- Asthma – selected as a disease endpoint.
- Particulates – selected as an important indoor air pollutant.
- Filtration/Ventilation Systems – selected as a mechanical engineering focus.
- Humidity/Moisture/Dampness – selected as an important physical factor.

These four topics are specific keyword entries in the IERIE thesaurus. The database is then interrogated using Views (a graphical user interface tool) through the Access 2000 data entry system. For each topic a View can be constructed containing two types of searches:

- All projects that have been indexed with the appropriate topic keyword (e.g. all project titles that have been indexed with the keyword of 'asthma').
- Any instance of the keyword in the project titles or abstracts (e.g. all projects that contain the word 'asthma' in the project title or the project abstract).

Once the queries have been run, a selection of top-level keywords from the thesaurus can be chosen to cross-reference against the results with the aim of highlighting any trends in the data. For example, projects associated with asthma that are also indexed with the 'pollutants' keyword, can be selected (i.e. a union join query). For each of the results, where further indexing has occurred, the pollutant keyword can be broken down to the second or third level of the thesaurus to identify more detailed information.

RESULTS
Project breakdown by indoor environment type and studies relevant to homes
Of the 70 projects on the database that specify a particular indoor environment, a total of 51% (36) are concerned with homes, 23% with offices and 16% with schools. Of the 36 projects to do with homes, 19% involve studies on asthma, 22% on filtration and ventilation, 42% on humidity/moisture/dampness and 17% on allergens of which 17% and 83% are linked to fungal and dust mite allergens, respectively. Figures 2 and 3 show the number of projects on IERIE that involve particular indoor environment types and studies relevant to the home, respectively.
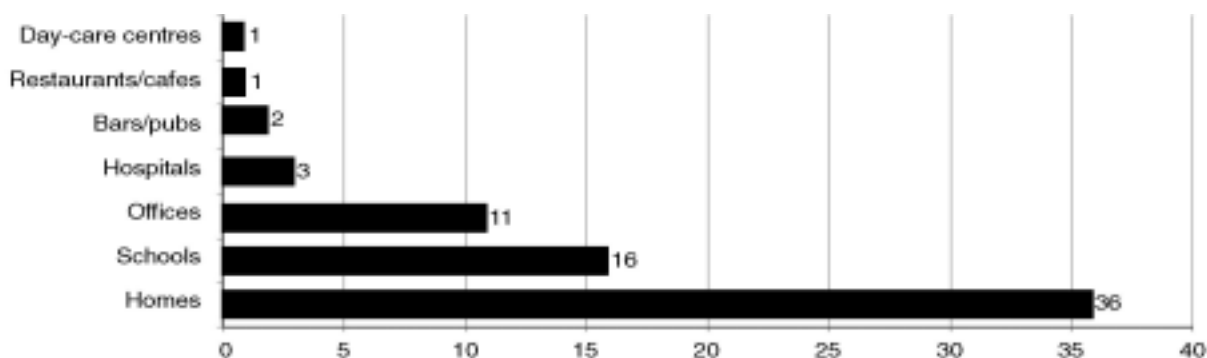
Figure 2. Types of Indoor Environment Investigated (No of projects)
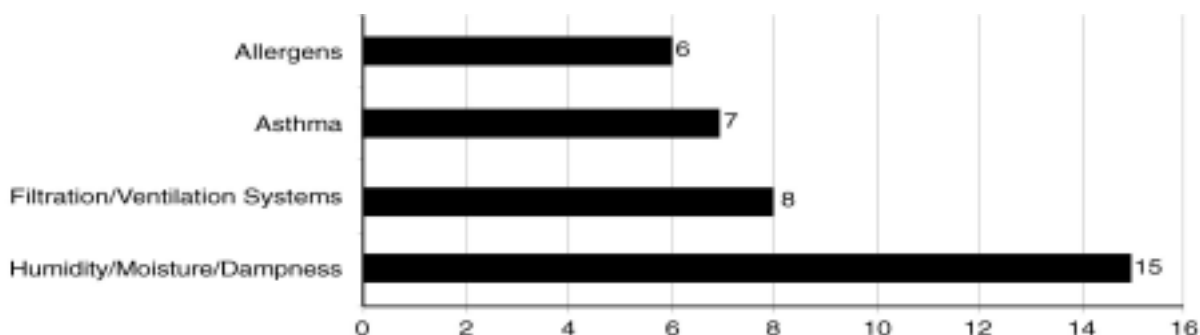
Figure 3. Types of studies in the home (No.of projects)

Analysis of particular study themes linked to homes
Humidity/Moisture/Dampness
A total of 15 projects on the database involve the study of humidity/moisture and dampness associated with homes. About a quarter of these are large projects receiving funding in excess of £250,000 and the remainder have an individual value in excess of £50,000. Over twenty

different funding bodies are involved. Half of the projects are being conducted in the UK and just under a quarter in Finland. Five projects involve epidemiological studies (1 cross-sectional, 2 case-control and 2 cohort design). A wide range of pollutants are being investigated in the humidity/moisture and dampness field; allergens feature in 6 of them, and volatile organic compounds (including formaldehyde) in 2, and oxides of nitrogen in 4. Six of the studies are associated with building repairs/modifications.

Disease/Disorders

The majority of studies are associated with respiratory disorders, in particular asthma. The other topics of investigation are immunological disorders, and general health and well-being.

DISCUSSION

In addition to the identification of current projects and details of researchers working in the indoor environment field, an important application of the IERIE database is in establishing patterns and trends in current indoor environment research. Using homes as an illustration, this paper has demonstrated how analysis can be performed on any theme associated with the indoor environment.

Clearly, the effectiveness and reliability of IERIE rests on the data it contains being complete, correct and up-to-date. The system currently established ensures that the data are current and reliable – the important next step is to ensure the benefits and applications of the database are widely known, and to promote the capture of more and more projects that are ongoing across Europe. It will then be possible to undertake further pattern analysis, including, for example, trends over time and a more robust analysis of the distribution of different kinds of study amongst the countries of Europe.

CONCLUSIONS AND IMPLICATIONS

IERIE is a useful tool to identify current research on the indoor environment and workers in the field and to evaluate current and changing trends in component topic areas. The analysis of extracted data in this paper has provided a useful and practical example of the potential use of the database to evaluate key research themes. It has shown that homes are a popular topic of study and that humidity/moisture/dampness and asthma are key themes in such studies. In time IERIE will become the primary centralised source of indoor environment project information in Europe, and will be of increasing value to policy makers as well as researchers and funders of research.

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