

Technical report No 48

Evaluation of the Air Quality Model Documentation System

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Summary

The Air Quality Model Documentation System (MDS) has been developed by the European Topic Centre on Air Quality (ETC-AQ) as part of the EEA Work Programme with the aim of providing through the Internet information and guidance to any user of air pollution models in selecting the most appropriate model for a specified application.

After almost three years of operation of the Model Documentation System, an evaluation of its functionality and utility has been performed through a survey of its users. The aim of the evaluation was to assess the system's usefulness and identify remaining weaknesses and help providing guidance for its upgrade and further improvement.

The report summarizes answers to a questionnaire from 41 respondents.

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1. Introduction

The Air Quality Model Documentation System (MDS) has been developed by the European Topic Centre on Air Quality (ETC-AQ) as part of the EEA Work Programme with the aim of providing through the Internet information and guidance to any user of air pollution models in selecting the most appropriate model for a specified application. A pilot version of MDS was installed on the World Wide Web in 1997, while an updated operational version was launched in the spring of 1998. Since then two workshops were held to review the documentation, to discuss the functionality of the system and to collect opinions on its possible further development. In March 1999 version 3.0 of MDS was installed as part of AIRBASE including a form for direct model submission over the Internet. At present (February 2000), a total of 91 models are included in MDS at <http://www.etcaq.rivm.nl/databases/mds.html> . The hit and visit statistics show that there are, on average, 20 visits per working day, including queries from North America and other Non-European countries.

In order to assess the system's usefulness and remaining weaknesses and to help upgrade and further improve MDS in the next years, interaction with the users of the system was regarded essential. Towards this aim, it was decided to set up an evaluation of MDS, which would seek to identify the opinions of various users with respect to the technical aspects of the system, the model coverage and presentation and the model quality assessment.

For this reason, a questionnaire was prepared and installed on the Internet, (URL: <http://aix.meng.auth.gr/database/questionnaire.html>) enabling users to submit replies directly after responding to the questions. A total of 41 respondents provided answers to most of the questions. The analysis of these answers and the findings that emerged are presented below.

2. MDS evaluation results

2.1. General information and user profile

A set of questions was asked with the aim of collecting information on aspects related to the user, such as professional and educational profile, modelling skills, the reasons for the search or finally the way that (s)he became acquainted with MDS. A graphical representation of the statistical evaluation of the answers is presented in charts 1-7. From these charts, it can be seen that approximately 75 % of the users are members of a research institute, while only 15 % belong to local authorities and administrations. Consulting firms form almost 10 % of the interviewees. Most of the users are group leaders or team members, while 20 % are heads of a department.

Regarding their scientific background, for the largest part (approximately 55 %) they are physicists or chemists. The rest are mathematicians and computer scientists (20 %), or engineers (17 %). A large majority of users have very high educational levels since most of them (around 70 %) are postgraduates, 20 % of them have PhDs or are Professors and only 10 % of them are first degree graduates. Most of them have good or excellent modelling skills while 20 % are of an average level. Only a very small percentage declares themselves as belonging to the novice level.

The users were informed about MDS mainly through a conference or a workshop (45 %) and from colleagues (33 %). Some were also informed through the EEA/ETC-AQ, the Internet or by other means. The main reason for their quest was their need to get information about various models, while an academic and general interest made more than 30 % of them visit MDS. Finally, 15 % of the users needed support for a specific application.

2.2. Technical aspects

Firstly, the evaluation questions aimed at an assessment of the technical aspects characterizing MDS database, such as clarity of criteria and options available, user-friendliness, malfunctions etc. A first conclusion from the analysis of the answers, as shown in charts 8 to 17, is that, from a technical point of view, the large majority of users assesses the database favourably.

More specifically, almost all users found the search criteria/questions that are used for performing structured searches in order to select the most suitable model for the required application, to be clear or very clear. Similarly, the answers/options given for each pre-defined keyword were regarded as very complete by more than 90 % of the respondents. About the same percentage of users was satisfied with the descriptions provided for each one of these keywords.

While the largest proportion of users think that the database distinguishes and covers all possible model categories, some users (15 %) do not share this opinion. A suggestion that was made on this issue proposed the addition of a new categorization of models according to the mathematical solution used in each one of them. More details on specific suggestions made by the users are given below.

More than 90 % of the respondents find the database sufficiently user friendly and all of them have been efficiently supported by the 'help' facility. The only

malfunction that was reported by a few (~5 %) of the respondents was difficulty in connecting to the database and hence was not really related to the operation of the database itself.

Finally, about half of the respondents have submitted a model to MDS, most of them by filling the model information sheet made available for this purpose.

2.3. Model coverage and presentation

Secondly, the opinion of the users on the actual content of MDS was sought. The intention this time was twofold: To evaluate, on the one hand, the completeness of the model coverage and the adequacy of their presentation, and on the other hand, to assess whether, and to what extent, the database has served its purpose, which is to provide information and guidance to any user of air pollution dispersion models in selecting the most appropriate model for a specified application.

This time, the user's answers cover a broader range of opinions, since each one of them has different needs, expectations and expertise. Overall, they have a high appreciation of the content of the database and specifically on the model coverage and the adequacy of the presentation (charts 17-19). Most of them (~80 %) characterize the model coverage as sufficient, while 20 % view it as average. Some users have noticed the absence of some well known US models. The absence of several public domain models in the area of accidental releases of chemical have also been pinpointed indicating that there should be more effort towards completeness. As far as the model presentation is concerned, more than 80 % of the respondents think that it is adequate. However, on specific issues, several users have pointed out weaknesses and suggested ways for possible improvements.

In particular, regarding the coverage of the various aspects that characterize a model, several respondents regard the documentation as insufficient. More specifically, about half of the respondents are satisfied with the coverage of issues related to input needed for a model, its technical features and its applications. This percentage is even lower (~35 %) when it is related to theory, model limitations or parameterizations.

Depending on the scientific background and the modelling skills of the user, needs, as far as the information given by respondents is concerned, vary. Expert users would wish to have more details on scientific issues like parameterizations, model limitations etc, while non-expert users would be more interested to know, for instance, what are the types of application a model can be applied to, what are the input data they will need etc. A simpler vocabulary (or interpretation of the terminology used) would also be preferable to them. For example, it is not quite obvious for a non-expert user that a model which handles 'line sources' is essentially designed to describe the effects from traffic air pollution. Abbreviations should also be avoided or explained since some users are not familiar with them.

All users, however, underline the need for a characterization of the models as regards their quality, in other words the reliability of their results. This issue will be presented in more detail in the next section. Information on actual use of the models is also regarded as very useful by the respondents.

Another remark is that the database is insufficiently updated with respect to references given, practical applications as well as contact person coordinates.

Regarding the assessment of the final benefit and utility of MDS, the result of the evaluation was quite positive as charts 20-26 allow to conclude. The large majority of the respondents (~90 %) declare having had a successful search of the database. More than half of them had access to the model(s) that resulted from their query and, in most of the cases, they applied these models and obtained successful results.

2.4. Model quality assessment

In the last part of the questionnaire, a set of questions was addressed to users aimed at exploring their satisfaction with respect to the level of information on model validation and evaluation currently provided, as well as their need or desire to have more quantitative information on model result uncertainty. As it has already been pointed out above, independent of their scientific background or modelling skills, the users would wish to be more soundly and objectively informed as regards quality assessment and quality control of the models included in MDS. As the modellers or model owners themselves have made the model presentation, it tends to be subjective. Some of them are very honest and report the model's limitations while others tend to exaggerate their model's capabilities. Also there is often a mixture of frequently used and well-regarded models and never-used and poorly regarded models and the non-expert user cannot distinguish between the two. These findings inevitably lead to the recognition of the necessity for an objective evaluation of the models either by a third party or by setting a well defined methodology for model quality assessment to be followed and reported by the modellers or model owners. These conclusions are derived both from the user responses to specific questions, as shown in charts 27-30, as well as from individual comments and suggestions made by the respondents.

More specifically, as far as the users' appreciation of the information given in model validation and evaluation is concerned, approximately 40 % would qualify it as sufficient, 30 % as average, while the rest think that it is insufficient or incomplete (chart 27). An important outcome of the analysis is that the users, almost unanimously, want quantitative information on model uncertainty to be included in MDS (chart 28). The largest part of them (more than 80 %) would appreciate a further expansion of MDS in order to cover aspects of model uncertainty in relation to input data quality. Finally, almost 70 % of them would desire model accuracy to be defined as a search criterion, in order to be able to set certain thresholds or quality specifications in the selection of the model they wish to access and use. All the respondents that explicitly expressed their wish for more sound information on model quality and accuracy stressed the point that this information should be objective and harmonized within all models and model categories.

2.5. Suggestions for possible improvements

In addition to answering the individual questions, many respondents commented further and made useful suggestions for improvements on several aspects related to MDS. The most applicable among them follow hereafter:

- Categorization of models according to their type (e.g. Eulerian, Lagrangian, Gaussian, puff, stochastic, etc) and definition of a new search criterion along this classification. This would be interesting to search for or to compare models with the same mathematical bases.

- Inclusion of equations on which the models are based in their long description for academic interest.
- Adding comparability capabilities in order to make model comparison according to model characteristics sufficiently easy. This could be realized by providing for instance the possibility for the user to perform a two-phase selection: a) select some or all of the models resulting from his search and b) select some items from the 'Long description' (such as 'Basic information', 'Intended field of application', etc) and get as a result a page with the desired information for all the selected models.
- Last but not least, a comment/suggestion made by many respondents in many different ways, regards the user need to get objective information on model reliability and quality assessment.

3. Conclusions

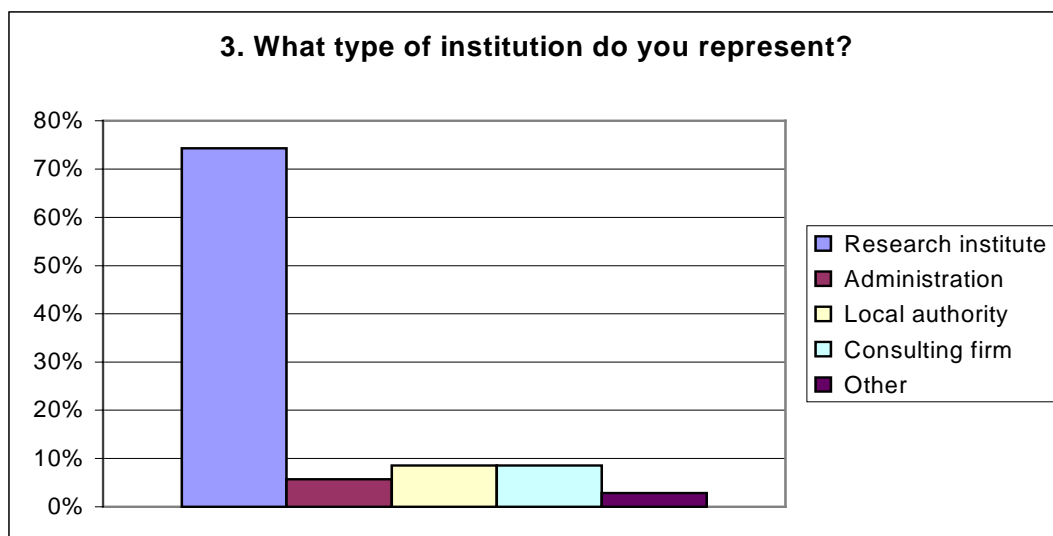
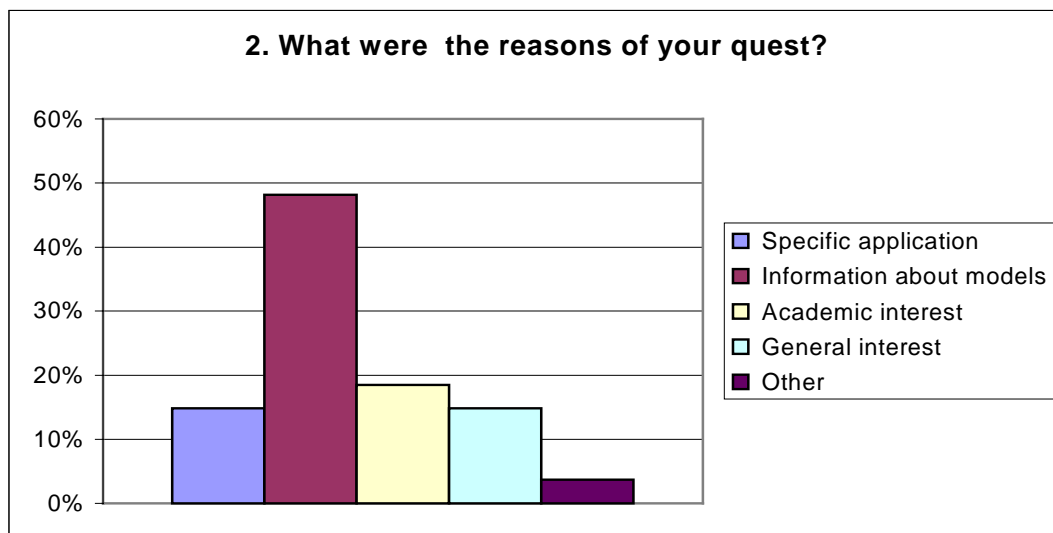
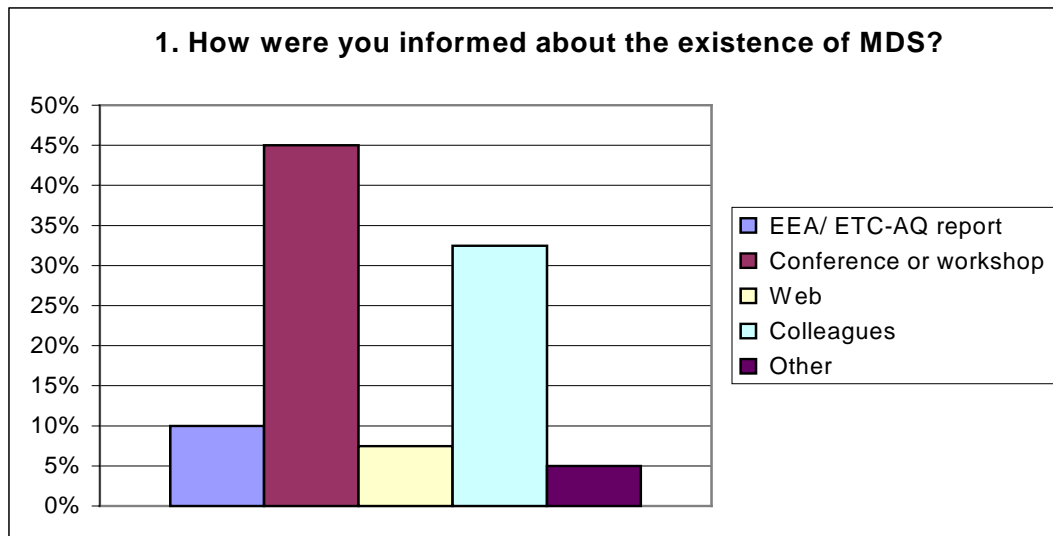
After almost three years of operation of the Model Documentation System, an evaluation of its functionality and utility has been performed through a survey of its users. The aim was to assess the system's usefulness and identify remaining weaknesses and to proceed to its upgrade and further improvements.

The results of this evaluation are quite encouraging, since they have shown that the MDS is very well accepted by the user community. Overall, they hold a high appreciation of both the structure and content of the database. Many users have used MDS to select an appropriate model for their needs, and their application(s) has led, in most cases, to useful results. There is, however, ground for further improvements in several directions such as completeness, enrichment of model presentation, and classification of models according to more criteria.

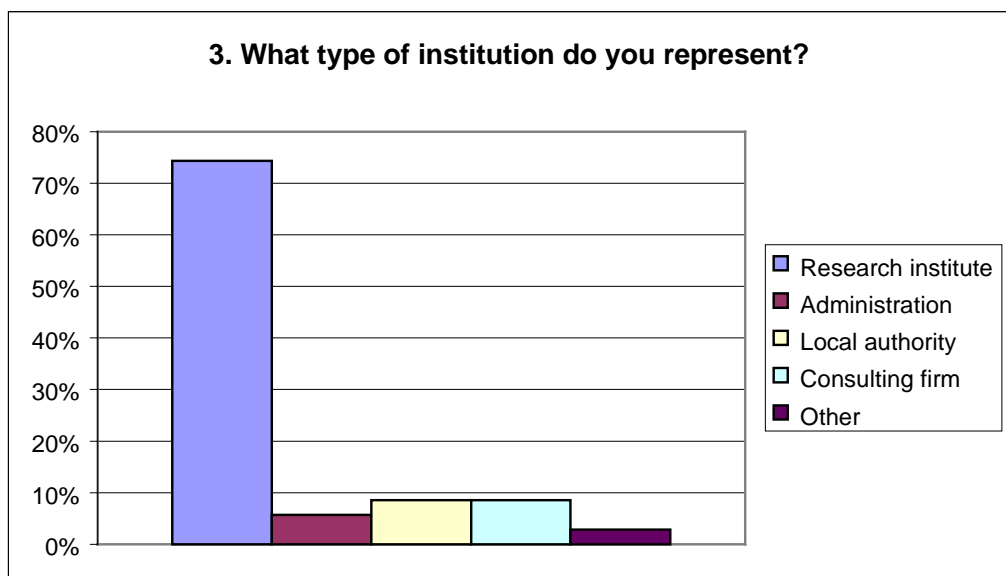
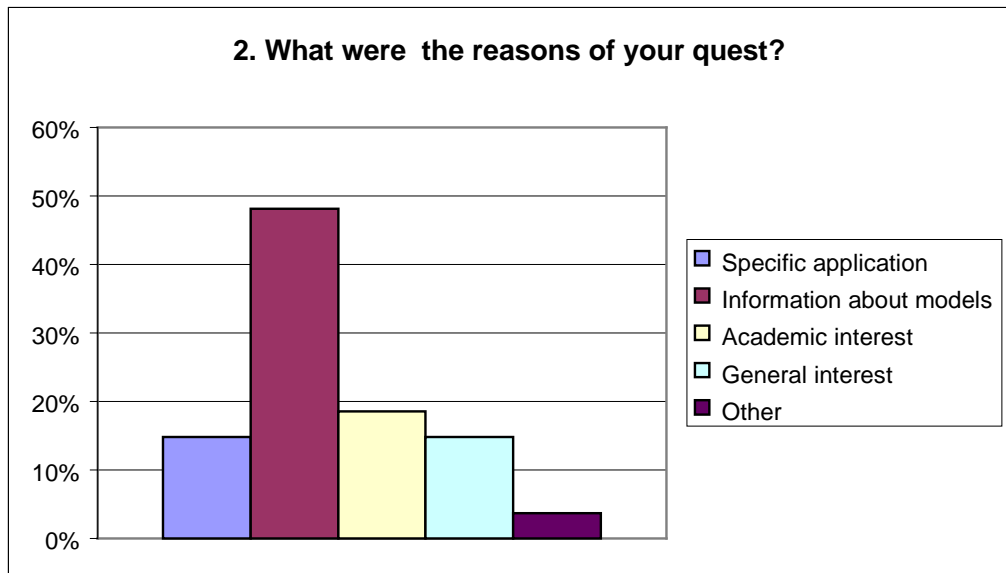
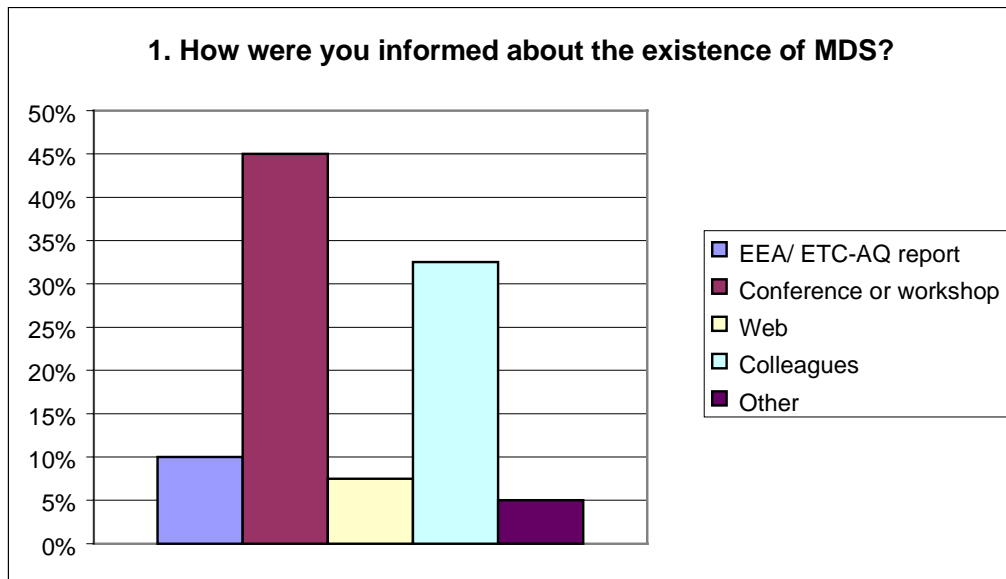
An important finding is that, although MDS has been visited by users from the majority of European countries, including Eastern European countries and even non-European countries such as the United States and Mexico, most of them belong to the academic community, while other user profiles, such as administration or local authorities, as well as the private sector are poorly represented. This implies that, either the dissemination of information related to the database was insufficient, or that these users did not realize the possibilities that were offered to them through the use of MDS. Effort should, therefore, be made to attract more non-academic users. Linking MDS to the EEA home page <http://www.eea.eu.int> and to the AIRBASE web site <http://www.etcaq.rivm.nl/databases/airbase.html> may help drawing the attention of a wider group of users to MDS.

Finally, one of the most important outcomes of the present evaluation, explicitly underlined by many users, which imposes on the directions for the future MDS expansion, is the necessity for a quality assessment and quality control of the models, following a well defined and harmonized methodology, that will be valid for all models and model categories. The users, by a large majority, regard as essential the inclusion in MDS of model accuracy, as one of the main selection criteria for air quality models in the future.

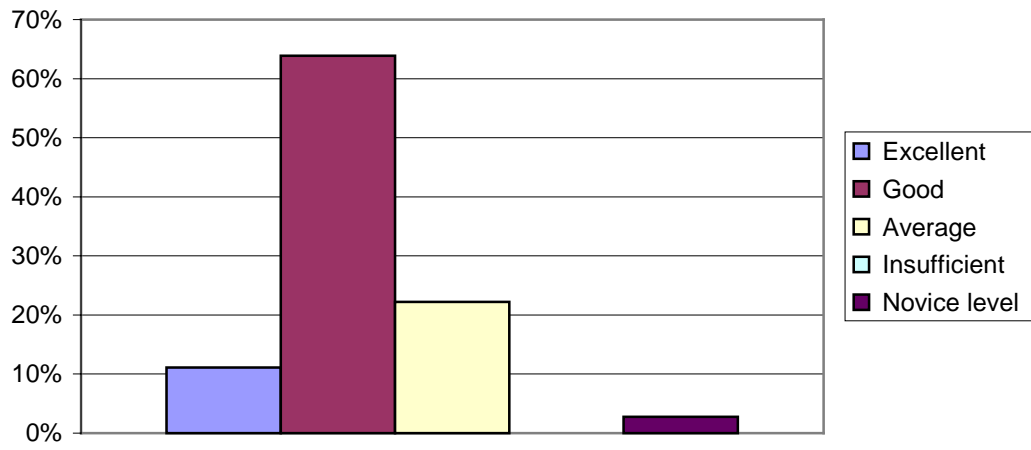
General information and user profile



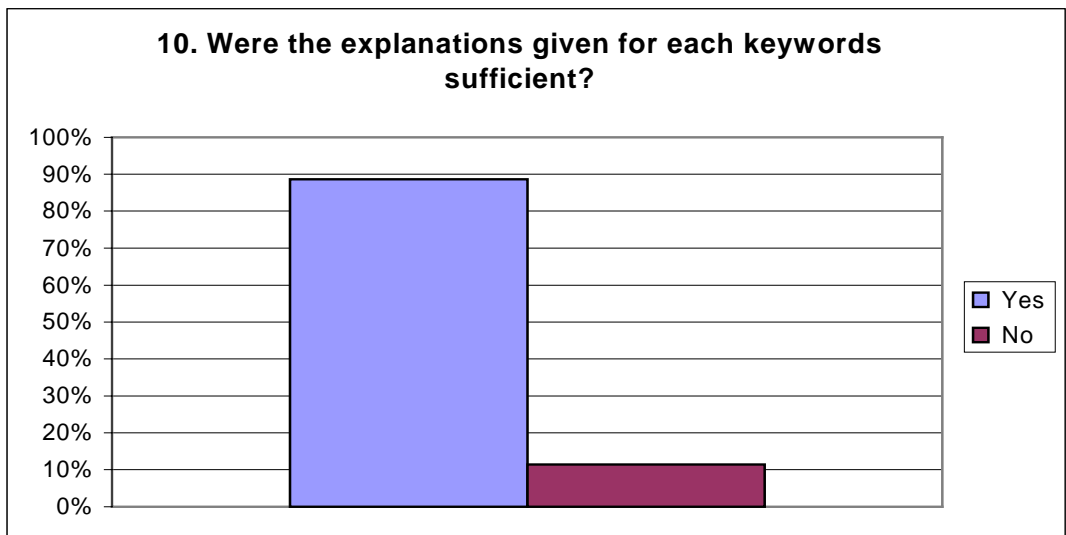
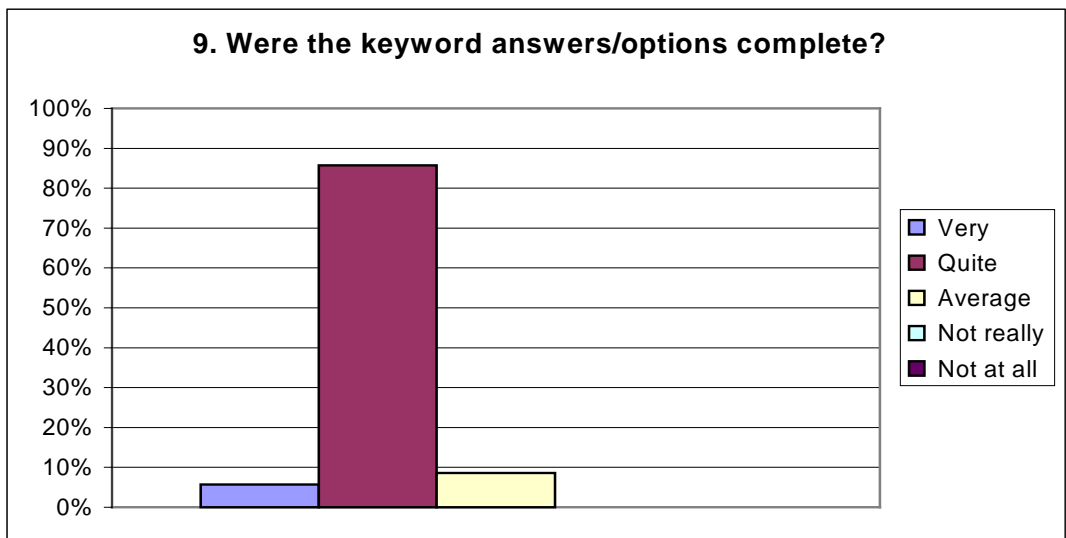
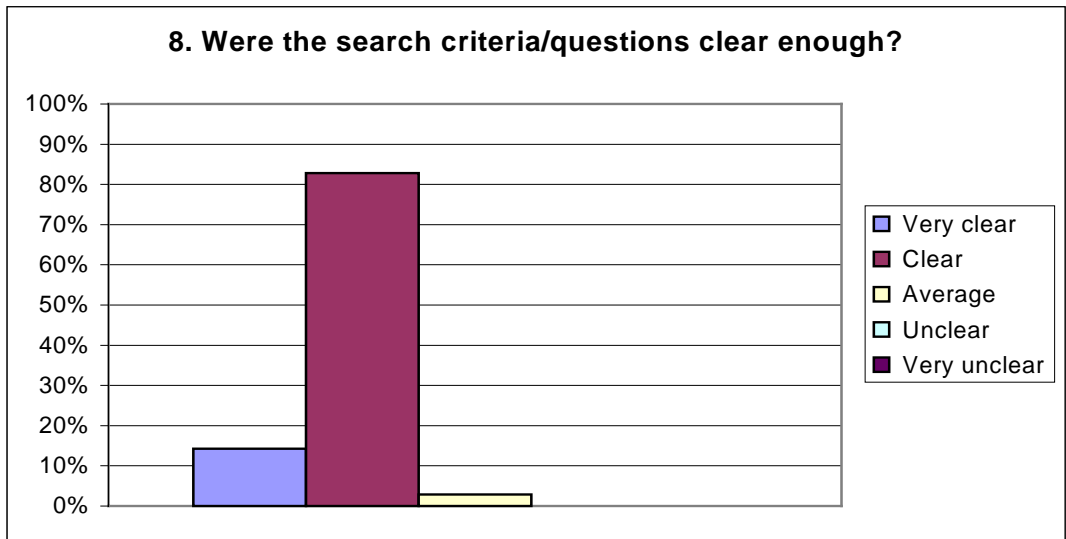
General information and user profile



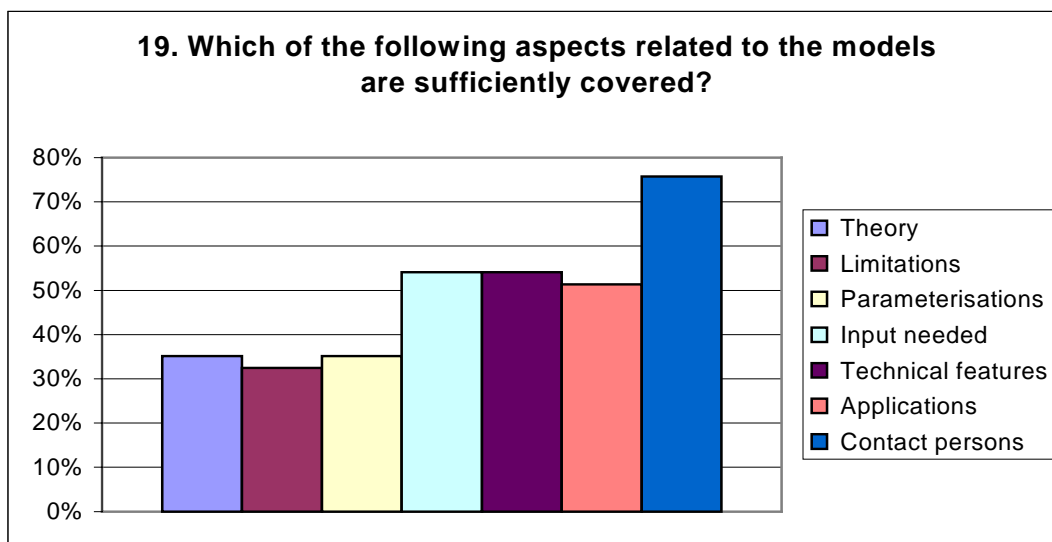
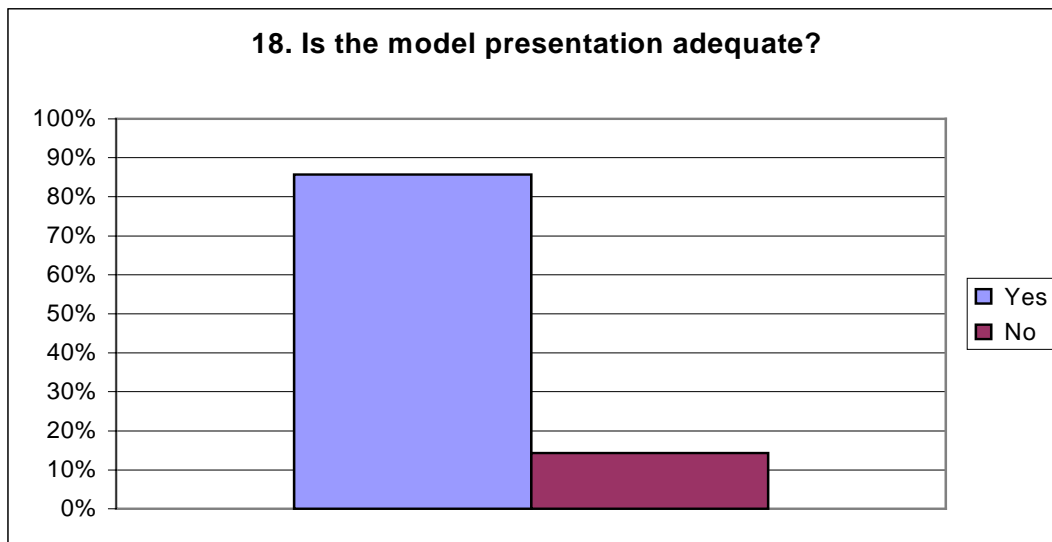
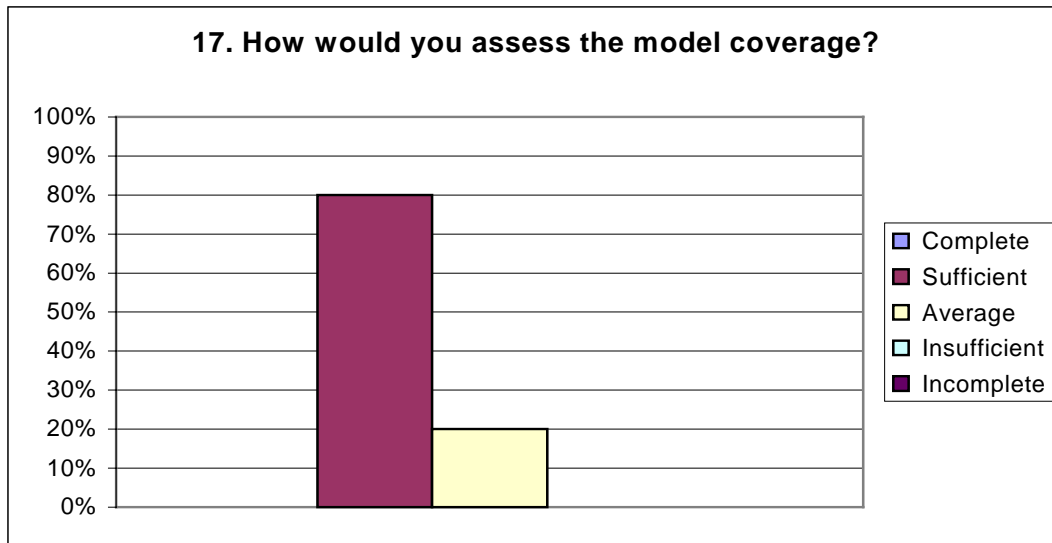
7. How would you assess your own modelling skills?

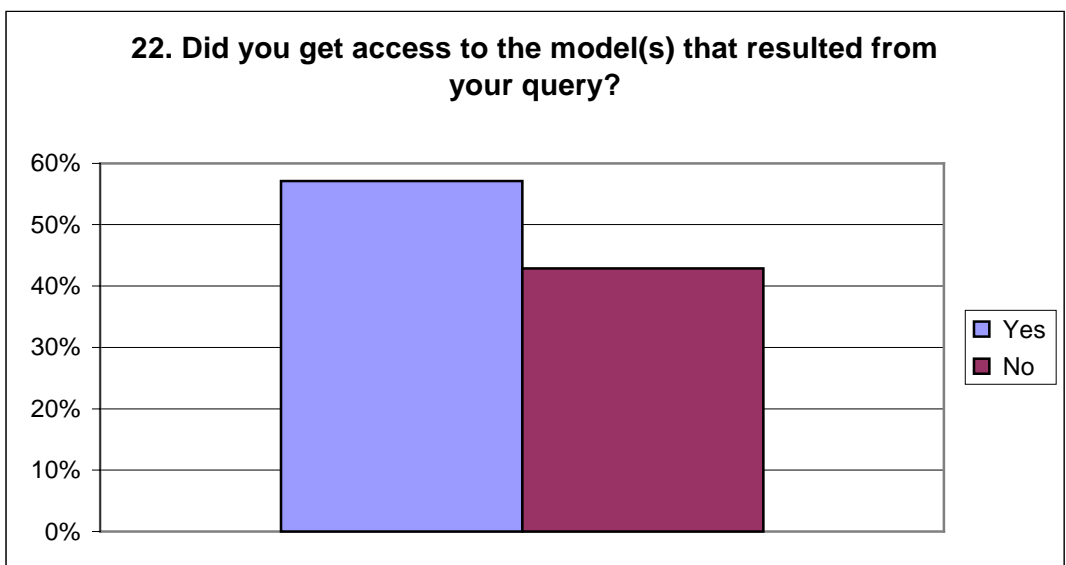
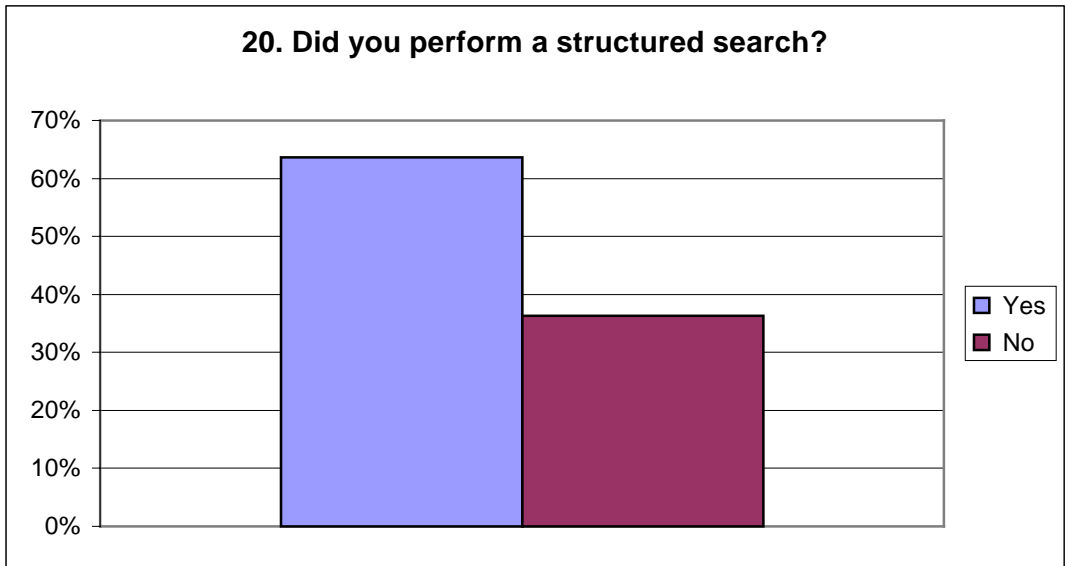


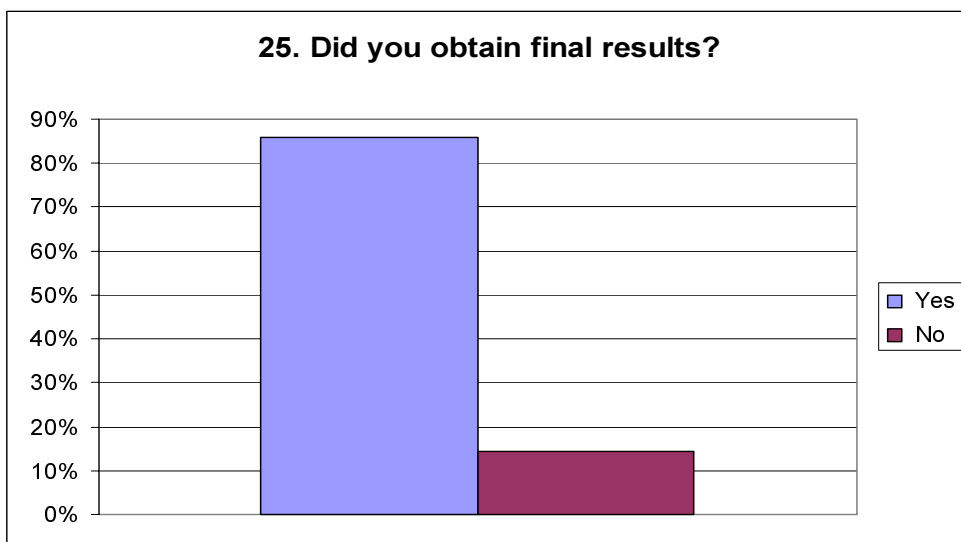
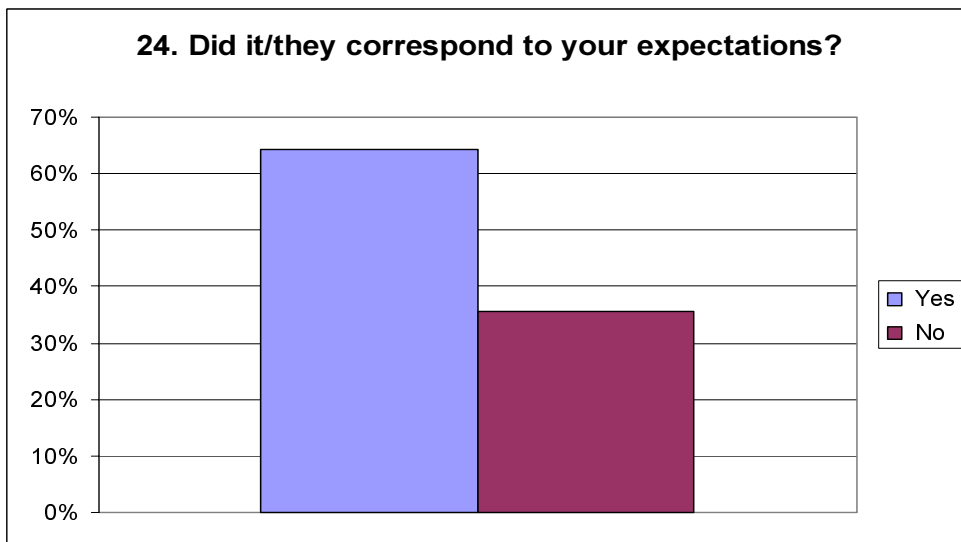
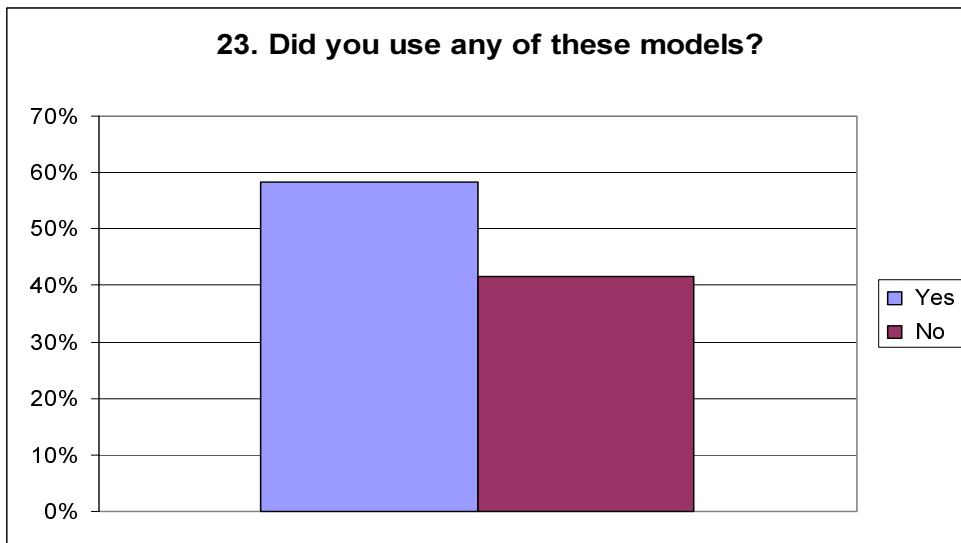
Technical aspects



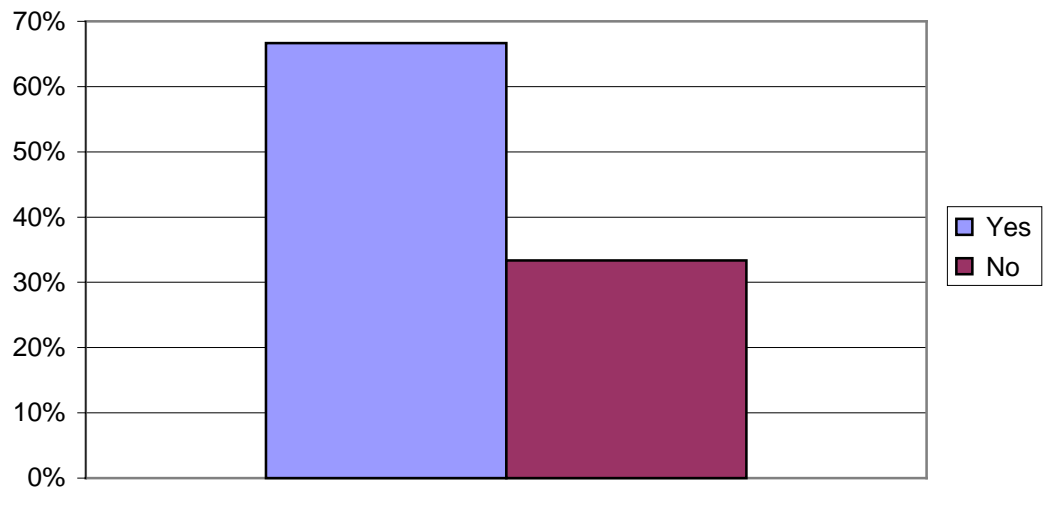
Model coverage and presentation



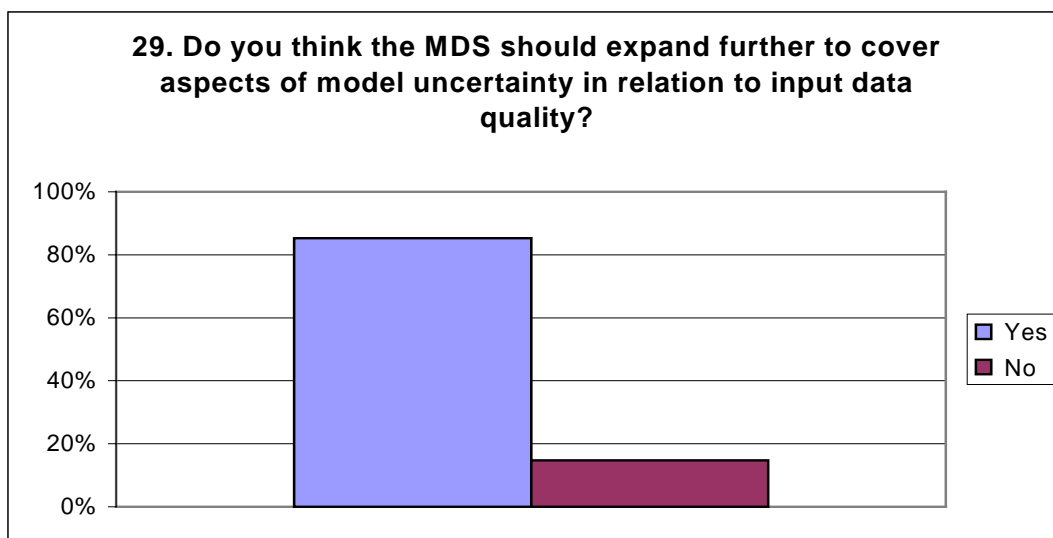
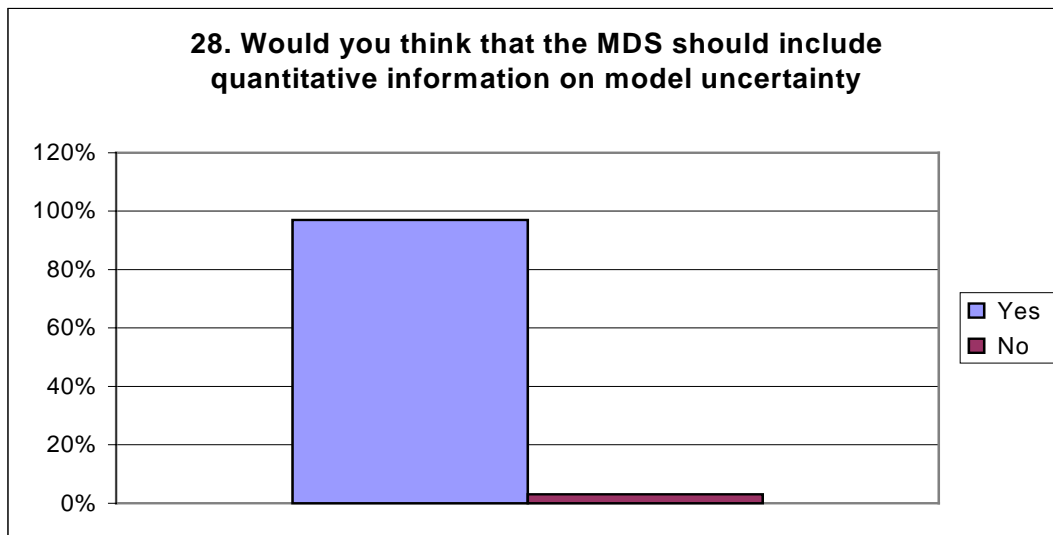
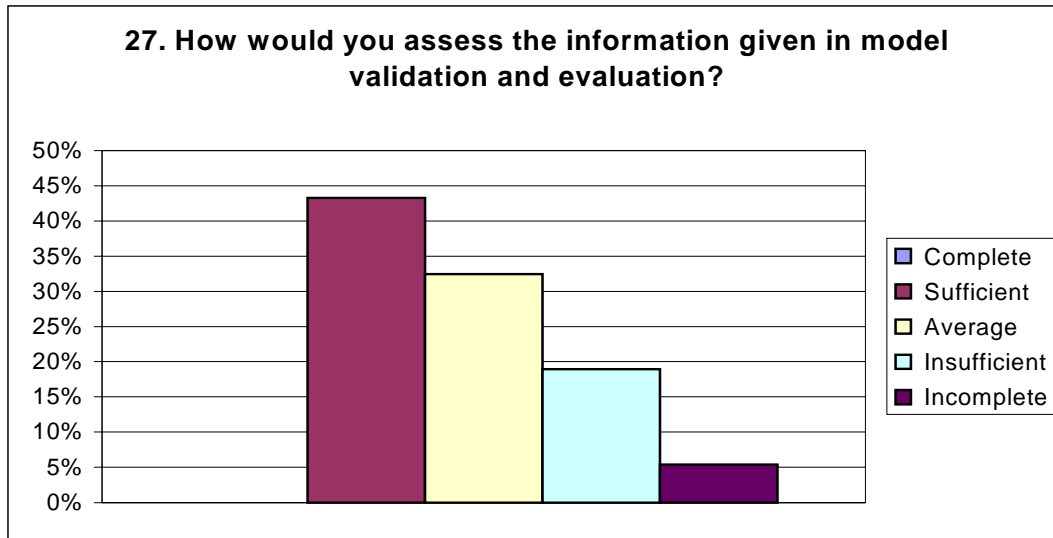




26. Did the MDS finally answer/help your initial quest?



Model quality assessment



30. Would you, as a future vision, desire model accuracy as a search criterion?

