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The EU model evaluation group

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Abstract

The model evaluation group (MEG) was launched in 1992 growing out of the Major Technological Hazards Programme with EU/DG XII. The goal of MEG was to improve the culture in which models were developed, particularly by encouraging voluntary model evaluation procedures based on a formalised and consensus protocol. The evaluation intended to assess the fitness-for-purpose of the models being used as a measure of the quality. The approach adopted was focused on developing a generic model evaluation protocol and subsequent targeting this onto specific areas of application. Five such developments have been initiated, on heavy gas dispersion, liquid pool fires, gas explosions, human factors and momentum fires. The quality of models is an important element when complying with the 'Seveso Directive' requiring that the safety reports submitted to the authorities comprise an assessment of the extent and severity of the consequences of identified major accidents. Further, the quality of models become important in the land use planning process, where the proximity of industrial sites to vulnerable areas may be critical.

Keywords: Model quality; Consequence analysis; Safety assessment; Land use planning

1. Introduction

The model evaluation group (MEG) was launched in 1992 as a result of a number of consultations the EU initiated with industry, regulators and scientists in Europe. The background was a growing concern that most of the models used in major hazard assessment studies had never been subject to a procedure of evaluation, but nevertheless had been used to assist in the decision making process. A comprehensive European benchmark exercise [1] on major hazard analysis has revealed large discrepancies between numerical results of assessments performed by different European teams independently. The choice and use of models were identified as contributing factors to the discrepancy in the study.

The EU also commissioned a report [2] on the evaluation of technical models used for major accident hazard assessments. The study concluded that there was little formalised

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evaluation of the quality of models and that a demand by users for a more structured evaluation procedure existed. The study recommended a European activity on the subject and noted that the EU was an appropriate body to play a role in managing an activity on quality assessment.

2. MEG—model evaluation group

The model evaluation group (MEG) [3] had the first meeting in 1992 with the members:

- Rex Britter, Cambridge University, UK
- Thierry Cartage, SOLVAY, Belgium
- Steve J. Jones, AEA Technology, UK
- Michael Schatzmann, University of Hamburg, Germany
- Ben Stork, TNO, Netherlands (resigned in 1994)
- Kurt E. Petersen, Risø, Denmark (chairman)

The objectives of MEG are twofold. The primary aim is to improve the culture in which models are developed and used ensuring that models are up to date and their use is correct with respect to the validity limits. To meet this goal effort is needed both on establishing requirements on models developers and on developing guidelines for quality assessment for model users. Secondly, the results will be applied by EU in setting up research priorities for future EU research programmes in major industrial hazards.

MEG has developed a generic protocol for assessment of the quality of a model. It was sent out for peer review in 1994. After completion, the protocol has been tested applying it to a number of specific topic areas:

- dense gas dispersion
- liquefied pool fires
- vapour cloud explosions
- human factors
- momentum fires

The activities targeting the generic protocol to the specific topic areas were carried in small groups consisting of European experts participating on a voluntary basis. An element in their activity was planning and managing an open exercise to test the specific protocol on a limited example. Several European teams or individuals have participated in the exercises.

The results of their work showed that the principles of the generic protocol did make sense and provided a valuable tool for further development. Further, the work clearly demonstrated some of the difficulties in performing a structured model evaluation. Two of the most important difficulties were the large effort needed in performing the evaluation properly and the importance of the selected set of data used in the validation part of the evaluation.

The results of the work in the expert groups will be published in reports in the EUR-series and have been or will be presented in international journals and at conferences and seminars.

3. Model evaluation protocol

The model evaluation protocol was issued by the EU in 1994 [4]. The model evaluation procedure consists of three main elements:

- scientific assessment
- verification
- validation

The scientific assessment should comprise:

- a comprehensive description of the model
- an assessment of the scientific content
- limits of applicability
- limitations and advantages of the model

Further, it should be clear if the evaluation will comprise the entire model or a specific submodel in isolation. Such a choice needs justification, as does the choice of the appropriate data set selected for the procedure.

The verification part deals with the question that the model produces the results in accordance with the specification.

The validation is dealing with the results and their relevance to the situation in question. The validation part comprises:

- database selection
- model characteristics/parameter selection
- uncertainty estimation
- selection of validation parameters
- applicability of code comparison exercises
- applicability of benchmarking

It is obvious that a comprehensive documentation of the evaluation is as important as the evaluation process itself.

4. Results obtained

The first results from the expert groups have been presented at a number of meetings and conferences [5,6]. The main findings were: (1) the protocol can be applied for model quality assessment; (2) on the basis of the relatively few test cases, the evaluation of the numerical measures suggested in the protocol was straight forward; (3) detailed comparisons for a transient event are difficult to carry out; (4) comparing only with a single measure, it is possible to produce a 'good fit' even if the model should not be used at all, while fitting to two or more parameters simultaneously was difficult or impossible (an example: a model not developed for dense gas dispersion can be tuned to predict say plume height for a dense gas cloud, but will fail if both plume height and width is required); (5) uncertain if the model questionnaire is detailed enough to detect the above; (6) for CFD models, additional questions need to be included, and (7) it is difficult to on combined or integrated models where the transition from one submodel to the next is hidden from the user.

The consequences of the above findings are that the model evaluation protocol needs continuing updating and refinement. Further, more research is needed on how to treat combined or integrated models, and similarly the more complex CFD models.

The attempt to use the model evaluation protocol outside the physical models areas, as it is done in the Human Factors expert group, looks promising, although more effort is needed in specifying and classifying the models used.

5. Conclusions

One of the statements given at the first European meeting on model evaluation was ''No model is correct, but some are extremely useful''. This statement contains very important information, since the ambition of MEG is not to identify a model which in all respect is the better. A model might be excellent for one purpose, not well-suited for another and totally useless in a third situation. The aim of MEG is therefore to provide assistance in evaluating the fitness-for-purpose of existing models to give the user a valuable support and not to rank models according to some universal criterion.

Another statement that contains important information was ''Models can only be used by the developer''. The statement clearly indicates the need of an appropriate documentation, since the truth in the statement refers to the almost always lacking complete documentation supporting a useful application of the modelling. So, in situations with poor or insufficient information, clearly the developer is the only person with sufficient insights to use a model effectively and correctly. This demonstrates the need for high-quality documentation.

From the conferences and meetings where MEG activities and results have been presented, it seems that there still is a demand for a structured and systematic approach

to model quality assessment. It seems that it has been possible for MEG to get a reasonably broad contact with the scientific community, so progress has been made, both in the MEG expert groups themselves and also in other national activities where the idea or work of MEG has been used as input. It has further been noticed that a stronger link to the users in industry and regulatory bodies is needed to be able to improve the implementation of the MEG results, and as a consequence of this the quality of the work. Activities have been initiated to remedy this problem.

The full success of the initiative will require a stronger involvement from the users and probably also investigations of a broader range of models than those used within industrial safety. This required and still requires a common European effort where the EU plays an important role.

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