

FINAL REPORT

I	The Name of the Institution to be evaluated	National Institute for Research and Development in Mine Safety and Protection to Explosion (INSEMEX), Petroșani
II	Evaluation Period	2007-2014
III	Members of the Team	
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Conclusions and Recommendations

1. The quality of R&D activities and their results

Given the historically determined nature of the research activities of the institute, which does not require in-depth analysis of complex fundamental phenomena, the R&D activities are of high quality. Industry and other clients appear to be keen to absorb the results. In general, the teams have a good income from their projects. Many papers are presented at a variety of conferences and the renowned German institutes in the field, the Bundesanstalt fuer Materialforschung und Pruefung (BAM) and the Physikalisch-Technische Bundesanstalt (PTB) show a continuous interest in cooperation. There is no lack of other international cooperative projects. Partnerships with Romanian universities are easily established with also the result of a relative abundance of Ph.D. students willing to work on the institute. At this moment much of the activities has the character of development rather than investigation in depth of phenomena and substance property. So, in all there sufficient proofs that the work is valued. However, as shall be further expanded below, the often empirical and simple theoretical methods are starting to show the end of their potential of solving the problems associated with the ever further developing requirements and needed improvements of products and performance of measures. So, the main recommendation is to strive for a higher sophistication level.

2. Human resources quality

The culture at the institute is excellent. The quality of the human resources is very good, particularly, where it comes to the practical approaches that thus far form the body of the work. The older core of the institute is formed by very dedicated, highly skilled people, but in quite a few instances they lack in building a vision of how the work should develop on the longer term. Several years ago already a development started to attract Ph.D. students who, after their promotion, are staying in the institute. The scientific level of the work increased due to this. However, because, as was noted above, the problems intensify in depth, the need for better instrumentation and computational means is rising while the possibilities in this respect are rather limited. Hence, for a further healthy growth it is recommended to give the trend sufficient attention, so that the more scientifically developed younger staff can deploy their full potential.

3. Quality infrastructure and its rate of exploitation

The existing infrastructure is for the largest part again very practical and well maintained. Its rate of exploitation is very high. However, the recommendations made above with respect to sophistication are also valid here.

4. Management efficiency and quality of the research environment

The impression is obtained that the management processes are simple, direct, without bureaucratic 'red tape'. As mentioned the culture is very good; no signs of unduly rivalry have been observed. In this respect no suggestion for improvement can be made.

5. Quality and credibility of the institutional development plan

Given the present limitations the development plan is sound. Further international partnerships and EU-project participations are sought. In view of the above noted trend it is recommended to try to publish in internationally higher level journals than in general is done today.



TEAM E1 – Research team of the Laboratory for Mining Safety and Industrial Ventilation

Research team E1 consists of 9 employees in the various categories (CSI - 0, CSII - 2, CSIII - 5 and CS - 2). The average age of the team is 49 years. Team E1 is not well balanced in terms of age distribution (the team is relatively 'old': 1 below 30, 2 between 30 and 40, and all others older than 50 (or almost)), nor in terms of gender (there are no women in this team). On the positive side, the team is experienced and mature, but 'fresh blood' could be welcomed.

The income of team E1 mounted to 387 k€ in 2013, which is 14,2% of the total income of the Institute. The income of team E1 is 32.2 k€ per employee.

Team E1 focuses on mine ventilation optimization in view of mine gas leaks and mitigating the effect of a mine explosion on the ventilation system. The presentation of the essentials of the work was not strong, but shows the four main fields of interest. The ambition of team E1 is to continue and further develop the existing research lines (mining ventilation; industrial ventilation; explosive and toxic gases; underground fires). There is good expertise to start from, but new domains should be explored. Acquiring new team members could help in this respect.

An ambition of team E1 is to develop Romanian software to simulate the effect of explosions on the ventilation in underground ventilation network (Jiu valley geometry) in real-time, as well as on the main ventilation station to optimize of mine ventilation network. This will be based on the known and available tools, in particular 3D software - CANMET (Canada), Ventsim (USA), VentGraph (Poland) and (Spain). The proposal to do this for a network of around 460 branches seems unrealistic, though. 'Optimization' is mentioned, but in fact the research refers to 'uniform redistribution'. Moreover, they refer to flows in the simulations where reality is more unruly.

Team E1 launched a project proposal on the CONRIS site in the Horizon 2020 framework. Horizon 2020 proposals (seeking partners) are ecologically oriented, but the own contribution is based on mine ventilation knowledge (particularly concerning the monitoring of the atmosphere).

Team E1 has a limited number of publications and patents, although 2 patents and 4 patent requests show a particular interest in this direction. However, all are at national level, so more effort could be done in the future concerning patents at international level.

The equipment (in particular the anemometers) does not seem suitable to validate the simulation results. As a consequence, only indirect 'validation' can be performed by comparing results obtained with different (validated) software packages. This is a point of attention for the future, since this research line will be continued by team E1.

The 'representative project' for INSEMEX also stemmed from team E1. The following points of attention occurred:

- o The 'visibility' was limited (mainly inside Romania and only in proceedings). More effort should be done to improve international visibility of the team's results.
- o The project is much more 'development' than 'research'. The research component mainly concerns the determination of the characteristics of the ventilation network within the framework of the models applied.
- o There is no validation of the simulation results by real-life data. It is important to establish experimental data to support the credibility of simulation results in the future.

The research program as presented by the team leader is very ambitious. Considering the perceived current potential of team E1, including its composition, the foreseen achievements within the assumed period of time, seems to be unrealistic. More strength will be needed.



TEAM E2 – Research Team of the Laboratory for Physico-Chemical Analysis

The research team E2 is young (average age 36 years) and consists of seven employees (CSI – 0, CSII – 0, CSIII – 1, CS – 5, IDT – 1), with six of them including the group leader being Ph.D. students! Such a structure of a research group is very unusual but has yet worked well in this particular case.

Although three researchers with the highest degrees left the group due to retirement (1 CSI in 2009, 1 CSII in 2010, and 1 CSI in 2013), the research outcome of the group permanently increased over past years. For instance, in 2007-2011, the group produced in average nine papers per year, with most of them being published in proceedings of conferences held in Romania. To the contrary, in 2012, the group published two papers in an international journal with impact factor larger than one. Furthermore, in 2013, the group published 23 papers in conference proceedings, with 11 of these contributions being presented at conferences held abroad. In addition, the team members have established two Romanian patents and published two books.

Income of the group from R&D activities A1 and A2 was also increased in 2012 and 2013. In 2013, the team amounted to 160.79 thousand Euros, i.e. 22.97 thousand Euros per employee.

The team is characterized by a wide area of work and well collaborates with other teams, e.g. team E4. In the area of basic research, the team determines flammability characteristics of gases, vapors, and liquids. The focus of applied research is placed on gas, dust and hybrid explosions and also physico-chemical aspects of environmental protection. The team widely uses physico-chemical analysis methods, performs electrical engineering research and development, runs and computational fluid dynamics (CFD) simulations.

The laboratory is accredited on ISO 17025 and authorized for occupational hazard determinations.

Team members are currently participating in European Project AVENTO.

The team suggests Horizon 2020 project proposals aimed at environmental protection and seeks for partners.

The team combines young, well educated and highly motivated researchers and, therefore, has one of the highest potentials of all to develop new applied research topics, such as evaluation of toxic risks of organic molecule deposits on dust particles, toxicity of soot particles, toxicity of explosion product molecules, selective elimination of explosion promoting molecules by adsorption onto zeolites etc., just to give a few examples. Accordingly, the group deserves strong support and needs investments into research equipment. In particular, computational hardware available in the group is definitely not sufficient in order to run CFD simulations of the European level. It is strongly recommended to significantly increase the computational capacity of the group, e.g. by getting access to significantly more power computer networks installed in other research institutes in Romania. Promotion of the team members to a higher research position is also recommended after Ph.D. defense. In spite of successful R&D activity of the team, advices and recommendations from older, more experienced researchers could be helpful in future. The work of this team clearly indicates that the future of INSEMEX is promising.



TEAM E3 – Research Team of the Laboratory for Risk-Rescue operations

This is a relatively small, but highly educated team of 5 members with an average age of 41 45 years. Income of the team in 2013 is 359 k€ (13.1% of the Institute) or 51 k€ per employee.

Half of the work is applied research, the other half is training of mine and fire brigade rescue teams. For the training a center has been built in which also individual fitness of rescue team members can be investigated. The research concerns about 2 projects per year. The team participates in a European project which is in progress.

Research is conducted in two directions: Development of an expert system for simulation of interventions as a management tool of organizing optimal rescue operations for all types of events and how training for rescue operations can best be performed including physiological monitoring. The latter also comprises training in smoky atmospheres and stressful conditions.

Over the period of review a relatively large number of journal (almost 2 per team member) and conference papers has been produced (almost 12 per team member) and 6 books. Through participation in international mines rescue conferences ideas have been exchanged.

The diverse training infrastructure has been examined and be assessed as excellent. In 2007 accreditation has been obtained for noise and vibration measurement.

Staff is skilled and highly motivated.

In the Call 'Crises and disaster resilience' of Horizon 2020 partners are sought for a project to develop a tool to increase resilience by a regional cooperation of rescue teams.



TEAM E4 – Research Team of the Laboratory for Environmental Protection

The research team E4 consists of 5 researchers in the various categories (CSI – 0, CSII – 0, CSIII – 4, IDT – 1) employees. The average age of the team is 41.2 years.

Research team E4 in 2013 amounted to 106.52 thousand Euros, which was 3.91% of total income of the Institute and per employee researcher gave 21.3 thousand Euros. Balance (ratio) between research projects to services is 40/60.

The team is too small to realize serious research projects. The projects have interfaces with the one by Occupational Safety and Health institute in Bucharest and therefore once per year there is a coordination meeting.

This team has clearly specified 4 research direction:

- Protecting human health and the environment by establishing measures to maintain the ambient air quality, based on the assessments of pollution level of the environmental factors
- Research aimed to establish rehabilitation and ecological reconstruction measures for areas affected by anthropic factors.
- Research on the environmental impact of different industrial activities
- Research on psychological advising and counselling for employment, in order to enhance occupational safety

The function of the team here are the mines related aspects, such as toxicology of asbestos, particulates, and toxic gas dispersion. The experimental approach to asbestos analysis could be significantly improved. This concerns monitoring, prediction of effect distances of emissions and reduction/mitigation techniques.

The team uses rather portable units to monitoring air parameters and focus on these. Facilities of infrastructure are well maintained and fit for purpose.

Environmental protection should consider not only the air parameters but for example water and soil. Monitoring of these parameters needs chemical analysis so Team E4 internally cooperates with Team E2.

Team realized 10 research and development projects, 2 of which are in progress. One of completed project (2009-2011), titled "Computer modelling of dust and gas dispersion at ventilation stations from the Jiu Valley mining units". For data analysis they used the dispersion software based on the Gaussian model which is rather simple. When problems deepen more sophisticated software has to be acquired. By means of experiments validation is realized.

They teamed-up with the University of Ferrara for a Horizon 2020 project with in total 24 partners. There are also other ideas, but these seem quite ambitious.

Many symposium papers have been drafted.



TEAM E5 – Research Team of the Laboratory for High Power Ex Equipment

The research team E5 consists of 8 researchers in the various categories (CSI -1, CSII – 1, CS III -1, IDT – 5) employees.

The average age of the team is 42 years.

Research team E5 in 2013 amounted to 370.38 thousand Euros, which was 13.6% of total income of the Institute and per employee researcher gave 21.3 thousand Euros. Balance (ratio) between applied research to services is 50/50 in effort measured in time units, but 15/85 when measured in income currency units.

The central topic is explosion safety of electro motors and other high-power equipment.

More of the activity focuses on tests for electrical equipment for different customers. Some research follows to try find causes of accidents and faults of electrical equipment. The research is much about the precise cause and development of accident events with equipment in explosive atmospheres. Finding out can be quite complex due to the many possible courses an event can take. Basis of the experimental investigation are explosion tight chambers of 1 and 3 m³ in which the minimum explosion safe gap of equipment can be determined and flame-proof enclosures can be tested. As regards the testing technology a rather intensive cooperation exists with PTB in Germany.

Preventive measures in the electric circuitry are switching from passive to active by absorbing energy at the right moment. A number of future research directions have been formulated. Although most improvements to equipment can still be made without detailed knowledge of the phenomenology of gas explosions, in due course such knowledge will become more important. For the future further sophistication of testing and calculation methods will be needed.

Knowledge and experience of the members of team E5 allows for the training of other personnel working with explosion proof equipment.

The team won for an innovation the gold award in Nuremberg. Three national patents and patent application have been made. Per member one publication was made to a journal and 4 to symposia and international conferences, while for more papers contributions were made.

In the role of notified body services to a large number of companies are made.

The test facilities were all well maintained and with respect to instrumentation up-to-date.



TEAM E6 – Research Team of the Laboratory for Electrical Low Current Ex Equipment

The research team E6 consists of 8 very experienced researchers, but not highly educated in the various categories (CSI – 0, CSII – 3, CSIII – 1, CS - 2, IDT - 1) employees in this one young Ph.D.

The average age of the team is 45.57 years.

Research team E6 in 2013 amounted to 436.96 thousand Euros, which was 16.04% of the total income of the Institute and per employee researcher gave 54.62 thousand Euros. This result is the best efficiency in the Institute. Balance (ratio) between applied research to services is 50/50 in effort measured in time units, but thanks to the many clients the ratio in income is biased towards services. Part of services is also training activities for industry staff and technology transfer.

This team focuses on very difficult problems supply electrical devices to work in explosion hazard atmospheres. The work of this team distinguishes itself clearly from that of team E5 by the preventive principle. Here prevention is achieved by playing with the parameters of the circuitry: capacity, resistance, induction in relation to voltage, current and temperatures. Sparks of which energy and power can be varied shall not ignite a mixture.

The work is very empirical, but attracts many assignments. There is no ambition to go into fundamental questions, although there is an interest to make use of sophisticated statistical methods, for example to make prediction of failure limit of 1 in 1000.

The team performs much accident investigation and trouble shooting. They are the expertise cell for the country's industry. Team members act as Chairman and Secretary of the national CT 137 committee.

With respect to dissemination over the review period about 1 book per team member was written, and per team member just a little more than 1 internationally indexed journal article, 1 article in local magazines and about 4 contributions to conferences. A bronze medal was awarded to the team for an innovation in EUREKA, Brussels, 2011.

Research project completed with one patent, connected with low current installations for areas with hazard of explosive atmosphere. The team realized research project (before 2007) with producer. Researchers of Team E6 one National patent and two patent applications were made. The team was accredited.

As everywhere else in the Institute, the experimental facility was set-up very thoroughly.



