

## **Institute of Forensic Engineering of Brno University of Technology (IFE BUT)**

### Questions of IEP and answers from institution (14.10.2020)

1. *Could the faculty/institute provide a self-reflection on where they currently position themselves in relation to similar faculties at other Czech Universities, as well as compared to several leading universities in Europe?*

In comparison with other comparative institutions, the IFE as a small part of the university with long history with emphasis on expertise activity, it is quite unique and only one institution in its scope and range in CR, especially with combination of activity orientation into solution of real-life practical problems from criminal and civil trials combining mechanical engineering, civil engineering, economy, transport, traffic and recently risk engineering as well. We could maybe more emphasize on those results in self-evaluation report, so it could be more understandable for evaluators.

If we start to compare our Institute with similar universities, our position is specific. This specification lies in the fact, that most of disciplines is created according to objects, that are the goals of their research interests (civil engineering, mechanical engineering, electro engineering, informatics, macroeconomics...).

There exist some exemptions, when the discipline is created of group of multi discipline methods. Typical example is risk engineering. Risk engineering is based on the file of methods, that are universal and we could apply them on any types of objects (buildings, machines, factories...). The similar attitude is also valid for forensic engineering, which is based on the file of methods that are universal as well (matrix of traces, matrix of reflection, correspondence of damage, computer simulation, analysis in same time and space) and those methods could be applied on several kinds of objects (accidents of various means of transport, failures and defects of several technical objects).

The development of those disciplines and methods in forensic engineering and risk engineering can be carried out in two ways:

- 1) Development according to the type of object (risk analysis in civil engineering...)
- 2) Development according to used methods

BUT has selected the second way, where the education and development in the field of safety is concentrated into one working place (institute) and the experts from entire university participate in it. Many universities have selected the first way, so the comparison to IFE is quite difficult. Both ways have its own advantages and disadvantages. Advantage is that interdisciplinary influence and good practices can influence each other and connect mutually as well. Disadvantage is that the applied research proceeds on cooperating faculties, so many results are not affiliated with IFE.

The position of our institution is strong in those matters and it is highly respected by public authorities in the Czech Republic, mainly police, courts, public prosecutors etc. Position of institute within university and cooperation with faculties at solution of real technical issues is the advantage that could provide best results for expertise in our point of view. The activity of institute primarily aims at causes of negative phenomena in these fields of interests with the goal to find causes and economical aftereffects and help public sector and decision-making authorities to find responsible subjects. It covers the very specific and difficult activity focused

on the difficult revision expert opinions (where it is a unique institution and perceived authority), but also research activity in its primary meaning. Even though IFE is only “small part” of BUT, it could be hardly compared with the faculties, but we still could be in most of the criteria comparable to the much bigger faculties. Interdisciplinarity brings also troubles, bigger faculties have better background in material and personal ensuring, better access to grants and also clear and unquestionable classification of results into FORDS and journals. We discussed if we, as the institute, should rather belong with our activities into FORD of Engineering or Social Science, we had to decide for only one option despite of inhomogeneity of solved issues and interdisciplinary composition of institute, so this is also the compromise.

Similar institutes in CR are entirely faculties oriented on individual interest’s parts of our results orientation (for example property valuation, most often departments within universities, Bata University in Zlin in the field of safety and crisis controlling etc.), or separate institutes (institute of property valuation, institute of forensic research in Krakow – Poland, transport research centre Brno, institute of forensic engineering in Zilina – Slovakia, institute of forensic expertise of faculty of transportation sciences Czech technical university etc.) or several fully commercial companies with no emphasis on research outcomes and no support provided towards experts. Compared to abroad there is no significant support of forensic sciences in the Czech Republic, no support of Ministry of Justice despite of EU regulation that says about the obligatory support of forensic sciences in individual member states. We have to apply our results very often with cooperation with partners, but it is also our big advantage (interdisciplinary influence).

Currently carried out activities of the institute are at the world-level, e.g.

- Projects focused on human factors and obtained results – similar research focus could be identified on MEA forensics, Virginia tech, TRL, University of Adelaide, Monash University etc.
- Crash tests and data from crash tests for the accident analysis – crash tests for the forensic engineering are realised also by ITAI or PSP etc.
- University of Colorado, Boulder (cooperation in Ph.D. research)
- Projects focused on injury biomechanics – obtained results are beneficial also for US – University of Michigan

2. *Please explain the evolution in staff members (professors and researchers) and how this relates to the evolution of research grants.*

Research projects enable among others the acquisition of data and research outcomes that are necessary for personal growth of academic staff members.

- Staff members participating in R&D activities:

	FTE at IFE BUT					
	2014	2015	2016	2017	2018	2019
professor	2,15	1,58	1,40	1,39	0,44	0,99
assoc. prof.	3,00	3,29	3,50	3,58	4,12	4,53
assistant professor	4,60	4,60	6,16	5,30	8,50	8,09
In total	9,80	9,50	11,10	10,30	13,10	13,60

The evolution in staff members reflects in recent years in higher number of proposed a solved research grants at IFE at consideration of very low staff numbers: For example the department of expertise in mechanical engineering, property valuation and road accident analysis is almost fully personally saturated with grants funding, follow up projects are being prepared, the number of grants corresponds with the time possibilities of staff members, we have strong partnership with cooperation faculties and institutes, that is reflected in recent project proposals.

R&D activities of IFE direct towards interdisciplinary issues solution, so we successfully found partners from several disciplines and sectors to carry out common research (psychology, law, defence, forensic medicine) and do our best to publish our results in agreement with methodology of research assessment.

There is an effort to support young talented researchers and successful effort to employ them at IFE, some of the application of projects follow up and develop former projects of specific research that employers solved during their doctoral study.

We are practically focused on applicable topics of dissertations, motivate young talented researchers to work in the academic environment and we are slowly expanding with regards to the limited personnel capacities.

3. *How can the system and rules for obtaining the title of professor and associate professor be adjusted so that achieving these levels of career growth is more accessible for younger generations? Do you think that this could bring new trends in innovation, or that it could lead to greater internationalization of the institution?*

Conditions to gain title doctor of philosophy, professor and associate professor in the field forensic engineering could be fulfillable for applicants. They are, in general, common for our institute and faculties, even though the possibilities of their fulfilment, especially in selected parameters is in comparison with faculties different and much more difficult. The reason is that there is the lack of interdisciplinary journals accepted by the methodology of research assessment. For example, only the best journal for traffic accident research is in Q2 journal ranking. Despite of it our results are widely published in proceedings and journals indexed in Scopus or Web of Science.

There are many specialized high-quality journals in fields of our activity orientation, that could be unfortunately hardly recognized as journals accepted in terms of methodology of research activities assessment, but some of them are in Polish or German language (Paragrafy na drodze, Verkehrsunfallreconstruction, IMPACT, Accident reconstruction journal...) are highly appreciated by expert's community. They are fortunately at least accepted as criterion fulfilment for obtaining academic titles.

IFE has, despite of size of the institution, its own scientific board that consists of internal members, external experts and experts from practice.

The problem could be the personal motivation and time options of key staff members, because there is often the cumulation of work tasks and limited number of academic staff members that could substitute the applicant in case of sabbatical absence at the institute. For example, at the department of traffic accident, there are in total 8 workers working on 4 projects (and preparing next 4 for the 2021 to 2023 period), providing education in master degree study programme, teaching in courses for experts, preparing revision expert reports for public sector, preparing annual congress, making crash tests, publicity etc.

Youngers generation, mainly internal doctoral graduates involved in projects often stay at the IFE as perspective staff members and new generation and this is the great result, so this should, without any discussion, lead to better internationalization.

We would like to improve in following matters.

- Creation of quality research teams (including young researchers, post-docs, senior researchers from the staff members, mentoring from senior researchers) with connection to the specifics of forensic engineering are the only possibility for sustainable development of research activities
  - We would like to be more familiar with commercial sphere (with an effort to motivate talented researchers).
  - The internationalization, that is necessary for the innovation.
4. *How does the faculty see further possibilities with respect to international activities such as committees and working groups, more active participation in journal editorial board, etc.?*

IFE makes huge effort to develop international activities and try to be active and more visible in world leading activities in the field of forensic engineering regardless of low staff numbers, this should be considered.

As a prove I could say:

- Membership in EVU as European leading association for accident research
- Negotiation with ENFSI as European leading association for accident experts
- Involved in the preparation committee of the world largest accident analysis conference in USA WREX2023
- Trainers for traffic accident SW called Virtual CRASH (CZ, SK, Romania, Germany, Georgia)
- We highlighted and supplemented other memberships in today's presentation

The acquired knowledge not only developed research activities and professional activities of IFE, but as Czech leading professional institute IFE also disseminate it among experts in the CZ, that is unfortunately not too visible from abroad and it is at least comparably significant.

5. *What is the experience of PhD researcher with respect to the PhD program, support for internationalization and career opportunities?*

Best way how to answer this question is to ask and present one of our Ph.D. student, for example Mr. Jaroslav Hruby, has also the separate presentation of his research activities and can answer corresponding topics:

- The researchers' experience concerning the Ph.D. program lies in knowledge obtained on the Institute of Forensic Engineering when developing documents for Expert Opinions for real-world car collision situations (traffic accidents) and participation in Institutes Research activities like Crash Days – the measurement of acceleration during the crash on a vehicle structure and other.
- Support for internationalization can be described as participation on projects at CU Boulder, where the Ph.D. researcher is a member of Wham Research Group. Wham Research Group focuses mainly on experiments for civil and aerospace applications. Civil testing applications are focused on seismic testing of small and large structures under dynamic loading and student teaching in the field of structural dynamics (primary seismic applications). Aerospace testing applications are focused on durability testing of components which are used on airplanes or for satellites. Another part of Wham

Research Group activity is safety factors investigation during construction works and forensic engineering – human body interaction with loosening objects.

- Career opportunities in a Ph.D. program at the Institute of Forensic Science strongly depend on individual capabilities and passion for his work. If the person studying at the Institute wants to work in some field, he is able to.

Jaroslav Hruby path:

- I was working at the Military Technical Institute (Test Engineer) plus a Ph.D. student.
- I was working at Kaitrade, spol. s. r. o. (Consultant) plus a Ph.D. student.
- I am working at Vibration Research Corporation (Middle and eastern Europe Manager) plus a Ph.D. student.
- I am working at Kaitrade, spol. s. r. o. (Consultant) plus a Ph.D. student.
- I am working at Kaitrade, spol. s. r. o. (Lab Technical leader) plus a Ph.D. student.
- I am working at CIEST CU Boulder – Wham Research Group.

6. *It is obvious that in an effort to increase the quality of study, there is a tendency to constantly increase theoretical knowledge and so it is more difficult to look for innovative forms of teaching in a limited time, such as e.g. solving several tasks in laboratories or solving specific tasks required from practice (eg diploma or dissertation thesis) or connecting teaching with industrial enterprises in the form of internships. What are the experiences of the faculty/institute? What percentage of final work can be attributed to those whose solution is directly required by practice?*

In order to teach at the highest level of knowledge the syllabus and equipment of laboratories is continuously and permanently improved, especially since the year of 2015, with the help of grants funding. This equipment serves also for R&D activities of our staff members, so the outcomes of staff members are also getting better with higher international impact, but the delay and later start is visible. Limitations are also low numbers of staff members and also the budget. There is a permanent effort to thematically direct diploma and dissertation theses for use in practice – e.g. work focused on real estate industry, real estate agencies, state and local government authorities, into the field of property valuation, property state assessment or towards human factor - influencing the attention of drivers by selected distractive factors, especially billboards (cooperation with the Police, Army), safety of pedestrian crossings (cooperation with the Police), vehicle damage including paint damage or insurance frauds (cooperation with insurance companies) etc.

We use teachers from practice to develop practical impact of gained knowledge (attorney office, real estate agencies, banks, transport research centre, transport companies, insurance companies).

We would estimate that about 70 percent of solutions ends with direct practical impact.

7. *Please explain the participation to spin-off and technology transfer initiatives. How actively is the institute currently exploiting these possibilities?*

As we tried to explain in written reaction on preliminary report outcomes “file clarification”, results of our research are very often directly applied in practice or are often required by practice from the beginning, they have big social capacity, recognition from authorities and impact, but very often also very limited financial benefit for IFE. This could be perhaps clarified more in self-evaluation report.

All the practical results are applied in the investigation of negative effects can lead towards increasing of technical object safety, but have almost no industry partners and users.

Regarding the type of results, the outcomes of our contract research activity have often the character of knowledge, not concrete commercialization results. There is a very limited area, we could maybe talk about forensic expert office that would use know-how, research results and that would enable students or external applicants to gain the practice.

Example:

1. Forensic medicine is able on the basis of human body state to estimate the approximate time of death. Those findings are very important with high social impact because they help to clarify criminal activities, those results are also very hard to sell for financial benefit, there is no partner from industry. The same is valid for example for traffic accident analysis, specialization of forensic engineering.

We should mention the currently solved project with company called Atomtrace: the goal is to develop device that is able on the basis of laser spectroscopy detect tyre traces on road, that are not visible by human eye. This could help us; police and other users predict the length and kind of tyre trace and more precisely calculate the speed of the vehicle before impact. The commerce potential is subject to negotiation.

Results users of research results are very often forensic experts and public authorities, they do not often want to provide financials, they need direct results.

The other option of commercialization in future could be the preparation and performing of commercial vehicle crash test for private companies. Our crash team with all the equipment including data acquisition and documentation devices is able to prepare almost any crash test configuration on site, for example for the usage of barrier testing, insurance fraud recognition and safety features tests, that are different from test made by car manufactures. But the industry partner is also missing.

The other option is to perform human factor research studies in real road traffic for private subjects, but the market in the CR is very limited.

Those activities however require the evolution in staff member and researchers, at this time many research topics are also being developed, including solutions with potentially commercialization effects.

In the future we anticipate the commercialization of the:

- developed device for detection of unrecognizable tyre road traces (development is actively underway),
- commercialization of knowledge-based database focused on vehicle characteristics damage (very beneficial for experts not only in Czechia, insurance companies)
- or human factor (very beneficial for experts not only in Czechia).

The contribution of these knowledge-based databases is proved by the direction of global activities in this field.

8. *What opportunities does the institute see to increase research grants and budgets?*

As evidenced by the current strategy of the institute and the vision of the further direction of the institute, it is currently an effort to follow up on the presented partial research activities.

There are no specific projects call oriented on forensic sciences, we are able to find approximately similar grants calls, but they not always correspond to needs of the institute and field development.

Project intentions correspond with the focus of IFE activities, some of the projects assume also products commercialization, but this is the subject of future negotiations with partners, for example:

- crash day - future potentially commercialization of characteristics vehicle deformation database (project DOPRAVA2020 in cooperation with Transport Research Centre), possibly commercialization of crash day itself – testing of anti-terrorism barriers etc. – discussion with University of Defence
- modern methods for accident documentation (development of LIBS – cooperation with industry (AtomTrace), Modern methods for accident documentation useful especially for police – project Ministry of Interior; cooperation with police, socio-economic benefit – minimalization of indirect costs)
- human factor – analysis of critical driver states as stress and fatigue – possible innovation for automotive, project result – database of unique data from real traffic with critical driver states (fatigue and stress), multidisciplinary approach; knowledge – based database for experts – innovation in forensic engineering, product commercialization

The research grant numbers could be certainly increased in the field and orientation on property valuation, property state assessment and civil engineering issues.

The rest fields of institute interest (for example human factor, expertise in road traffic accident) are limited to personal capacity, time and expertise activities required by state authorities that forced by law. The number of grants is also limited from the financial reasons, because the cofunding is required and it is often covered from expertise activity and applied incomes with no industry partnership.

9. *Explain the relation between the institute and the membership to particular faculties. How is this practically organized.*

The institute in his scope is the institution, that covers huge range of activities from forensic activities and safety issues. With respect to the multi and interdisciplinarity of solved research projects or expert reports, some of solved problems are carried out in cooperation with other BUT faculties (mechanical engineering, electrical engineering, civil engineering and business and management), Masaryk University, University of Palacky, University of Defense, with industry or other institutions, e.g. Institute of Forensic Medicine. However, IFE, with the size of bigger Faculty department, is the separate institute mainly due to the range of activities in the field of forensic disciplines. As we described earlier, the experts from individual faculties of BUT also cooperate in educational activity of BUT, especially since the year of 2008 when BUT made decision to concentrate education in safety issues at IFE and authorise IFE to ensure this in the form of university-wide study program. Experts from IFE provide lectures in terms of BUT study programmes as well. This make mutual cooperation stronger.