

## **Collaboration between Czech universities and industry The point of view of the Technology Agency of the Czech Republic**

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### **INTRODUCTION**

Research at Czech universities suffers from lack of “institutional” money, i.e., lack of the fixed part of a budget allocated to research. Substantial part of research activities must be financed from various grants. The Czech Republic has two main grant agencies, the Grant Agency of the Czech Republic (GA CR), which supports fundamental research projects, and the Technology Agency of the Czech Republic (TA CR), supporting applied research and innovations. These agencies are included as independent institutions into the Czech act about research [1]. In addition, some ministries also have their own programmes supporting applied research and development (e.g., the Ministry of Industry and Trade, the Ministry of Environment, the Ministry of Culture).

Applied research and development should form one of the main activities of schools oriented to engineering. They can contribute also to educational activities, as they should be a part of a basis for passing on practical experience to students and for good quality master and doctoral theses, which reflect needs of practical life. The programmes of TA CR give a wide space for collaborative research of technical universities and engineering faculties of general universities on one side, and industrial companies on the other side. They are not only important contributors to limited budgets of universities, but they are also important contributors to spectra of themes of projects, in which advanced students can be involved.

## **1 PROGRAMMES OF THE TECHNOLOGY AGENCY**

### **1.1 Mission**

“The Technology Agency of the Czech Republic (TA CR) is the main organisation which implements the state policy in the sphere of applied research, development and innovations. The mission of the TA CR is to create and implement effective and transparent system of applied research, development and innovations support to the whole extent thereof. The TA CR participates in the conceptual orientation and creating of research environment of the CR, in the preparation of National Policy of Research,

Development and Innovations, produces strategic documents in the field of applied research, development and innovations and implements key programmes in this field, in particular based on national priorities of oriented research and development. The Agency performs analysis of results and data received from its activity and provides them for the needs of further course of applied research, development and innovations. It comes from and develops international cooperation with partner agencies of applied research. The TA CR cooperates upon the preparation of programmes with other sectors and providers of support in the field of applied research, development and innovations and promotes its activity by effective cooperation among research organisations and application sphere and contributes to the attainment of strategic economic and social goals of the Czech Republic while respecting the sustainable development principles.” [2]

## **1.2 Programmes with significant impact to university-industry collaboration**

The ALPHA programme, which has been the first one of the announced programmes, has aimed to support applied research and experimental development especially in the field of advanced technologies, materials and systems, energy resources and the protection and creation of the environment and the sustainable development of transport. The relevant outputs have been patents, pilot operations, proven technologies, results with legal protection (i.e. utility models, industrial designs), technically realized results, i.e. prototypes, functional samples, certified methodologies and procedures, maps with expert content and software [3]. It can be noted that papers in scientific journals have not been included among these relevant outputs. This means that the recognized outputs from the point of view of evaluation of results reflect specifics and needs of collaboration between academic sphere and industry, however they might be less accustomed for some research departments at universities, for which a publication in a scientific journal with high impact factor is the most frequent and the most relevant output. The ALPHA programme ends in 2016, but it is replaced with the very similar EPSILON programme, which will extend till 2021. Expenses of research institutions, including universities, may be fully reimbursed, whereas industrial companies must contribute 20 to 75 % (depending on their size and character of the project) from their own sources.

Similar conditions are also in the other programmes. The Competence Centres programme supports the establishment and operation of large (virtual) centres for research, development and innovation with many participating institutions. Universities in the Czech Republic have also a statute of research organisations, and as at least one research organisation must compulsorily be a member of a consortium, the wide area for participation of universities has been opened here. The duration of the programme is 8 years (2012-2019). Emphasis is placed on the innovative potential of projects and the sustainability of the research agenda of the competence centres. Applicants commit to the sustainability of the agenda of the centre for a minimum of five years after completion of the project.

The programme GAMMA is one step closer to the immediate needs of industry, as it aims to support the verification of results of applied research and experimental development in terms of their practical application and to prepare their subsequent commercial use. It has two sub-programmes: Sub-programme 1 is aimed at supporting verification of the practical use of R&DI results that were created in research organizations and have high potential for application in new or improved products, manufacturing processes or services. It focuses on support of the stages of R&DI, beginning with the identification of practically utilizable results of R&DI and ending with verifying the possibility of their use as a commercial model, functional sample or

prototype. Only research organizations may be the main recipients, industrial companies may take part as collaborators. Sub-programme 2 is aimed at supporting projects leading to the commercialization of the achieved results. The support will be provided for projects involving the completion of functional prototypes, verification of their properties, verification of test series and evaluation of all technological, economic, social, health and other impacts of new products or services. Only enterprises may be the main recipients. Research organizations may participate as other project participants.

The other programmes are rather specific: The main objective of the programme OMEGA is to strengthen research activities in the area of applied social sciences. Therefore, the relevant outputs are adapted to this type of sciences: certified methodologies and practices, including specialized maps with expert content; software; results promulgated into legislation and standards; results promulgated into directives and regulations of a non-legislative nature which are binding within the competence of the relevant governmental body; research reports. Universities can take part in this programme, however it is of minor importance for engineering.

The programme BETA is oriented to the specific topics and issues that state authorities want to address in the area of research through public procurement. Some demands of state organisations as, e.g. the State Office for Nuclear Safety, can be of interest also for engineering faculties.

And finally, the programme DELTA supports mutual collaboration with foreign institutions and companies in the framework of agreements with similar agencies as TA CR abroad. As it is oriented only to a few selected countries (e.g., Vietnam, South Korea), it is not a matter of preferential interest for universities.

### **1.3 Budget**

As an example of financing programmes TA CR, we can mention the sums in the last year. The total budget of TA CR for 2015 was nearly 3 milliard CZK (slightly more than 100 million EUR), less than 4 % being used for institutional operation of the agency. 1 125 904 700 CZK, i.e., more than one third of the budget, was transferred to universities in grants. Companies and other commercial subjects obtained about 1,5 milliard CZK [4].

### **1.4 Selected examples of projects**

Let us choose a few successful projects, which were recently finished, to show the wide variety of collaborations which took place (and most of them further continue) and topics solved. This selection is more or less accidental, the only criteria, why we are talking just about these projects, are collaboration between university and company and positive evaluation of results.

The Škoda Electric Company developed in collaboration with the Faculty of Mechanical Engineering of the University of Western Bohemia in Plzeň a prototype of a fully electrically powered bus. Two versions of these buses were presented at a few fairs and, hopefully, can contribute to the ecologically purer urban transport. One of them has the range 150 km and can be charged in 70 minutes, the other one has another type of batteries with lower capacity (the range 30 km), but it can be fully charged by the ultra-fast charging station in 5-8 minutes, e.g., during a break at the terminal.

The project Modified materials for treatment of chronic and acute wounds has investigated new types of materials (especially carboxymethyl cellulose) in the form of textile. This material can be used as the primary cover on wounds and helps in healing and prevention against infections. It can be applied both in the case of acute injuries

and in surgery. Nowadays, application of this material is included into possible financing by a medical insurance. The project was carried out by two companies together with the Veterinary and Pharmaceutical University in Brno, the Technical University in Liberec and the University of Pardubice.

The Faculty of Information Technologies of the Technical University in Brno together with three companies has dealt with the project Technology of voice processing for effective communication man – computer. Advanced techniques of voice recognition developed in the framework of the project should be used for practical applications, e.g., search in the electronic dictionary in mobile devices, in dictating translations, in dialogue systems and systems of customer care, in security and defence, etc.

The project oriented to the modern multi-layered optical systems was the joint activity of the Palacký University in Olomouc, the Institute of Physics of the Czech Academy of Sciences and the traditional Czech optical company Meopta. The applied research covers both proposal and optimisation of production technologies and experimental realisation of new types of simple and multi-layered systems for various purposes.

The Palacký University in Olomouc together with the Technical University in Liberec, the Institute of Microbiology of the Czech Academy of Sciences and 6 industrial companies have established the Centre of Competence oriented to environmentally considerate nanotechnologies and biotechnologies for cleaning of waters and soils. The title of the project is self-explanatory, however, the planned activities include also analytical methods for determining organic pollutants, toxicity, and for monitoring nanoparticles in the environment.

The Josef Božek's Competence Centre for Automotive Industry is called after the Czech engineer, who built the first steam powered car in the Czech lands in 1815. The Centre integrates activities of the Czech Technical University in Prague, the Technical University in Brno, the Technical University in Liberec and the Technical University in Ostrava with 9 industrial companies, including the Škoda Auto, Honeywell, Tatra, in innovation in vehicle design and drivelines with combustion engines and electric motors to reduce fossil fuel consumption and emissions. Maximum safety, comfort and pleasure from driving are also considered. This is one of the largest projects, with the total cost of 351 402 000 CZK and the grant support of 243 141 000 CZK from the budget of TA CR, for the period 2012 – 2017.

These few examples are far from completeness and do not in the least cover all fields of sciences and technology, to which activities of TA CR are oriented. They include the traditional technical branches, but also biological and medical technologies, environment, agriculture, etc. It can be seen that the programmes of TA CR are a useful contribution to developing science and technologies at universities and their support of collaboration between universities and industry is not substitutable. However, the situation is not as idyllic as seems from the previous paragraphs. Let's go to some problems.

## **2 SHADOWS AND PROBLEMS**

### **2.1 What does research and development mean for universities and for companies?**

Experience from the mutual contacts of managements of universities and companies show that expectations of companies and academic institutions are often different. Universities prefer long term fundamental research guaranteed by stable financing. In many countries, their research is evaluated according to the number of publications, impact factors of journals, in which their researchers publish, number of citations and

h-factor of individual academic employees. The number of Nobel candidates is a nice bonus. No one of these criteria is interesting for an industrial company.

Industrial companies in general do not need topic scientific results with the long way from investigations to practical applications, they need to innovate their products as quickly as possible with the aim to have applicable results earlier than their rivals. Economical aspects of the proposed solutions also play a crucial role. Finding common language with academic world is sometimes difficult.

The way out from this discrepancy is not easy, but it is possible. First of all, evaluation of universities, and especially of engineering branches at universities, should not be based mostly on their publication record. Agreements with industry, patents, prototypes and functional devices, original software written for the needs of information and automation in industrial companies should be comparably prestigious outputs.

This way, students will be also better prepared for their future jobs, as they can take part in real projects with defined practical outputs. Frequent complaints of industrial managers to the address of fresh graduates are: they are perfectly theoretically prepared, but they are not prepared as well for practical life, they have deficiencies in communication, their practical experience and readiness to solve unexpected problems is not as high as desirable.

## **2.2. Is the success rate sufficient?**

Any grant competition with the success rate lower than, let us say, 30 – 40 %, loses its sense, because the waste of effort spent by preparing unsuccessful projects is enormous. Unfortunately, the hunger for financing projects in the programmes of TA CR is enormous and the budget does not allow the satisfactory success rate.

The success rate in the programme ALPHA was 27,4 % (961 projects, 3501 applications), in the programme OMEGA 30,2 % (196 projects, 650 applications), in the programme Centres of competence only 16,2 % (34 projects, 210 applications) and in the new programme EPSILON only 12,1 % (88 projects, 725 applications). Slightly better situation is in the programme GAMMA – 38,2 % (21 projects, 55 applications). Programme BETA, as mentioned above, is rather specific, as topics of projects are announced on demand of the state authorities. The success rate in this programme 78,2 % (309 projects, 395 applications) is rather high, but this is not a typical grant competition.

Any grant application asks for a lot of data not only about the research needs and plans and about the proposed budget, but also about the institutions applying for the project. Its preparation needs many hours, or rather days, of work. Some part of this work can be executed by an administrative staff or by an external company specialised in this administration, but most of the work, especially regarding the professional content of the project, must be carried out by researchers participating in the project. This means that highly qualified specialists, both in universities and other research institutions and in industrial companies spend a lot of their valuable time by writing projects, which finally end in a waste bin. The number of applications, as seen in the paragraph above, shows that financing of research, development and innovation in the Czech Republic is insufficient and unbalanced. It would be superfluous to say that situation in fundamental research, as reflected in grants of GA CR, is similar.

## **2.3. Is the administrative load adequate?**

Universities and industrial companies are institutions with very different legal positions. As most Czech technical universities belong to the public sphere (private universities are oriented mostly to softer branches than science and technology), this collaboration

is a typical example of a public-private collaboration. However, there is lack of experience with such collaboration in the country and, moreover, the legislation is not much supportive. Administrative load in projects, in which organisations with different statute take part, is therefore enormous. The whole process of submitting and evaluating projects lasts many months. Running projects are periodically evaluated and writing evaluation reports takes also a lot of time. Though TA CR has improved and simplified the process of submitting and reviewing projects during the years of its existence, the situation is still not satisfactory. Unfortunately, due to the necessary conformity with the Czech legal system it cannot be improved much in the near future, if the legal system is not substantially simplified. The other administrative problem can be expressed by a slightly improper comment: A lot of clerical work is connected with the grant agenda on the side of grant providers, starting by the ministerial level and ending by the level of the agency. And no clerk is interested to simplify the agenda too much, as this way he would become needless. Therefore, the administrative loads belong to all aspects of our life, not only to the university – industry collaboration.

#### **2.4. Is reviewing of projects equitable?**

As in all grant competitions, the problem of highly qualified reviewing is substantial. Search for the best projects in the situation of lack of funds is extremely problematic. The projects can be usually (and more or less easily) divided into three groups: the excellent ones, the “grey” zone, and the unacceptable ones. If the success rate is as low as in some programmes of TA CR due to lack of funds, in some cases even some excellent projects cannot be financed. In such cases, the subjective approach of individual reviewers, their demandingness or moderateness, can play substantial role. Reviewers are chosen by a lot from the database of specialists. In a relatively small country as the Czech Republic, the possibility that the reviewer has some relation to a rivalrous company and, therefore, he gives a bad rating to a project, also is not negligible. Reviewers from abroad would solve the problem, but we are dealing with projects in collaboration of academic sphere with industry and industrial partners are afraid of escape of important know-how. This problem is much weaker in competitions on grants for fundamental research, where mostly academic institutions participate (e.g., projects managed by GA CR). A lot of notices of appeal against the results of competition then comes from dissatisfaction of unsuccessful participants.

### **3 CONCLUSIONS**

Collaboration with industry in grant projects of TA CR is not, of course, the only possibility, which universities and companies have. The wider view can be found, e.g., in [5]. As universities are also (and in the first instance) educational institutions, it is possible to point out especially the study programmes fitted according to the needs of industry, and the whole area of lifelong learning (e.g., [6]).

Increasing collaboration between engineering universities and industry is one of the actual tasks, which moves industrial technologies and the quality of life forward. It is needless to say, that it also helps to improve both practical competences of universities and their budget, and contributes to their equipment with modern instrumentation, software and methods. Regardless of some problems mentioned in the part 2 of this paper (and if somebody would like to act as the “advocatus diaboli”, he would certainly be able to find more imperfections), agencies similar as the Technology Agency of the Czech Republic can play very important role in this business. Degree of their usefulness is, of course, strongly dependent on their external rules defined by law, as well as on their internal rules. Balanced financing of research, development and

innovations from various sources is also very important, universities cannot be so strongly dependent on this type of grant financing that it leads to fluctuations endangering the integrity of their research teams.

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