

# DEVELOPMENT OF THE UNIVERSITY RESEARCH CENTER AND TRANSFER OF ITS RESULTS AND NEW KNOWLEDGE INTO TEACHING

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## Abstract

Theoretical models of organizing research and development at technical faculties are presented. Their main advantages and disadvantages with respect to research performance and education quality are listed. The case study presents 3 main periods of the existence of one mechanical engineering research center at a technical faculty in an industrial region (from 2010 to the present). An overview of the main research results achieved, including income from contract research, is presented. An organizational change is suggested, which should bring about an improvement in the transfer of new research findings into student education.

**Keywords:** *Organizing research and development, impact of research results into education.*

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## 1. Introduction

In practice, there are several approaches to organising research and development (R&D) at technical faculties. Each of them requires certain prerequisites, has advantages and disadvantages, and, of course, also has connections with the education of students. The paper generally characterises 3 typical schemes of organising R&D. It gives a concrete example of its transformation over the years at the Faculty of Mechanical Engineering of the University of West Bohemia in Pilsen, Czech Republic.

## 2. Organization of R&D at technical faculties

### 2.1. Model A

R&D is organised within departments, and the research team is usually centred around a key professor or several key professors if the department has several partial units. The advantage of this arrangement is the closeness of the implemented R&D to the teaching content provided by a specific department. Disadvantages include a certain professional monothematic nature and closedness and the necessity to organise ad hoc cooperation in a more complex project/contract assigned to the department.

### 2.2. Model B

The need to solve more complex R&D tasks leads to establishing research centres. Employees from various departments put their specialised competencies and capacities into them. Or equipment. This leads to the intermingling of knowledge and approaches from several scientific fields. In some cases, this can lead to a certain "weakening" of the departments in terms of capacity, on the other hand, the feedback from the implemented R&D is directly transferred to the teaching by specific personalities. An indisputable advantage of research teams organised this way is an interdisciplinary approach to solving specific research and development projects. Research centres are often product-oriented, so it is necessary/practical to be managed by an expert with deep professional knowledge and respect in the given industry. Such an expert is sometimes not easy to find. Its education takes many years and requires close cooperation with practice (if we are discussing applied research and industrial development).

### 2.3. Model C

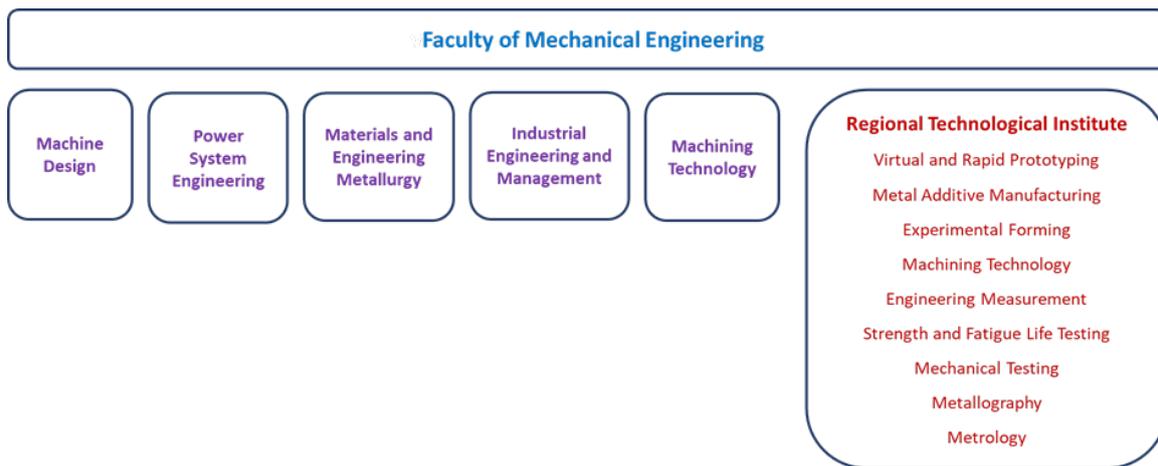
In some cases, faculties build their autonomous research institutes. These institutes differ from the above-mentioned research centres because they are larger and have a specific management and internal organisational structure similar to independent research organisations. Research institutes are mainly devoted to R&D and are organizationally next to the departments. It is advantageous if the structure of the laboratories of the research institute corresponds as much as possible with the teaching provided by the

departments. In such a case, verbal methods, which are always the basic starting point for teaching students, can easily be supplemented with demonstration methods within the framework of a nearby research institute. The best students can then be enabled for practical active work, typically within the framework of doctoral studies or even during the preparation of diploma theses.

### 3. Case study

With the support of the European Regional Development Fund, a separate unit called the Regional Technology Institute (RTI) was started in 2010 at the Faculty of Mechanical Engineering. The total investment was approximately EUR 20 million. New jobs were created in R&D (gradually up to 60 FTE), half of them for early-stage researchers under age 35, focused exclusively on research and development. A modern infrastructure (research equipment, supporting machines, hardware and software) was acquired, for example the laboratory of additive manufacturing. In the organisational structure of the faculty, RTI stands next to (at the same level as) the departments dealing mainly with education (see Figure 1).

Figure 1. Model C in praxis.



To date, the administrative and research team of the RTI has completed 3 characteristic five-year periods:

**I** - phase of building, period 2010-2014 (project design, construction of a new hall, acquisition and commissioning of new equipment with full financial support, start-up grant for gradual recruitment of research staff and step-by-step expansion of research and development activities);

**II** - sustainability phase, period 2015-2019 (mandatory full occupancy of newly created jobs and operation of purchased infrastructure, primarily for the implementation of research and development, were partially financially supported);

**III** - follow-up, independent operation, period 2020-2024 (research and development within the open market).

In all of the above phases, the measures of success of this relatively independent research center were the research results achieved. The results can be divided into two main categories: publications and application results. Cooperation with industrial companies is best measured by income from contract research or services such as accredited tests and expertise. Table 1 shows the structure of the results.

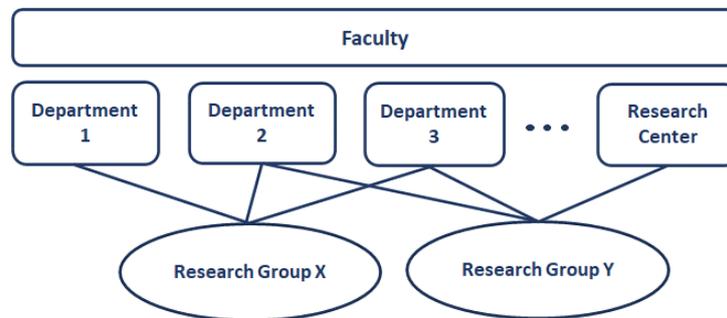
Table 1. Results of RTI research center.

Main categories of results achieved in the evaluated periods of RTI operation	Period I	Period II	Period III
	2010 - 2014	2015 - 2019	2020 - 2024
Publications	127	511	195
<i>of which registered in WoS or Scopus</i>	not registered	93	95
Applied results	88	295	235
<i>of which patented</i>	21	39	47
Contractual research	584	3 815	3 701
<i>thousands of EUR</i>			

The table shows stabilized cooperation with industry and increased quality of both main categories of results. This is evidenced by the higher percentage of publications registered in accepted scientific databases and the growing number of original patentable results.

In the above organizational structure, the faculty increased its research output, but this did not automatically lead to an improvement in the quality of education, in which the best researchers were only marginally involved. Therefore, research and teaching activities are currently being transformed into a model that is close to the above-described Model B (see Figure 2). Academics and researchers should collaborate in subject-oriented research groups. Their determination is now a matter of decision-making by the faculty management.

Figure 2. Plan for the reorganization of research activities.



Researchers will gradually become more involved in teaching. At the same time, it is respected that university teaching has its own specifics. The prerequisite for success is not only the deep knowledge of the field that new teachers have acquired during their time at the RTI research center, but also thorough preparation, communication and management skills, and the ability to motivate and improvise. University teachers should focus on issues of quality and effectiveness of their teaching. An important aspect of the professionalism of university teachers is interest in students and respect for their personalities. The decisive criterion for designing teaching should be the student, which is a very demanding area of the pedagogical work of a university teacher. If a university teacher can create appropriate conditions, students can bring innovative ideas and propose solutions to teaching and research.

For example, Ramsden and Ramsden (2003) formulated the main principles of higher education, which is an effort to respect as much as possible.

### Acknowledgments

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### References

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