

CAPITALIZATION THE CREATIVITY POTENTIAL OF UNIVERSITIES BY INNOVATION AND TECHNOLOGY TRANSFER

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Abstract

The paper presents the results of an experience based on the management inside the team, which combines the intellectual power and the emotional impact, specific to the innovative and creative activity, and which can be a response to the problems with which the academic technical education and the research face nowadays: the candidates and students' lack of motivation while in an acute need of rehabilitation/rejuvenation and automation of industrial activities; the decrease of the competitiveness of the Romanian institutes of research; the necessity to transform the universities into entrepreneurial units where the share of extra-budgetary financing increases proportionately to the financing from the state budget; the lack of legal and organizing frame within which the students could acquire and practice creative-innovative and applicative-practical skills.

Keywords: innovation, technological transfer, university

1. Innovation. Technology transfer

Innovation has almost the same definition in all specialized literature [1],[16] as being an activity of improving a product in order to be applied in industrial activity which comprises its design, its production, its experiment and its market launch. As a result, innovation, in comparison with

invention, does not represent absolute news, but its application and speed implementation are more accessible.

Within engineering society from Romania, invention has had a privileged status compared with innovation, fact which stimulated the setting up the group of the „patent collectors”, thinking that the number of the patents is more important than the number of the applications of an invention.

At the same time, in universities it is unanimously accepted the idea that scientific papers are valuable even if they avoid, through number stimulation or direct evasion, confront with practice, application or applicability. These two mentalities are not useful for the creator and for the social life.

It can be said that the definition, the demonstration of a solution opens the way towards progress, and its application, namely the innovation, carries the society towards progress. By these associations we can justify the saying “innovation is a way of capitalization the academic research”.

Taking into account the experience accumulated during years, we defined innovation as an architecture (figure 1) based on:

- a idea, a concept, a scientific procedure;
- a qualified industrial partnership;
- a network of national and/or international capitalization;
- a powerful extended protection of industrial property.

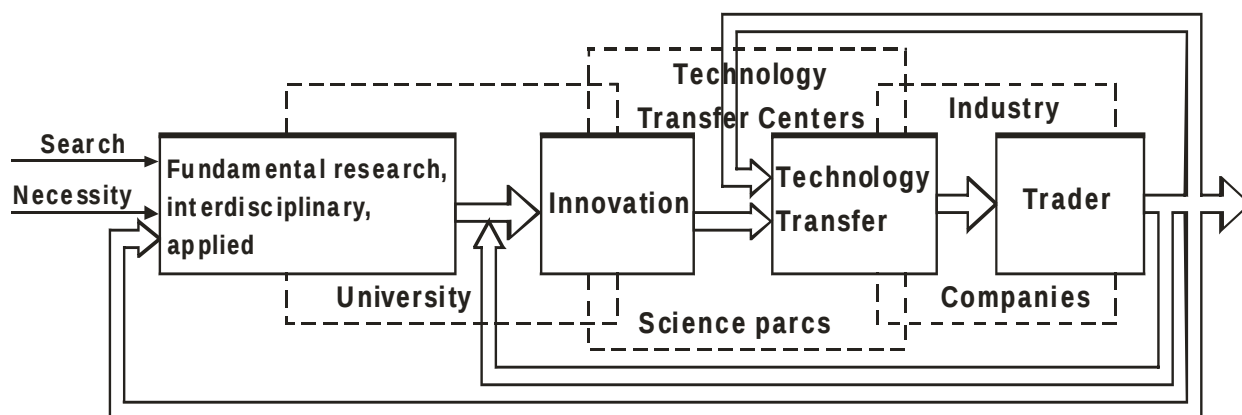


Fig.1 Explanation regarding innovation concept

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Technology transfer is regarded either as a sub-process of innovation or as a stage which follows it in order to complete the architecture of innovation concept. Within the context of capitalizing the research results, the technology transfer can be achieved as:

- a transfer between two research activities – from fundamental research to applicative science;
- a transfer between applicative research and industrial application;
- a transfer from creative-innovative activities carried out by individuals (Ph.D. students, inventors, creators) to applicative activity (we have to mention that sometimes it is necessary to have an intermediate stage of applicative research or technological adaptation).

It results that units, organizations in charged with technology transfer are an interface among interested social groups: the bidders of research results and the potential beneficiaries.

Based on our experience, we can state that for the Romanian academic conditions there is possible for centers of innovation and technology transfer to function because they are directly connected with research and they can easily set up intermediate contracts, of interface.

The object of technology transfer is made up by the research, innovation and development activities for which it was signed an intellectual property document and which is made up of knowledge, products, procedures, methods, technologies, execution documents, computer programs, data bases. The results or/and the intellectual property documents can be transferred. [16]

2. CITT Craiova – my example or case study

The Centre of Innovation and Technology Transfer was set up in 1992 [15] as a unit of Ministry of Education and Science, and nowadays it functions as a Research Department within University of Craiova [14]. Its initial purposes [2],[3] have permanently been completed and adapted [4],[5] so that they can be fulfilled [6]. Currently, the purposes of the centre are:

- capitalization of research results and technology transfer from research and development units to interested companies together with necessary technical assistance and service;
- fund management from different sources in order to sustain the innovation and technology transfer projects;
- organization and participation to local, national and international activities which stimulate innovation and technology transfer;

- stimulation of new technological companies which are organized or led by graduates, especially from University of Craiova;
- representation and market launch strategy for new products and technologies, drawing marketing policies and strategies;

3. Management of human resources

Management of human resources [7],[8],[10] was adapted to current economic conditions, in which the research project subjects have had a spectacular development. This phenomenon needs to convince the best specialists to join the existed research teams, taking into account, at the same time, the fact that all of them cannot be maintained in these teams for a long time because:

- they are wanted in other research teams;
 - they can not perform at their maximum professional capacity; sometimes their specialization is overshadowed;
- This is why the human resources has two components (fig.2): full-time employees and collaborators (professors, Ph.D. students, specialists, students). For each category we can enumerate the arguments for their collaboration and their selection criteria, but, in this paper, we will insist on full-time employees.

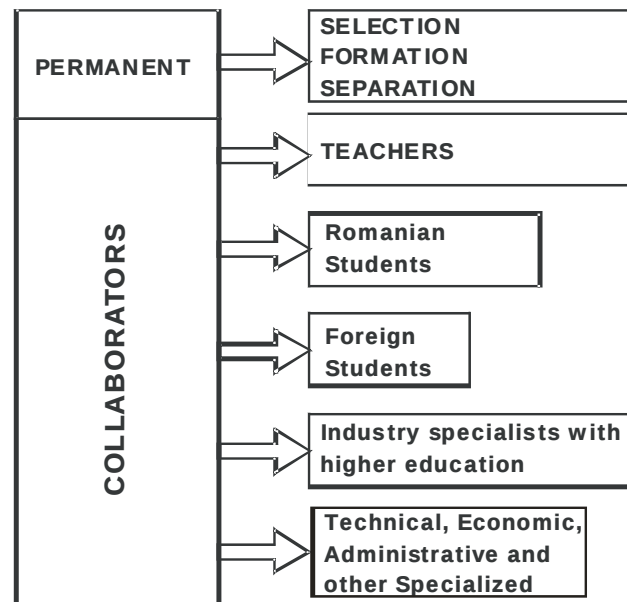


Fig.2 Human resource management, general assembly

In the first place, the existence of these categories is absolutely necessary in order to form an organizational culture, otherwise this culture will be naturally imposed or borrowed from the university the centre and research department functions in.

The strategy for selecting the full-time employees (fig.3) is based on several value criteria, following their performances, collectivity spirit, motivation capacity for innovative research oriented toward application and technology transfer. The target group is formed of students from technical faculties, but also from science faculties.

It is recommended that these students should be supervised before being employed during several types of activities (professional, social, associated) over 1-2 years, and the best of them should be selected, the ones who are motivated and who are capable to integrate themselves within an already formed research team. Their capacity should be previously checked during common activities.

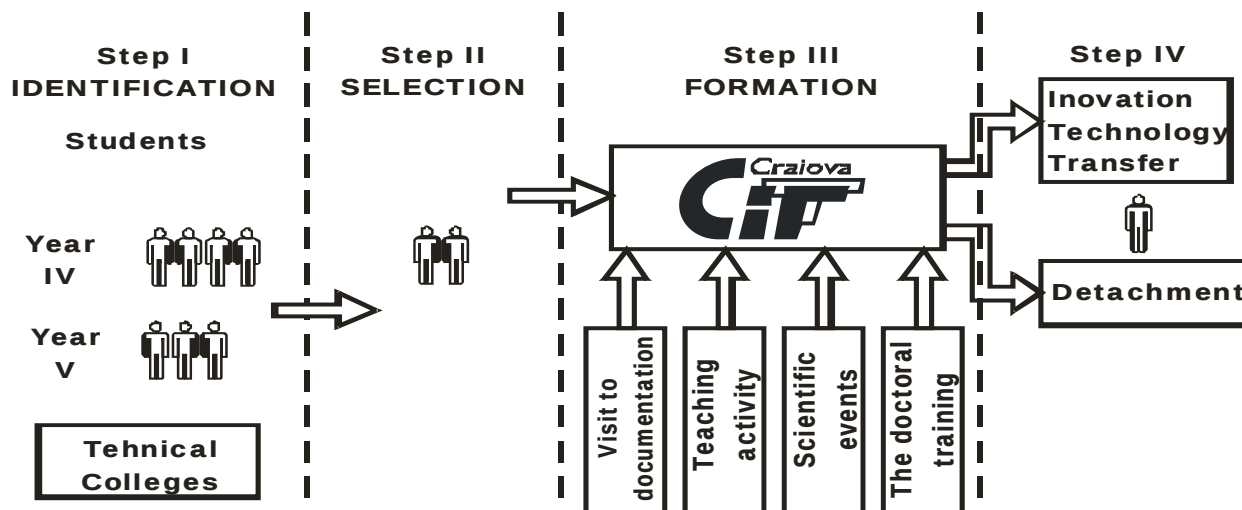


Fig.3 Strategy to select and form full-time employees

4. Management of research projects

The research activity is organized in such a way that every research project should comply with the following stages:

- market study regarding the product necessity;
- identification of a potential manufacturer and of a potential distribution of the product;
- research;
- design;
- manufacture of the prototype;
- experiments;
- technology transfer.

We also consider that centers of Innovation and Technology Transfer which functions together with a university should select research themes taking into account the following characteristics:

- they use latest technologies;
- innovation- transfer cycle is short;
- for use there are not necessary huge investments or the production conditions already exists;
- resulted products are largely required on the market;
- they have a strong social impact;
- they can be used also in complementary fields apart from the basic one.

Within this context the strategy of the themes of B.A. diplomas, of M.A. diplomas and Ph.D. thesis should take into account the following initial sources:

- the research contracts of the Centre;

- the Ph.D. thesis written or supervised by the professors;

- internal researches of the departments which can represent a starting point for a future research project;

- requests from companies when signed professional contracts between professors and representatives of these companies.

5. Link to the socio-economic environment

The University is permanently present in educational, social, economic and cultural life. Its activities must be permanently adapted to the environment which also changes all the time and which considers "excellence" to be a priority. Nowadays, when the market is regulated by demand and offer, the University makes available its values to the economic environment, helping the field of contractual research and continuous training.

The offer of university belongs to the fields of fundamental research –institutional base, applicative research, services for society.

In Europe the link between a university and socio-economic environment is made up through an interface which holds several names – Link Office with Industry, Companies-University Interface, Centre for Technology Transfer. This interface allows companies to take advantage of the human and technical resources which is concentrated in university and to adapt the

academic research results. It facilitates: capitalization of researches in economy, continuous training, promotion of researches, identification of research projects, professional assistance in research field.

The advantage of an university consists of interdisciplinarity based on an exchange system in which every part does its best. Within local development and world growth, an university represents a guarantee for success for all companies that ask for its help.

The roles of the interface are:

- identification of companies' necessities: filed study and data analysis which can allow a correct interpretation of the collaboration between University and Small and Medium-Sized Companies;
- transfer of academic excellence: it can accomplished by technology transfer, industrial projects design, patent use, etc;

- searching the opportunities of collaboration with socio-economic environment, promoting companies with universities, promoting the equipment in universities and the academic services in industrial field.

6. Results of CITT regarding innovation and technology transfer

6.1 Frequency and power static converter for ACVAR variable speed electro-mechanical drives

This example (fig.4) illustrates both the application of human resources strategy and the innovation: applicative research, patenting the product, transfer to SC AS INTERNATIONAL SRL. It is emphasized the fact that technology transfer is also concerned here with the human resources delivered by CITT.

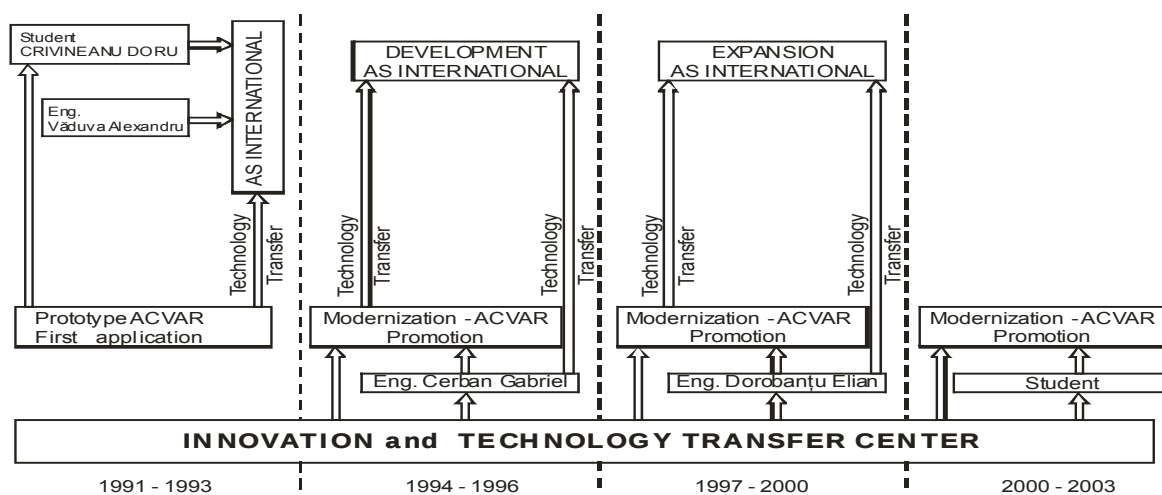


Fig.4 History of ACVAR

6.2 Heating System with elements having SIR DUNA 2000 positive temperature coefficient

This example illustrates the way in which the products that use high technologies were selected and the possibilities of use them in more fields.

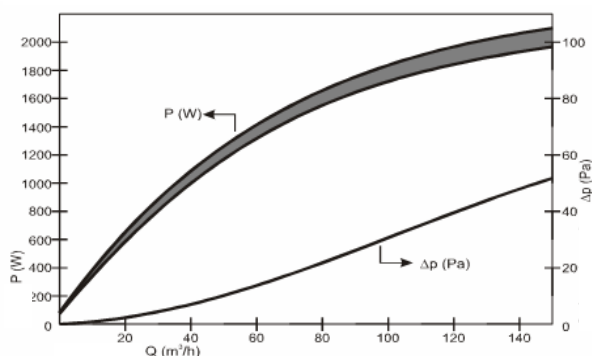


Fig. 5 Static characteristics of heating element

The application was started with a heating unit which uses an element with a positive temperature coefficient. The electric power obtained (up to 2000 W) depends on the air flow that goes through it (figure 5).

In order to regulate the flow it is used a micro motor (50W) which is supplied by an AC variator. Initially, the heating unit, called DUNA 2000, was developed for home appliances, but the big success was represented by warming up storage rooms for food products. For this application [9] it was used a system with a microcontroller (figure 6) in order to measure the temperature in several points of the storage room and to regulate the dissipated power by every heating unit according to the zone in which it was placed [11]. Presently, the product is used for heating the cabin of electric locomotives modernized by several Small and Medium-Sized companies from Craiova and for heating the spaces where Pleurotus mushrooms are planted [12],[13].

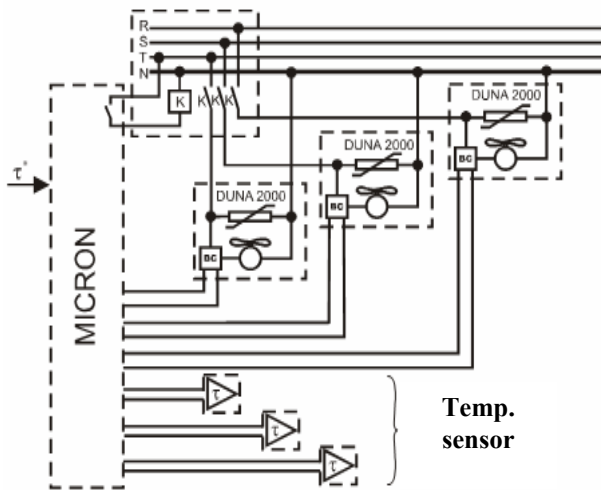


Fig. 6 The structure of SIR DUNA 2000 heating system

6.3 Programmable PROCOMAND automaton

Starting from the conclusion that the Romanian industry needs retechnologization, modernization in automatizations, it was created a basic system with a microcontroller MICRON [3] which was used in several applications (figure 7), one of them for SIR DUNA 2000 system. The advantage is determined by the fact that the hardware is accompanied by software that assures capitalization of creativity potential of professors and students. One of the applications, the teaching variant called PROCOMANDID, is used with students during lab classes from the Faculty of Electrical Engineering from University of Craiova.

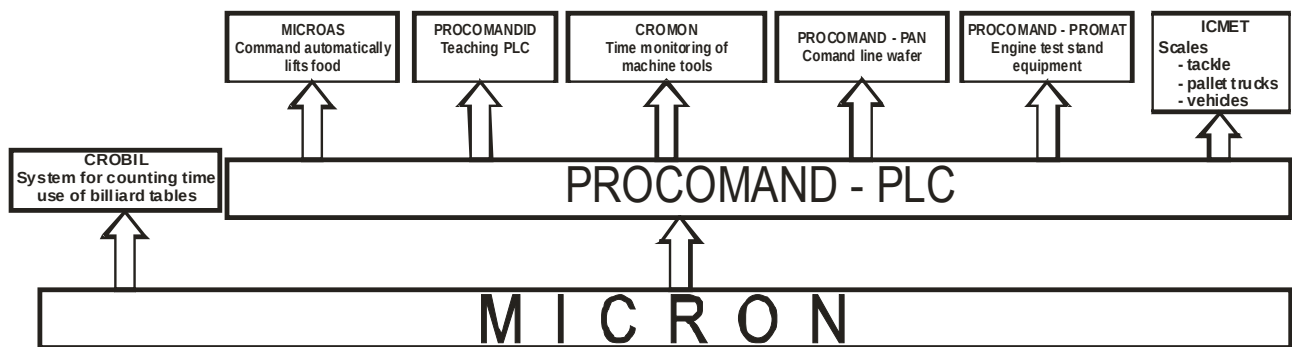


Fig. 7 Applications PROCOMANDID automaton

6.4 Monitoring System for testing rubber products – MONIPRES

This example illustrates very well the concept of innovation that can be defined as an activity of improving, of modernization of a product. SC RONERA from Pitesti is a company specialized in building composite subassemblies - metal, rubber. The external beneficiaries requested the supply of

some electronic bulletins. RONERA has several presses which registered the diagram $F=f(s)$ with a pen on paper (figure 8). The modernization proposed by CITT was represented by a purchase system (figure 9) based on the programmable automaton MICRON and on a software that analysis the information obtained during the test (figure 10).



Fig. 8. Unmodernized press



Fig. 9. Modernized press

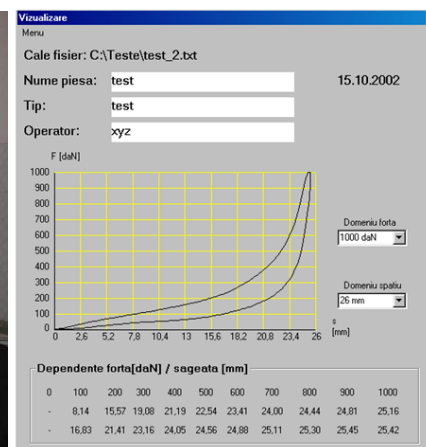


Fig. 10 Stretching - force diagram

The same solution was applied in 2012 at ARTEGO Tirgu-Jiu.

6.5. System for monitoring the launching units of anti-hail rockets

This example illustrates the strategy of elaborating the subjects of B.A. diplomas, of M.A. diplomas and of Ph.D. theses and the strategy of industrial property protection with the help of patents and the internationalization of researches. The National Anti-Hail System was set up in Romania in 1999. This type of system functions in two neighbouring countries for more than 40 years: The Republic of Moldavia and Bulgaria. Based on the collaboration with the Technical University of Moldavia, it has been developed a monitoring system of transferring the energy from the photovoltaic panels to power elements and to consumers so that some functional conditions should be fulfilled (fig. 11). The subject was developed by Laurentiu Alboteanu, professor at Faculty of Electrical Engineering, in his M.A. diploma, his Ph.D. thesis and during a post-doctoral research. For the solution he proposed he was awarded the Invention Patent.

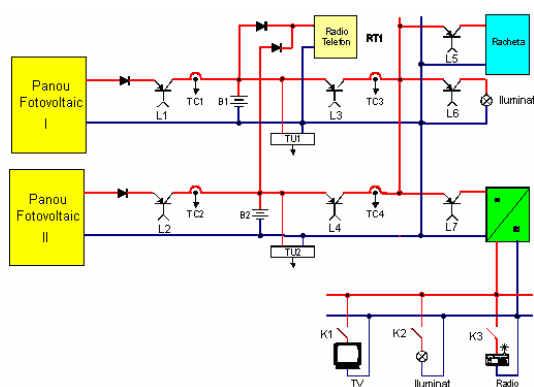


Fig.11 Energetic system of launching units of anti-hail rockets

This example also illustrates the approach of some research themes with a strong social impact. Taking into account the fact that the National Anti-Hail system in Romania is developing, the researches have continued with two Ph.D. theses. One, which will be submitted this year, belongs to Constantin Dulea who proposes a complex integrated system to monitor the important information regarding the fight against hail. For the proposed solution it was applied for an Invention Patent A00452/20.06.2012. the second thesis, started in 2011 by professor Stefan-Marian Nicolae, who graduated the Faculty of Automation and Computers from Craiova, discusses the automatic positioning of the launching ramp of anti-hail rockets (figure 12), and the solution is part of the integrated system for which it was requested an invention patent.

The analyzed theme is also the subject of a cross-border project between Romania and Bulgaria during 2011-2014. Among the products that will be modernized within this project is also the launching

ramp of rockets which will have a different concept and which will be used in Romania, Republic of Romania and Bulgaria.



Fig.12. Manually positioned ramp

6.6. Example regarding technological animation

Technological animation done by a university supposes a permanent research of the opportunities which led to the better relationship between social and economic environment and university; it also supposes the promotion of companies within academic environment and of academic idea within industrial environment.

An example of this promotion is represented by the relationship between CITT Craiova and Cummins Generators Technologies Ltd. The collaboration started by carrying out some tests regarding the heating of the connections between the windings of the generator and connecting cables with the exterior (fig.13)

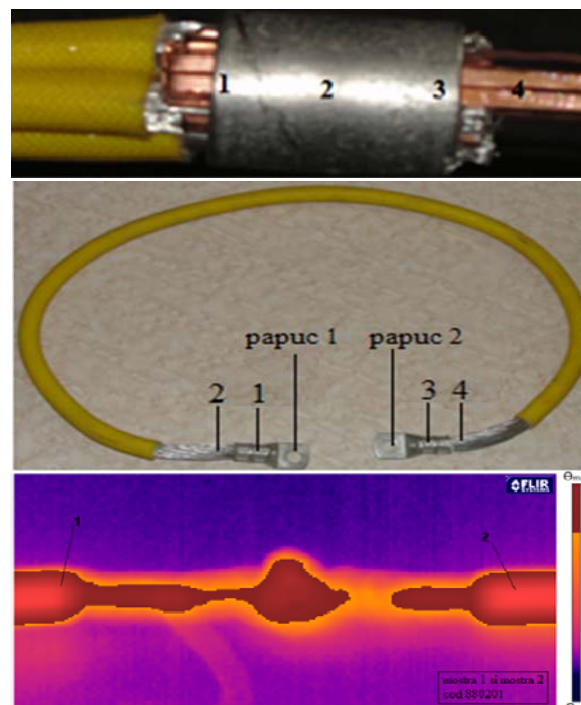


Fig.13. The exemplification of the connections and their thermal values

Afterwards, the collaboration consisted of teaching some 8-hour courses by professors from Faculty of Electrical Engineering. After these courses, there were signed some contracts which

follow the steps described in figure 1: fundamental research, the application of the solution to the beneficiary. This can be also exemplified with the heating of the connections. There were produced models which were analyzed mathematically and by numeric stimulation. The best technological



Fig. 14 After visiting Cummins



Fig.15 After discussions at faculty

7. Conclusions

We consider that the accumulated experience in over twenty years of activity carried out in the above presented context justifies the setting up of a dialogue regarding technology transfer, capitalization of academic research results, link between university and socio-economic field. We have to emphasize that this experience should be considered a model which can be extended, adapted, but not neglected.

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solution was chosen. There were built several samples of connections which were tested. The reduction of the contact resistance was from 20 $\mu\Omega$ to 12 $\mu\Omega$. The technological animation was repeatedly discussed between the engineers from Cummins and professors [17] (fig.14), (fig.15)

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