

EU Research Programs – the Way to the Quality Increase of PhD Study

Ivan Szendiuch¹, Edita Hejátková², Alexandr Otáhal³, Boleslav Psota⁴

¹ BUT, FEEC, Department of Microelectronics, CZ- 616 00 Brno, szend@feec.vutbr.cz

² BUT, FEEC, Department of Microelectronics, CZ- 616 00 Brno, hejatka@feec.vutbr.cz

³ BUT, FEEC, Department of Microelectronics, CZ- 616 00 Brno, xotaha00@stud.feec.vutbr.cz

⁴ BUT, FEEC, Department of Microelectronics, CZ- 616 00 Brno, xpsota03@stud.feec.vutbr.cz

Abstract

The content of this paper is at the beginning to recall some facts about the application of the quality system in the academic sector. Further deals with new aspects and approaches applied in the doctoral study program in the field of electronics in the Faculty of electrical engineering and communication (FEEC) at Brno University of technology (BUT). Describes one of the options to increase the quality of doctoral studies, which is the active involvement of students in European projects, whose leaders are international manufacturing companies. Processes, not only technical, but also organizational and managerial, which take place during the project, they are an important part of an effective education system. These processes provide not only technical growth of students, but also develops managerial abilities and experience. They help to understand the difference between decision-making in manufacturing and contributory organization, and reinforces the thinking in economic decision-making in the academic sector, where successful and able students are rates of return. At the conclusion of the paper is shown one of the examples of the project program Eureka Euripides with participation of PhD students. This article is a reminder and an incentive at the same time, how to prepare for the successful adoption of managerial position in academic practice.

Keywords: *Quality in PhD study, Technical research in University, EU research projects.*

1. Introduction

There is the fact PhD study in technical fields prepare people to continue in his professional carrier for some leading or managing position both in academic or scientific and production areas. Here, however, is one of the shortcomings the fact that fresh PhD continues his career on academic position, in non-profit institution, without the practice in the area of the undertaking. The reality is that there is a different way of thinking when making decisions. One possibility to rectify this is to elaborate a dissertation in the project, which is a leading participant in the research and development sector of company. Good options here are national and European research projects in which the cooperation of the University is associated with the research and development activity in industry area. In this paper is described, except for certain related considerations, one successful example that is realized under EU program Eureka. Doctoral students are involved in the project, whose participants are from four European countries, among them three manufacturing entities from different countries.

Just as in the manufacturing sector is trying to achieve the highest possible quality, it is useful and desirable to enhance the quality in the educational process. Today the leading area of technical science is undoubtedly the electronics, which is now included in all industrial areas of our daily life. Just development in this area in terms of education requires special attention, since the demand for trained and skilled professionals is growing larger.

The technology has undergone in recent decades, large qualitative and quantitative changes. In the field of electrical engineering and electronics, this rapid development has highlighted the fact that the components are getting smaller and more sophisticated, while equipment for their production are increasingly more

complex and costly. For the University is therefore difficult to obtain high-end equipment for laboratories in which it would be possible to train specialists not only in theoretical knowledge, but also develop their skills and abilities into practical form. New investments in technological equipment are further complicated by their small workload, and also the associated return on such investments. One way to solve this problem is to work with industry. There are various possibilities for cooperation between school and enterprises now, but as one of the most effective proved to joint participation of both parties in research and development projects. The development of their managing abilities when making economic steps is very important factor for their education, since financial flows in the company and in the school are very different. This is highly relating with the level of education quality at a university, which can be achieved. Therefore, the involvement of doctoral students in common projects with industry is so important, especially for those students who wish to continue their professional career at the University.

A reminder of this document is contained in four chapters, where are the main 2 and 3. Chapter 2 describes the research on FEKT, where increase in financial support gives more possibilities to involve students in research work. There are also described the principles of quality management system in the academic sector. Chapter 3 shows the structure of the activities in the Eureka Euripides BoB project and their mutual relation. The main benefits for the participating graduate students are also mentioned.

2. Technical Research in University and Quality System

2.1. General Overview of Research Activities at FEEC in BUT

The Faculty of Electrical Engineering and Communication provides education in following six disciplines:

- Electronics and Communication,
- Cybernetics,
- Control and Measurement Techniques,
- Teleinformatics,
- Microelectronics and Technology,
- Power Electrical and Electronic Engineering.

There are more than 4,000 students in Bachelor's and Master's study programs, and several tens of PhD students.. But quality control in the academic sector has specific approach from the industry and requires different procedures. Because the output product in university are students, there was introduced a system of evaluation from their perspective. As it turns out, is increasing the number of students who looks for practical classes in laboratories and also who are interested in participating in research projects. In Figure 1 are shown increasing activities in research and development at FEEC.

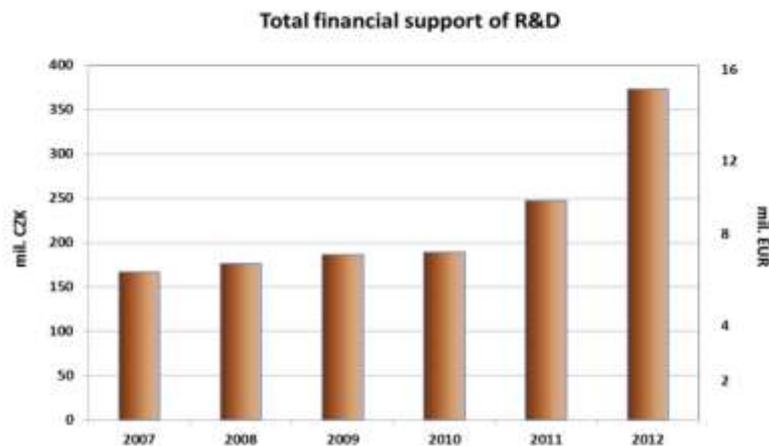


Figure 1. Development of research activities at FEEC BUT. [1]

It is the fact that more than 90 % of students involved in participation on projects are PhD students. The reason is their professional skills obtained with Master Diploma and immediately continued four-year cycle of time for PhD study, allowing their full participation in the project, which typical time period is three years. In Figure 2 is shown the system of participation subjects for the establishing research and development project, where the University is a subject located among the ministries and industry.

Research activities at the FEEC are funded from national grant projects (Czech Science Foundation, grants from the Ministry of Trade and Industry, and others) or, from EU Structural Funds. The staff is involved in research for industrial partners on the basis of contracts, and within the framework of diploma theses and dissertations. Companies interested in cooperation can write directly contact to the particular departments.

There are two basic opportunities in the Czech Republic to receive financial supports, specific and institutional. Specific one can be one of three types of financial support:

- grant projects,
- programed projects,
- public contracts.

First is granted from the Ministry of Industry and the Ministry of Education (GACR, FRVS), second from the state administration body and third means an open contract from some institution.

An important objective at University generally is to give transparent and clear programme for research activities with a possibility to join it, or to offer possibility to join, to start and to develop these activities. Engagement of University staff and constitution of research team in University is an important step in this operation.

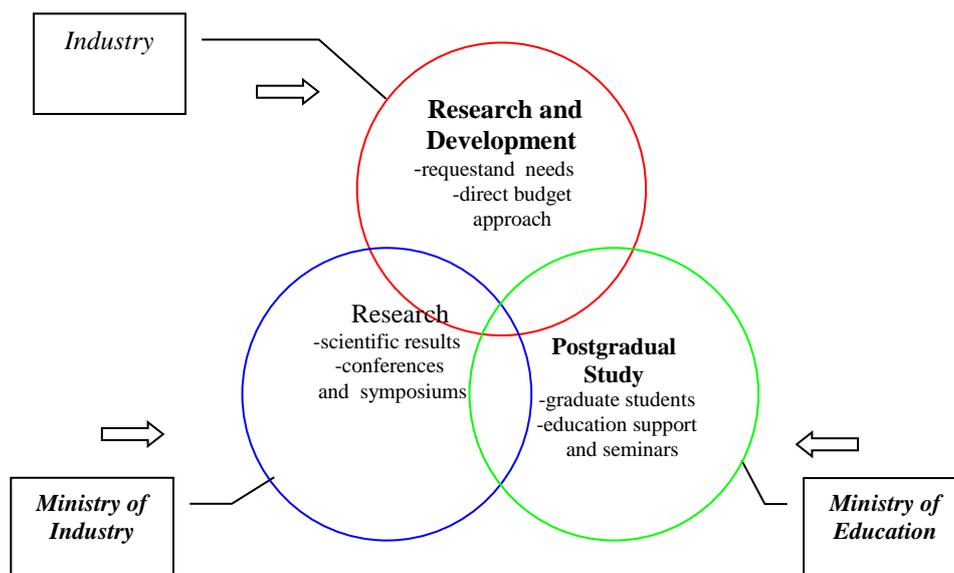


Figure 2. General system for project establishing.

2.2. Factors Affecting Quality

The quality plays the important role in our life. Implementation of ISO rules in the educational system has many similar factors as its implementation in other processes generally, but also some specific facts. The main difference is that the company must recoup the funds, which the nonprofit organization is not directly controllable. All responsibility for the quality of the university depends on the maturity of management and his experience. The main structure for quality assurance in the educational system is designed in Figure 3, in the widest context including more necessary factors to reach good and powerful result.

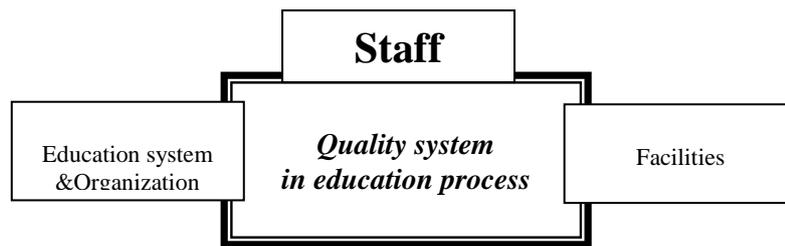


Figure 3. Main structure of quality system in the education.

There are three main areas in quality management which are [2]:

- Staff, which must be both technically and pedagogically high-level,
- Education system, which must be transparent, with clear rules and expertly balanced,
- Facilities, which must provide access not only the theoretical but also practical training.

The very first experienced staff is irreplaceable. Science is still ahead and the requirements for leadership are still higher. This applies not only technical expertise but also the way of financial management. And here is the best school experience, you cannot replace theories.

Experienced staff is a guarantee of quality for academic and management functions. The science goes forward and the requirements for these positions are still higher. This concerns not only technical knowledge, but also academic and managerial (methodology, rhetoric, psychology, working with people, financial decision making, etc.). And participation in projects that are associated with the industry gives doctoral students the best practical experience that they cannot replace a theory.

3. Eureka Euripides Project BoB

One good example, how to achieve complex experience for PhD students is to involve their thesis in some research program that is led by some company. One possibility is Euripides as cluster of Eureka programme. As an example, there is shown the research activity carried out at the Microelectronics Department of FEEC, which has the title “Board on Board” (BoB). This project is concerning development of the new package configuration for special camera. Output is the “hi-tech” product characterized by new solution of electronic assembly and construction performance with high reliability. Financial part is carried under EU Eureka project, which main investigator is Thales Group from France. Other participants are Celestica Spain, Cimulec France, AT&S Austria, Lem3 from France, and also Brno University of Technology from Czech Republic.

3.1. The Origin of the Project

The origin of this project comes from the involvement of various actors (including PhD student supervisors) at international conferences where they were contacted. There is generally one of the main objectives of participation in technically-oriented international conferences to establish contacts in the relevant field and specialization. Making contacts not only requires good technical skills, but also some communication and managerial skills. There currently plays an important role PhD student’s supervisor, who must be a person with some international experience, supported the results obtained on the international field of science. After the approval of cooperation the project leader defines the subject of research and development with the appropriate output and begins negotiations on the project structure and the positions of the individual partners. Immediately thereafter, each participant will enter into negotiations on the allocation of grants with the appropriate ministries. The organogram of this structure, showing block schemes the basic activities, is shown for BoB project in Figure 4. In this project the aim is to develop a new type of mobile cameras implemented new technologies in the construction of the 2.5 D electronic packaging.

The basic prerequisite for the start of the project is a good knowledge of the structure of the announced projects, in our case Eureka, clusters Euripides. In case of these technical solutions, these are projects that

combine co-production entities and universities. There is general rule; the main objective of company is to produce economically, cheaply and efficiently. In the case of new products this means to optimize a variety of operations, and technological steps, which is quite time consuming. And this is where the role of the university, which has a scientific capacity. The exchange of results in both practical and theoretical level brings for the industry new ideas and innovative impulses, and vice versa for the students the opportunity to develop talents and theoretical knowledge to skills and abilities.

3.2. Organization of the Project

As shown in Figure 4, the main solutions can be divided into those which require production facilities (blue fields), and those which can be solved independently of the devices which have a universal use (yellow fields). And these subtasks are destined for solutions at the university. The solution procedure is similar to the normal procedure used in industry for the "contract manufacturer", except that the output is not the products, but the results of simulation and testing. Mechanical and thermomechanical tests, as well as other electrical measurements, are areas that can achieve a high quality at the University. [4] Two students on half the workload are included in the project, one on mechanical and the other on the thermomechanical simulations and tests. These students must constantly coordinate their work and achieved results with other participants in the project, which is part of their education.

All of these activities (blue and yellow) must be constantly coordinated and optimized. This requires the joint effort of both manufacturing companies and universities, which creates an environment where students are actively working, becomes part of the production company. This makes it possible to develop for student's complex thinking not only in the technical sense, but also in other areas of management, including economic considerations. The production phase of work under the joint proposal is the responsibility of the manufacturing entity (green box).

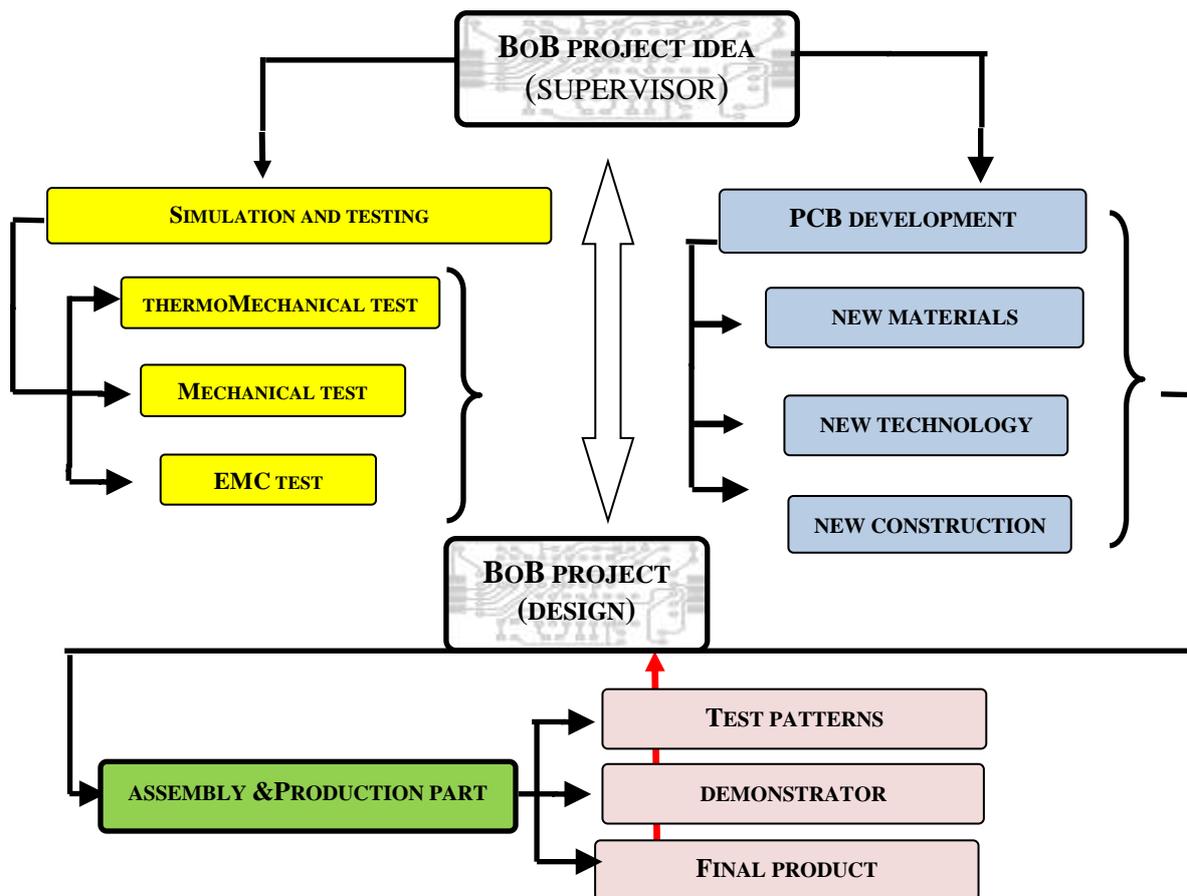


Figure 4. Block structure of activities in BoB project.

Output of the project (pink fields) has three levels. The first level is “Test pattern”, which serves for optimizing of partial construction. Any new structure must be tested and optimized in terms of the electrical, mechanical and thermo-mechanical properties, suggesting the red arrow. The second level “Demonstrator” is already representative of the possible solutions, and must also be thoroughly tested. The third level “Final product” is the result of an overall solution.

As can be seen from Figure 4, the project requires broad cooperation between the all partners involved. That's the best form of teaching PhD students that cannot be replaced by any theoretical teaching. In the course of the project, PhD student gets through direct access to modern technologies, including possible participation in working meetings, to improve the following knowledge and skills:

- technical specialization (access to hi-tech and the possibility to participate in their solutions),
- managerial skills (negotiation, planning, management... etc.),
- deepening the knowledge of the language.

Along with the active support of the supervisor is one of the highest forms of which increases the quality of the whole educational process.

4. Conclusion

Education at the technical level of PhD study requires a somewhat more sophisticated approach than in the study of engineering. The reason is that the degree PhD graduates are often determined for the managerial position. It is a fact that in the area of the electrical engineering is worked with many different materials, with many different devices, and the resulting outputs are often complex, heterogeneous structures. During these processes it is necessary to decide, in many cases, not only the technical solution, but also be able to find the most effective solution to saving cost.

In this paper is presented one example how to give to doctoral students practical experience. The optimal realization of the PhD thesis in the University is, when student has the opportunity to realize this thesis as a part of the project, which is controlled by the external company. One example is presented as EU research program Eureka cluster Euripides, which is successfully carried out in three-year cycle. The solution of BoB project, referred to in this paper, was initiated in the year 2012, and all indications are that this year will be successfully completed. Good occasion for near future is the new EU project Horizon 2012 for EU Research & Innovation that was announced for years 2014 – 2020. The hope is that the massive investment will boost Europe's knowledge economy and promote scientific breakthroughs, helping the continent keep pace with global competitors [5]. In any case it is a good opportunity for the academic staff of the University, not only for the involvement of the PhD students in project solutions with the industry, but also to obtain practical technical and managerial skills.

5. Acknowledgements

Funding for this research work was supported through project of EU EUREKA Euripides no. EUR-10-101 “Board on Board Technology” signed LF13007/OE 1830 1001 and grant project of the Czech Ministry of Education for Brno University of Technology FEKT-S-14-2168 “Research of modern innovative technologies for microelectronics packaging and interconnection”.

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Authors

Principal Author: Ivan Szendiuch holds a Master degree in Electrical Engineering from the Brno University of Technology and PhD degree the same. He joined Tesla Company in 1969 and in period 1992-2008 he was managing director in Vemer Ceska Group Company. In 1990 he became Assoc. Professor and in 2007 received in San Jose Fellow IMAPS. He is author of 5 books and many papers worldwide. At present he teaches Microelectronic Technology at the Brno University of Technology.

Co-author: Edita Hejátková holds Master degree in Electrical Engineering from the Brno University of Technology. She is presently an assistant at the Faculty of Electrical Engineering and Communication and she is specialized for electrotechnology branch. At the same time she works as a student's adviser.

Co-author: Boleslav Psota holds Master degree in Electrical Engineering from the Brno University of Technology. He is presently PhD student at the Faculty of Electrical Engineering and Communication. He is specialized for simulation and modeling in Ansys software.

Co-author: Alexandr Otáhal holds Master degree in Electrical Engineering from the Brno University of Technology. He is presently PhD student at the Faculty of Electrical Engineering and Communication. He is specialized for non-vacuum technological processes regarding to interconnection and packaging in microelectronics.