

EDUCATION NETWORK: PRECISION ENGINEERING

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Abstract. *Precision Engineering is an important key stone for the development of many modern technologies, among them Mechatronics, Bioengineering, Quality Control and Metrology. In Brazil, however, “high tech” industries continue to be concentrated in the south in spite of substantial support provided by the Brazilian Government to change this situation. One of the reasons is the gap in availability of trained personnel in Precision Engineering between the developed South and under-developed regions like the Center and North. That is why an Education Network for Precision Engineering has been established recently between the Departments of Mechanical Engineering of three Brazilian universities and one German university. The principal goal of this education network is to support young industrial centers of high technology with knowledge and human resources in the field of Precision Engineering in order to make them sustainable. It is the intention of this work to report on the content of such education network and the current state of its implementation.*

Keywords: *Precision Engineering, education, international co-operation*

1. Introduction

In Brazil there is still a wide gap between south and north as regards to economic power and level of education. The Brazilian government continues former policies giving financial support to their under-developed regions. However, this process will, certainly, take decades until the necessary infrastructure is available.

One principal goal of such policies is to generate human resources, which are sufficiently well trained to gain access and to develop base technologies, taking into account their specific local conditions. The support of universities that educate engineers in the under-developed regions is, therefore, one of the key tasks for sustainable development.

For more than a decade, the Department of Mechanical Engineering of the Federal University of the State of Santa Catarina (UFSC) has been successfully cooperating with the Faculty of Mechanical Engineering of the Technical University of Ilmenau (TU-Ilmenau), with special emphasis on Precision Engineering. Several new important courses like Precision Mechanics, Methodologies of the Design Process and Methodologies of Adjustment, to name just a few, have been introduced into the curriculum at UFSC as part of this co-operation. Based on agreements between the Deans of both universities, as well as PROBRAL projects and technical partnerships via Deutscher Akademischer Austauschdienst (DAAD) a stable co-operation has been achieved that involves academic staff, young researchers, graduate and under-graduate students.

Now, the idea is to extend this co-operation into a nationwide network that contributes to the technological development of the Center and North of Brazil. Basically, TU-Ilmenau and UFSC are giving support by teaching young researchers at the Federal State University of Bahia (UFBA) and Minas Gerais (UFMG). The specialization “Precision

Mechanics”, introduced into the under-graduate and graduate programs of Mechanical Engineering at UFSC serve as a basis for a gradual implementation of such an important technology into the curricula at UFMG and UFBA.

In the central and northern part of Brazil industries still experience a lack of qualified personnel. Adequate product configuration with respect to its function and fabrication, metrology, rigid quality control, reliable and reproducible processes of fabrication, these are all important components in order to achieve the preconditions for an elevation in technological level. By means of this education network, it is expected that these regions could also be integrated better within Latin America and, especially, into co-operation with Germany. Hence, the partnership between UFSC and TU-Ilmenau experiences an extension that, hopefully, results in the creation of several centers of international co-operation.

2. Members

This international partnership is to work on teaching engineers and young researchers in the field of Mechanical Engineering, with special emphasis upon product development and fabrication of precision engineering products. Therefore, an International Education Network “Precision Engineering”, as shown in Figure 1, has been established, which involves the following member universities:

- Technische Universität Ilmenau, Fakultät für Maschinenbau
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- Universidade Federal de Santa Catarina (UFSC), Departamento de Engenharia Mecânica, Florianópolis/SC,
Responsible: Prof. Dr.-Ing. Walter Lindolfo Weingärtner
- Universidade Federal de Minas Gerais (UFMG), Departamento de Engenharia Mecânica, Belo Horizonte/MG,
Responsible: Prof. Dr.-Eng. Meinhard Sesselmann
- Universidade Federal da Bahia (UFBA), Departamento de Engenharia Mecânica, Salvador/BA
Responsible: Prof. Dr.-Eng. José Amaro de Oliveira



Figure 1 – International Education Network and its member universities

3. Methodology

The experiences collected during the partnership between TU-Ilmenau and UFSC form the basis for a successful implementation of the specialization “Precision Engineering” at UFMG and UFBA. New courses are to be introduced, beginning in the graduate program. Industrial projects as well as modern research tasks are to be used for the elaboration of dissertations and qualification of young researchers. Figure 2 shows the structure of that methodology.

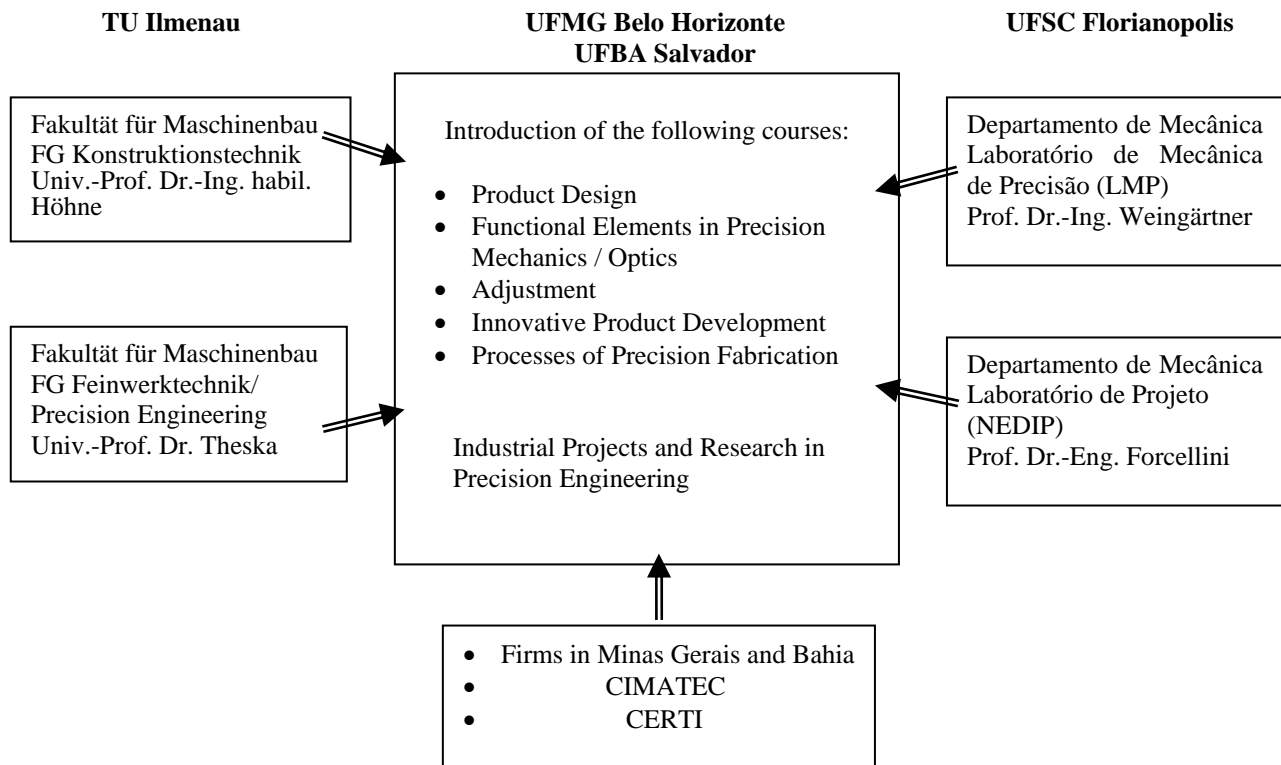


Figure 2 — Structure of methodology applied to the co-operation

Existing courses like Industrial Metrology and Quality Control at UFBA as well as Metrology and Bioengineering at UFMG are to be integrated into the project. The following activities were planned in order to establish the specialization “Precision Engineering”:

1. Detailed verification of the existing conditions and equipment at UFMG and UFBA for establishing the specialization “Precision Engineering”;
2. Analysis and determination of necessities for the curriculum with respect to application fields in nearby industries and research institutions;
3. Elaboration of curricula for the graduate program based on existing courses at UFMG and UFBA. A modular concept is to be adopted in order to allow gradual implementation of the specialization “Precision Engineering”. The concepts of precision engineering are taught by involving students into on-going research projects, where the participation of German students is included;
4. Organization of contents of new courses to be created in co-operation with partner universities and preparation of lecturers at UFMG and UFBA;
5. Elaboration of didactic material for teaching, transferring know-how from UFSC and TU-Ilmenau to the other partner universities;
6. Qualification of lecturers from UFMG and UFBA by means of training courses and studies at UFSC and TU-Ilmenau;

7. Initial test phase at UFMG and UFBA using tele-teaching, promoting lectures, symposia and conducting joint teaching programs by colleagues from TU-Ilmenau and UFSC;
8. Exchange of students between UFMG, UFBA and the other partner universities, especially for practical terms in laboratories, the execution of projects and experiments as part of a dissertation;
9. Joint orientation of projects in the under-graduate and graduate programs, including choice of topics and problems for dissertations.

The following contents are explored by the new partners for the training of their students by means of the participation in local industrial projects:

- Processes of Precision Fabrication of computer peripherals (UFBA supported by the Laboratory of Precision Mechanics at UFSC);
- Optimization of fabrication by iron casting (co-operation between UFBA and CIMATEC, Salvador);
- Measurement systems and positioning systems and its application in Mechanical Engineering and Bioengineering (UFMG supported by UFSC).

The implementation of the education network is divided into the following main steps:

- I (2004) The curricula, as well as future lecturers, of Precision Engineering are defined at UFMG and UFBA. Future lecturers initiate their specialization;
- II (2005) Definition and elaboration of teaching material is finished. Initial test phase with selected students;
- III (2006) Future lecturers at UFMG and UFBA complete their specialization. Execution of projects with under-graduate and graduate students. Visiting students from UFMG and UFBA at UFSC and TU-Ilmenau. Participation of German students in Brazilian industrial projects.
- IV (2007) First graduate students defend their master dissertation. Evaluation of test phase. Regular graduate students studying Precision Engineering at UFMG and UFBA. First industrial projects completed.

4. Results

The exchange of academic staff included one visit per year (one German visit and one Brazilian visit) to detail and supervise the project, as well as to gain contact with local firms and industries. One graduate student from UFMG visited TU-Ilmenau to analyze the German curriculum and compile teaching material in the field of Precision Engineering.

Except Innovative Product Design, the teaching material for all courses to be introduced at the new partner universities has been defined during 2004, currently being developed in Portuguese at UFMG and UFBA. Several courses have already been initiated in the graduate program for tests during the second term of 2004 throughout 2005. These test courses include Applied Optics at UFMG, as well as a combination of Product Design and Functional Elements for Precision Mechanics at UFMG and UFBA, lectured by German professors. First results show that motivation of students is high, although their practical experience in Technical Drawing and Embodiment Design was rather low. Therefore, several adjustments in the distribution of contents of Precision Engineering in both under-graduate and graduate program are still necessary at UFMG and UFBA in order to balance them. For the second term of 2005, more lectures by visiting professors from Germany are planned, testing the teaching of new content in Precision Engineering at UFMG and UFBA, especially in the field of the Design Process.

Furthermore, two graduate students will study at Ilmenau for one term by the end of this year. Additionally, two professors from UFMG and UFBA are preparing a specialization at TU-Ilmenau in 2006, as part of a post-doctoral study in the field of Precision Engineering. Their stay at TU-Ilmenau makes part of a new research project between the four partner universities, elaborated in 2004 and currently financed by DAAD and CAPES.

5. Conclusions

The Education Network "Precision Engineering" is the first of its kind in Brazil. Supported by an international partnership between TU-Ilmenau (Germany), UFSC, UFMG and UFBA (Brazil), this education network has successfully started to prepare two new Brazilian universities (UFMG and UFBA) for teaching engineers and young researchers in the field of Mechanical Engineering, with special emphasis upon product development and fabrication of precision engineering products. The principal goal for the future is to support young local high-tech industries with knowledge and human resources in the field of Precision Engineering.

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7. Responsibility notice

The authors are the only responsible for the printed material included in this paper.