

FLEXIBLE MODULAR EDUCATIONAL PROGRAMME IN ENGINEERING

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ABSTRACT

The paper describes the structure and the aims of a new modular educational programme in Manufacturing Engineering (ME) which will be developed in the scope of a European project and implemented in the Tunis College of Sciences and Techniques (ESSTT). Today, Tunisia looks forward to a high technology transfer. One of the national projects, that have a great effect on the Tunisian national economy, is the "modernisation of Tunisian industry". To achieve this programme in a consistent way, it is essential to prepare a new generation of engineers that can cope with the latest advances in the technological aspects related to industry. For the development of a new modular educational programme in ME for the Tunisian bachelor and continuing education, which is based on the Bologna process, a new project has been initiated in 2007. It has been granted by the EU Programme TEMPUS and aims to establish and improve ME curricula for manufacturing engineers. The institutes from universities and the industry sector in Sweden, Germany, Poland, and Tunisia are partners of this project. The central activity is to construct the study plan for the modular curricula in ME, develop the new curricula of the courses, teaching materials in English language, and methodologies. Part of this also includes the updating of skills of teaching staff and technicians by training courses at the partner universities, on-site training, workshops and seminars, and establishing new ME laboratories.

Keywords: Modular educational programme, Manufacturing Engineering (ME)

1. BACKGROUND OF THE PROJECT

1.1. The highly strategic importance of Manufacturing Engineering

Manufacturing engineering is the only speciality of professional engineering that is able to understand, apply, and control engineering procedures in the manufacturing processes. The field of Manufacturing Engineering (ME) involves processes, materials, products, industries, and the applications of technology that are vital for the operation of manufacturing companies. Therefore, it is important to provide an educational programme based on the needs of industry. The growing prosperity of emerging nations is based upon developing its wealth creating sectors such as manufacturing. The manufacturing sector is essential for any nation's economy, economic growth and jobs. Many service jobs depend on a successful manufacturing sector. If we consider only Europe, the manufacturing activity today represents approximately 22% of the EU GNP. It is estimated that, in total, 75% of the EU GDP and 70% of employment in Europe is related to manufacturing. This means that each job in manufacturing is linked to two jobs in manufacturing related services [1].

1.2. ME industry status in Tunisia

Tunisia became the first country in the Middle East and North Africa to sign a free-trade agreement with the European Union, parallel to the structural adjustment programme of 1986, its accession to the General Agreement on Terms of Trade/World Trade Organisation (GATT/WTO) and its membership in the Maghreb Customs Union, on 17 July 1995. One of the main aims of this liberalisation programme was to encourage growth and efficiency in the manufacturing sector. Between 1986 and 1996 the manufacturing industries as a whole increased their labour force from 413,050 to 553,000 – an increase of 33%. In recent years, Tunisia has compiled one of the Arab world's most successful records of economic growth, an especially impressive achievement since the country is only a minor oil producer and a net importer of energy hydrocarbons. The real growth rate of GDP in Tunisia, between 1996 and 2000, averaged 5.7%. The World Economic Forum organisation, most widely known for its annual high-level conferences at Davos, Switzerland, rated Tunisia as the most competitive African nation in its 2000 rankings [2].

Approximately 2,000 manufacturing companies have already set up there, and are either totally or partially producing for the European, American and African markets. 50% of these manufacturing companies are joint-ventures or foreign-owned, and have reinforced the transfer of technology and know-how, contributing to the country's efforts in economic and social development. The service industries, notably those linked to industry, are also experiencing an important evolution. They contribute to 47% of the total investments, 51.3% of GDP growth and 44% of job creations [3]. Tunisian companies need a reservoir of expertise in manufacturing to take full advantage of the new opportunities and to meet the challenge posed by foreign competitors. There is a large demand for manufacturing engineers who are competent in technologies and management. The re-training of the existing manufacturing engineers in new methods and technologies is another major priority for industry. It is also necessary to bridge the gap between academia and industry by introducing a coordination mechanism that will ensure the sustainable development of manufacturing in Tunisia to attain this goal.

1.3. ME higher education status in Tunisia

Tunisia has been devoting great resources to higher education. There are currently 326,724 students, more than half of whom are women. To manage the flow of the new secondary education graduates (about 55,000 new students each year), the government adopted a new university scheme including the creation of higher education institutions in different areas of the country. In addition to the effort aimed at providing university training to any graduate, the Tunisian educational system is tapping into new information technologies. A broad program to digitalise teaching aids has been launched to support modern teaching methods and interactive communication tools between the students and their university environment. The number of teachers at Tunisian universities has more than doubled in a decade, from 4,225 in 1989-1990 to 9,370 in 1999-2000, and 10,293 in 2003-2004, which is still below the real needs of the increasing number of students. Great effort is being made to modernise the training curricula of Tunisian graduate students and encourage Tunisian researchers living abroad to return home. Tunisia cannot hope to realise its ambitions without investing in knowledge. Therefore, it is necessary to develop the capacity of lifelong learning and to prepare oneself for new professions. The school and the training centres must be connected to the new system of continuing education. In Tunisian universities, there is a relatively large number of students from North of Africa and Middle East such as Algeria, Morocco, Yemen, Libya, Lebanon and Qatar [2].

Today, there are many educational problems and needs in Tunisia. The status of ME-education is summarised by the following (only general considerations):

- There is no specialised education programmes for ME (only general mechanical engineering studies with some emphases on ME).
- There is no LMD (Bachelor/Master/PhD) system in Tunisia now using the Bologna process. The LMD system will be initiated in the following years (2007, 2008) and Tunisia is planning to join the Bologna declaration, and to replace the magister studies (4 years) by bachelor studies (3 years), beginning with the faculties of sciences and the higher colleges of sciences and technologies and finishing with the national engineers schools.
- The status of ME in Tunisia is far from EU state of the art education.

- The higher education study in mechanical engineering and ME is theoretical and not industry-oriented enough due to the lack of sufficient laboratory equipments and machines. As a consequence, there is no acceptable university-enterprise relationship because of the large difference to industrial practice particularly in ME. Although some students cooperate with some companies in the scope of their final study projects or have some industrial visits during the study, the university-industry contact is not commensurable with the one in Europe.
- There are problems in recognition of study abroad (except for France, Belgium and some French-speaking countries like Canada).
- There is a poor mobility of teachers, students, and engineers inside the system and outside the country because of the heterogeneity of education systems, the different levels, and the lack of money.
- The study is not attractive enough for the outside world (only enough for the Mediterranean countries and some African as well as Middle East countries) [4]. There is low financial support for developing, updating and improving education programmes.
- There is a need for the quality assessment of education and for improving teacher and staff competence. The teachers need to develop new teaching methodologies. Many higher educated teachers are working in universities outside Tunisia. In order to improve the quality of education, it is necessary to attract many of them back to work in Tunisian education.

In order to eliminate these barriers, the project MEDPRO has been initiated as a result of discussions between European partners with the Ministry of Education in Tunisia and representatives of TEMPUS programme in this country. MEDPRO is considered by the Tunisian authorities as an ambitious programme that will contribute not only in ME but in general in engineering education as a whole.

2. THE PROJECT

There is a need to develop and implement a specialisation in Manufacturing Engineering at the Tunisian universities. The manufacturing engineer must understand production, production control, design, facilities planning, plant layout, methods engineering, quality control, work standards, systems engineering, statistical process control, processing, and manufacturing engineering management; in other words, the whole spectrum of manufacturing concerns. The aim of the MEDPRO project is to anticipate the needs for education of Tunisian manufacturing organisations and to provide a new generation of manufacturing engineers that meet these needs. The long term objective is to vitalise the Tunisian manufacturing industry and to strengthen its competitiveness on the global market.

The MEDPRO objectives are:

- Defining and understanding the needs of the Tunisian manufacturing industry of today and of the future for education and training in manufacturing engineering.
- Developing and implementing a modular ME curriculum and educational system for both undergraduate and continuing education, taking into account all the needs for academia and the industrial point of view. The system will support the transformation of Tunisian higher education according to the Bologna process. A long-term perspective is to use the knowledge acquired, throughout the project, as a basis for applying the Bologna process in the Tunisian educational system. The ultimate aim of the process is to establish a European higher education area, by 2008, in which staff and students can move with ease and receive a fair recognition of their qualifications. It would be very helpful and beneficial for Tunisia to apply these same procedures to increase student mobility with Europe.
- Providing the EU state of the art education in the field of ME that results in more flexibility in learning and qualification.
- Establishing five new labs in manufacturing engineering at the ESSTT. The main aim, thereby, is to give students the opportunity to support the theories presented in the lectures.
- Increasing the mobility of students, teachers, and engineers at national and international level.
- Training teachers and university staff on the new courses, methodologies and equipment.
- Enhancing the transparency and comparability of the Tunisian system, based on the Bologna process; therefore, facilitating the recognition of studies abroad.
- Making the ME study more attractive not only for Mediterranean countries but also for the entire world. For this reason, the language of study should be English.

- Fortifying the university-enterprise relationship by facilitating the access to the labour market.
- Attracting students from outside Tunisia in the ME-programme.

The European dimension in the cooperation in ME education implies not only a guarantee of a common level of knowledge and skills for the graduates, but also assures a high quality level of teachers and the sustainability of the ME education. The project will focus on the establishment of a new modular programme in ME at the ESSTT. Due to its modular structure, the goal of the programme will be to establish the undergraduate education (BSc) and the training of manufacturing engineers in Tunisian companies for a long life learning strategic activity.

Relevant experience from the EU programme Leonardo da Vinci is available for the development of the curricula. During two years, partners from universities, industrial organisations, trade unions and other institutions have worked together in the EPRODE project [5] to design the curricula for the European Production Engineer. The programme addresses the issues of long life learning and is primarily devoted to the accreditation of institutes which deliver ME education in Europe. Test courses were organised in Germany, Poland and Sweden. This evaluation demonstrated the importance of a unified education programme in ME. The dissemination activities carried out in EPRODE also demonstrate the immense popularity that such a common education in ME would have.

The focus of the MEDPRO project will be on the recent advances and modern techniques used in ME. The requirements of Tunisian industry, related to this field, will be studied. The curricula will cover not only the technological problems but even the managerial issues. In this way, many of strategies can be implemented even in other economic areas such as services, transportation and energy.

Laboratories in CAD/CAM, Metal Forming, Machining, Welding and Automation and Control will be established. In addition, a learning studio will be developed for video conferences and lectures, as well as e-learning activities. These are important aids in educational system which will be implemented at the ESSTT. The programme has received special attention from the Ministry of Education and is considered a top priority for the ESSTT. The director of the university, Professor Jilani Lamloumi, is taking personal responsibility for coordinating the project from the ESSTT side.

3. THE PROJECT PARTNERS AND EXPERTS

The partners of the TEMPUS project MEDPRO are:

- Depart. of Production Engineering, Royal Institute of Technology, KTH, Stockholm, Sweden
- Institute of Forming Technology and Lightweight Construction (IUL), University of Dortmund, Germany
- Warsaw University of Technolog, Warsaw, Poland
- Tunis College of Sciences and Techniques (ESSTT), Tunis, Tunisia
- The company AGA AB, Stockholm, Sweden

The experts of the project are:

- Abdelwaheb Dogui, professor and director of the Mechanical Engineering Laboratory, National Engineers School of Monastir (ENIM), Tunisia
- Wassila Bouzid Sai, professor at the National School of Engineers of Sfax (ENIS), Tunisia
- Seifallah Ayari, head of Mechanical Engineering Department, Higher Institute of Technological Studies of Sousse (ISET), Tunisia

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5. REFERENCES

- [1] N.N.: MANUFUTURE, A Vision for 2020, Report of the High level group, November, 2004.,
- [2] N.N.: African Economic Outlook 2004/2005, www.oecd.org/dev/aeo.,
- [3] Haouas I., Yagoubi M., Heshmati A.: Labour-Use Efficiency in Tunisian Manufacturing Industries: A Flexible Adjustment Model, UNU/WIDER project on New Directions in Development Economics, October 2002.,
- [4] N.N.: Indicators for Tunisian Higher Education, Ministry of Higher Education, July 2005.,
- [5] EPRODE home page: <http://eprode.iip.kth.se>.