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Establishing a Model Faculty of Advanced Information Technologies*

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A three-year developmental programme has been undertaken to design and implement at two provincial Bulgarian universities a faculty structure in applied engineering that provides the facilities required for a modern western university education. In its first phase the project will concentrate on providing an up-to-date undergraduate degree course in information systems engineering. However, the infrastructures are being designed with a view to other areas of engineering being eventually encompassed. The project is funded as a joint TEMPUS project (JEP 2614), the main collaborators being the Technical Universities of Rousse and Plovdiv in Bulgaria, Brunel University in the UK and the Technische Fachhochschule Regensburg in Germany.

INTRODUCTION

THE PROJECT, which started in October 1991, envisages the creation of an educational infrastructure across two Bulgarian provincial universities that will act as a focus for the development and delivery of a number of undergraduate degree programmes in engineering. Initially, a small division accomplishing teaching and training in the important subject area of information systems engineering is planned. The division is considered to be a model of a complete pattern of western type education, both as regards organisational structure and teaching methodologies.

It is hoped through further projects to extend this programme into the areas of electrical engineering, and manufacturing and systems engineering. New departments are not envisaged, but those staff in existing departments who show the ability to contribute to the new degree programmes will have the opportunity to do so. Thus the faculty will act as a kernel accelerating reform in other divisions and subject areas. In addition the faculty will provide the base for modern equipment and resources that can be used by other sections of the Bulgarian universities.

BACKGROUND

Bulgaria is experiencing dramatic changes in all spheres of life and economy. The higher education sphere is in need of cardinal reform. However, there is consensus that reform should bring Bulgarian university education in line with European and world standards. The transition process is a slow and difficult one. The moment of inertia of the existing structures and academic staff is considerable. The final state at which the reform is aimed is as yet unclear. Even the basic milestones are not yet fixed. For example, the degree of 'engineer' has, until now, implied a course of five-years' duration. Probably the Anglo-Saxon shorter degree pattern will be adopted but the new Higher Education Law has not yet been passed. The western schemes of higher education differ considerably and are known to only a few specialists. Also in conditions of serious economic crisis the budget for higher education is totally insufficient.

The two Bulgarian universities involved are the oldest (Rousse) and the newest (Plovdiv) technological universities outside the capital, Sofia. Each has a heavy engineering bias with computing expertise in narrowly defined areas, some of them well established. The perspective and the demands have now changed. It is no longer fruitful to expand these areas in competition with western markets. For instance, there is no point in preparing engineers to design and produce various kinds of electronic boards, devices and computer peripherals, or weaker analogues of western computers, system software and application packages. Other areas of expertise, such as artificial intelligence have started to be built up from visits to western universities in the past.

PROJECT FOCUS

In many areas Bulgaria's needs for high-quality engineers and researchers are quite limited. This is in contrast to the situation in the field of informa-

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tion technology. Expertise in this latter area will be vital for the effective functioning of most spheres of the economy and society. An inevitable computerization in the near future will lead to a strong demand for professionals in information systems as well as academic staff for their training.

The aim of the TEMPUS project is to prepare the resources, both human and material, needed for the provision of a modern information systems engineering undergraduate degree syllabus. It is planned to start teaching the first students on this new course in October 1993. This will be done within a faculty structure that enables other discipline areas to be added when appropriate. The project has to be carried out in the context of the existing situation in Bulgaria and so must meet the aims of promoting substantial change and yet being capable of evolving naturally out of the resources and structures currently in place. Thus the new structure does not imply the creation of completely new departments to deliver each subject, but will provide a framework within which staff in existing departments can be encouraged to prepare themselves for participation in the new courses.

EDUCATIONAL AND PROFESSIONAL ASPECTS

Course ethos

The Model Faculty is being designed to provide a structure for education provision in applied science, engineering and information systems. Both scientific and engineering approaches are emphasized.

For the first courses in information systems, the design of such systems will be firmly focused as an engineering activity. A good engineer draws from his or her scientific knowledge to construct artifacts by evaluating their fitness for a purpose. The objects that an information system engineer creates (software packages or integrated hardware/software systems) are of a very high complexity and reflect comprehensive human concepts. This is then precisely an area where the use of an engineer's systematic approach to the management and assessment of solutions is of vital importance. In this connection, it is worth mentioning the visible shift internationally from considering and teaching of computing as an engineering discipline.

Teaching considerations

The present expertise of the Bulgarian staff overlaps with that required for the new schemes of study. However, it is within restricted areas of computing and has a bias towards applications of certain areas of traditional engineering.

The country has had no business community with the competitive markets upon which a large part of the commercial information technology of western computing degree courses is focused. Western businesses use many PC-based computing systems in the accounting, production and marketing of products. Also larger companies and specialist computing firms use project teams to construct the software for large systems using the concepts and disciplines of 'software engineering'. This is seen as the application of engineering principles and methods to the construction of software. Both of these areas are new to existing Bulgarian academic staff and will require them to re-train so that they are in a position to educate the next generation of information technologists that will be needed to lubricate the structure needed for western-style commerce.

Other areas of knowledge will be easier to accommodate. There is a common grounding in mathematics though some aspects in discrete area and logic away from the traditional engineering material will need addressing. Expertise already exists in computer architecture, although the present equipment available is dated by western standards. Our aim of the project is for teachers to deliver the final courses in English rather than Bulgarian. Initially both English and Bulgarian will be used for teaching, the move towards English being dependent on the evolving expertise of the available staff.

The monitoring of standards as practised in British universities differs considerably from that of Bulgaria. Consensus through examination boards and the input of external examiners is crucial to the maintenance of standards and their comparability between institutions. At present there is nothing similar within the Bulgarian higher education system.

Another aspect that differs between the western institutions and the Bulgarian ones is the style of teaching. British universities, through schemes such as the Enterprise Initiative, are introducing much more student-oriented learning processes. These have less emphasis on content but more on personal development. This is certainly the case at the main partner, Brunel University, in England. The current Bulgarian approach is more traditional and it remains an interesting question as to how much of the British style of teaching could, or even should, be imported into the new degree courses.

Professionalism

One important characteristic of computing degree courses in the UK is that of professionalism. Students are thinking in terms of a career as a professional engineer—an 'information systems engineer'. The UK professional body for computing, the British Computer Society, can nominate computing professionals for chartered engineering status, recognized by the Engineering Council. For degree courses to qualify for academic recognition on the route to chartered status they must contain certain 'engineering' material. These are referred to as the EA1 and EA2 components. EA1 is provision within the course for the acquisition of a number of practical skills, such as the use of design methodologies, programming, etc. EA2 is the application of appropriate skills in a problem

solving environment. In Bulgaria there is no similar history of professional bodies that monitor the training and standards of engineers. Consequently, one design aspect of the new course is to define what are the appropriate skills needed in the new environment and to decide the appropriate application areas.

PHASES OF THE PROJECT

Phase 0—Organizational structure of the project

This preliminary phase concentrated in setting up the structure to:

- create communication links between the partners of the project;
- develop a management structure for the monitoring of the project and for the development of its further phases;
- allow for the distribution and transfer of funds to enable the various activities to be carried out;
- draw up appropriate rules for accounting for all activities within the project.

Beside the four main partners there are a further six other institutions playing a minor role. A series of meetings of the main partners has adopted rules for the organization, control and administration of the project. The management of the project is at three levels. The meetings of the main partners ratify major decisions. The Contractor and the Project Manager (the authors of this paper) form an 'executive pair' to carry out the implementation of the project and each institution involved has a contact person responsible for the activity within that institution.

Phase 1—Initial investigation and faculty structure

This phase took up most of the first year and consists of three major activities. Firstly, information has been collected on all aspects of the current position regarding educational provision in western countries. This includes the western partners being able to learn about the strengths and weaknesses of the Bulgarian situation. Secondly, the institutional plans for the faculty structure have to be drawn up for approval at the Bulgarian universities. This includes a top-level syllabus design for the new computing course. Thirdly, money has been allocated in the first year of the project for the purchase of equipment for laboratories and administration of the new faculty.

A necessary feature of this first phase, to enable the above work to be carried out, has been the enabling of a large number of visits of varying length by staff and students both to and from Bulgaria.

Faculty structure. One feature of paramount importance to the success of the project will be the relationship of any new structure created to that of the existing structure of the two Bulgarian universities. The project does not envisage the creation of super departments of elite staff. This could only be divisive within the present institutions. On the contrary one major aim of the new faculty is to make it a catalyst for further change. Bulgarian staff must come to see it as a major helpful resource in the preparation and delivery of future degree courses. The new faculty will then not consist of new permanent departments and will not contain permanent teaching staff. Instead the faculty will decide on the structure and content of a particular course and then the Dean will assign teachers from existing departments to teach particular subjects and modules. This teaching can be enhanced by lecturers from partner universities and from other Bulgarian universities. The assigned lecturers must have shown themselves capable of delivering the material to the required standards. The present Bulgarian staff must not become to feel threatened by the changes. The opportunity must be given for such staff to develop their present expertise so that they can contribute meaningfully to the new courses. To this end it is not sufficient to just spend money on equipment for modern laboratories. Staff need the opportunity to visit western institutions to assimilate the different ways of delivering a modern curriculum and then be given time to see how best to modify, if need be, current teaching practices in Bulgaria.

To achieve the aims of the project the faculty will require a substantial academic autonomy whilst needing to work with existing frameworks and resources, both human and physical. A faculty board comprising representatives from the partner EC universities will consider major academic issues.

Mobilities. To enable all partners in the project to learn from each other the programme for the project includes many mobilities both from Bulgaria to western countries and vice versa. These transfers fall into different categories. The main one is that of the update of knowledge of Bulgarian staff in the fresh areas of expertise that are needed in the new degree course. Also there has been the opportunity for staff at western universities to visit the Bulgarian universities for short periods, to familiarize themselves with the current expertise of Bulgarian staff and to share knowledge through lectures and discussion in areas less well known to the Bulgarians. Students have been able to spend protracted periods at western universities and also gain work experience at companies in Ireland and Germany. There have been some interesting practical problems in initiating these mobilities, mainly due to the transfer of funds across frontiers, but those undertaken to date seem successful.

It is worth emphasizing that the process involved is not one of a simple transplant of an existing course from one country to another. Certain Bulgarian staff have had the opportunity, through contact over many years, to study a variety of western educational systems. The current institutions visited under the programme vary widely in scope, activity and approach e.g. several British universities, the Fachhochschule in Germany, INSA in

France and the American University in Bulgaria. The aim is to take what is best from a variety of current practices and then to transplant them into the Bulgarian context in a positive way.

Another aspect has been to continue to gather top-level support for the project from within the two Bulgarian universities. One major aim of the project is to have a significant impact on the future structure and behaviour of both of these institutions. For this to be achieved the project must have the active backing of the managers and the academic community of these universities. To enable this, visits to the other main partners in both Germany and the UK have been arranged for Rectors and Vice-Rectors from both Bulgarian universities. Again, these seem to have been successful with institutional approval of the initial faculty structure expected shortly.

Phase 2—The new computing course

Design considerations. The two main computing courses at Brunel University are built around a core of 'software engineering' material. One course, the Computer Science degree, adds to this core by examining the formal side of the processes involved whilst the other course, Applied computing Systems, concentrates on the business applications of computing. Neither course is suitable for wholesale direct transfer to Bulgaria. The new course has to evolve both in the usefulness of its product and, more importantly in the short term, in the interests and expertise of the staff available to teach the students. This means that the course will initially have to have an engineering application bias. However, as one objective of the course will be to produce graduates who have the expertise to create the information processing systems needed for re-generated Bulgarian commercial activity, the new material cannot consist solely of material to the scientific computing area.

The core material in both of the Brunel courses is regarded throughout the United Kingdom as a necessary component for any modern degree course in the information systems engineering area. Thus the partners have agreed in principle that the subject material covered by this core should be an essential part of the new degree course. This does not imply that complete syllabuses can be taken directly and used without modification. The material will be sensibly re-packaged in new modules for delivery in the Bulgarian context. Some of the more student-oriented delivery mechanisms may not be suitable at present as they require changes in attitude to how students are taught. To be successful in this both students and staff must be motivated and trained to work in this fashion. This is one of the greatest challenges in relation to the successful implementation of the project.

Work on the design of this new course has started with the contact persons at the two Bulgarian universities being able to spend protracted periods in the UK, assisted by other members of Bulgarian staff. They have been able to investigate in depth computing courses and all the elements of the organization of teaching at a range of British, German and French universities and other types of higher education institutions. Also consideration has been given to published recommendations from professional bodies such as the ACM and the British Computer Society. From this they have been able to go on to prepare the first overall scheme of study for the new degree. This work has identified areas of mutual concern in the revision of material. Joint work has been proposed with Brunel University to develop a set of modules in the theoretical foundations of computing that can be used both at Brunel and in the degree in Bulgaria in 1993. Staff on mobilities from Bulgaria will work in conjunction with Brunel staff in the construction of this material.

The flesh on the overall design will be added during the academic year 1992–93. A computing system, within the faculty umbrella, will be designed and implemented for handling the administration of the new course. Work will continue on the design of the individual modules within the new degree scheme of study. The course details will be stored on a system, similar to the one used at Brunel, which holds all the module syllabuses, course outlines and study guides. These will be available to students as well as forming an official statement concerning the new degree. In addition the practical work to be carried out by the students needs to be defined in the Bulgarian context. Computing exercises, workshop programmes and project work has to be defined and set up for access by the students. Decisions concerning the amount of group work in the new degree course need to be taken. This is regarded as important in the British context as many graduates will eventually be working in project teams designing large computing systems.

Equipment. A modern computing department makes use of several levels of information technology. The practical exercises and workshop activity within an undergraduate degree course require student access to a range of computing equipment from stand-alone PCs through networked workstations to wide area networks for information retrieval. At present the Bulgarian facilities could attempt to provide only the first of these requirements based on IBM compatible machines. Also an administration infrastructure is needed for student records, course procedures and regulations, module outlines and study guides and, increasingly, for teaching purposes such as automated assessment and the provision of self-paced material via technology.

During phase 1 Bulgarian hardware specialists increased their knowledge by studying the present-day facilities used in computing departments in both the UK and Germany. Consequently in phase 2 they are deciding on the components of the new systems required to equip the laboratories and workshops of the new faculty. One factor in

delaying this process has been the slow introduction into Bulgaria of outlets for western computing systems. These distributors must be able to provide professional maintenance for the systems that they sell. It would be easier but entirely unsatisfactory to purchase hardware from cheaper sources that cannot provide the necessary back-up.

SUB-AIMS OF THE PROJECT

As well as the central features described in previous sections the project has several sub-aims. These are, firstly, the establishment of a research and application centre for technology transfer, consultative advice and co-operation with industry. This will provide an environment within which teachers and students can work on partner and other companies' research and application projects. Secondly, the creation of a multi-media facilty concentrating on the production of learning materials. Part of this activity could involve the preparation of material for Bulgarian companies. Thirdly, the production of a teaching set (textbooks, video and audio cassettes, test materials, etc.) for the study of the Bulgarian language by foreigners.

It is to be noted that the terms of the funding of the current project rules out a lot of work at research level. However, the European Commission, through further initiatives, are providing the opportunity for Bulgarian academic staff to collaborate with western partners in research projects and to have the opportunity to spend periods in research groups in western universities. This activity will be carried out with the aims of the current project in mind.

CONCLUSIONS

The project is nearing the end of its first active year. During that time much activity, particularly mobilities, have taken place. However, the magnitude of the task, undertaken with only a few active but willing people, has had to be faced. The initial proposal, to design a completely new degree course for delivery to its first students in 1992, has had to be set back by a year so that a good course, well-thought through and properly designed, can be offered. The decision on the equipment required, the purchase of this equipment from bona fide suppliers, training of staff in its use and then their preparation of appropriate teaching packages involving the equipment—all of this has proved impossible to carry out in the first year. What has been achieved is the more active participation of wider groupings within both Bulgarian and EC universities, the major groundwork done in preparing the foundations for the faculty structure and a considerable amount of mutual learning by both Bulgarian and western participants so that in the next academic year a good course can emerge for students in the last year of the funded project.