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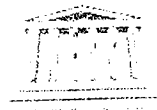
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Directorate-General
Research

IUPWARE : a case study of interdisciplinary education and training

IUPWARE : un cas d'étude d'une formation interdisciplinaire

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Abstract

The Interuniversity Programme in Water Resources Engineering (IUPWARE) evolved from the integration of two existing 2-year postgraduate programmes in Irrigation Engineering and Hydrology. The paper gives a brief description of the evolution of the two separate postgraduate programmes into a single interdisciplinary 2-year postgraduate programme. Emphasis is given on the changes introduced in the programme to make it truly interdisciplinary. The changes required to make postgraduate training interdisciplinary are highlighted by describing the evolution of the IUPWARE programme since 1981, the starting date of the two postgraduate programmes, which led to the establishment of IUPWARE. It is concluded that achieving an interdisciplinary programme requires more than the simple amalgamation of existing programmes and the introduction of new courses. The complete programme environment and structure need to be adjusted. The foregoing needs to go hand in hand with the introduction of measures to assure that the training is given in an interdisciplinary way, requiring a drastic change in the mentality of the lecturers, the way courses are taught and the programme operation.

Résumé

Le programme interuniversitaire en Ingénierie des Ressources en Eau (IUPWARE) est le résultat d'une intégration de deux programmes de troisième cycle respectivement en Ingénierie en Irrigation et en Hydrologie. L'intégration de ces deux programmes résulte d'un besoin de concevoir de nouvelles approches multidisciplinaires dans le domaine de la gestion des ressources en eau. Cette approche doit permettre d'apporter des solutions durables. Ce manuscrit donne un aperçu de l'évolution des deux programmes de troisième cycle à partir de 1981 vers le programme actuel IUPWARE. Le document accentue les évolutions introduites dans le programme visant une interdisciplinarité. Il est clair que le développement d'un programme interdisciplinaire exige plus qu'un simple regroupement de programmes existants et l'introduction de nouveaux cours. C'est surtout le cadre de travail et la structure du programme qui doivent être ajustés. Ceci exige un changement de la mentalité des enseignants et du déroulement du programme. Cette approche a résulté dans un programme multidisciplinaire d'enseignement de deux ans en ingénierie des ressources en eau.

1. Introduction

The Belgian Administration for Development Co-operation (BADCO) took in 1981 far-reaching measures as to assure that from 1982 the budget for university cooperation, as well as for other sectors of development cooperation, between the Flemish and the Walloon

Communities was adjusted in proportion to the population of both regions. In the past most of the funding for development cooperation went to the French speaking region of the country. The foregoing was the logical consequence of Belgium's colonial past whereby most aid for development cooperation went to the former colony, the Belgian Congo, and other French speaking countries in Western and Northern Africa. The new measures gave enormous opportunities to the Flemish Community, in particular the Flemish universities. The Flemish (Vlaamse Interuniversitaire Raad, VL.I.R.) and Walloon (Conseil Interuniversitaire des Universités de la Communauté Française, C.I.U.F.) Interuniversity Councils co-ordinated from the early beginning the activities of development cooperation at university level. Whereas C.I.U.F. continued focusing on the training of overseas students at the undergraduate level, as a way to maintain government funding to the universities by keeping up the number of students in the 1st and 2nd cycle programmes of the universities, the VL.I.R. pursued a completely different approach.

The university development cooperation activities selected by VL.I.R. consisted of :

- the establishment of research oriented projects between a research unit of a Belgian University and a department or school of a university in a developing country, with the overall objective of strengthening overseas local training and research capacity;
- the establishment in Belgium of short and long-term postgraduate training courses for young graduates of the developing countries; and
- the establishment of a grant programme to enable overseas graduates to enrol at a Flemish University for the PhD-programme.

Further, VL.I.R. proposed and implemented the restriction that 65% of the budget available for interuniversity cooperation should be allocated to projects in the developing countries, and that development-oriented research and training projects in the developing countries and Flanders are not automatically extended, and that with time training programmes in Flanders are transferred to the developing countries.

Over the years many overseas projects between a department/laboratory of a Flemish University and a university in Asia, Africa and Latin America were established, whereby the majority of projects were located in Sub-Saharan Africa. Those projects were mainly research oriented, with a small extension component and in most cases co-ordinated by one academic staff of a Flemish university. Projects had traditionally a narrow scope, were commodity oriented, had a maximum duration of 4 years and a total budget ranging between 8 and 16 million Belgian Francs. In general, the budget was just large enough to accommodate the salary cost of one full-time expatriate, responsible for the project co-ordination and implementation. With the exception of the travel expenses of the responsible Belgian professor/scientist and some administrative expenses varying in cost between 10 and 15% of the total project budget, the remaining budget was spent in the overseas university. Over 100 projects have so far been implemented, spread over an equal number of universities and in as many developing countries.

VL.I.R. soon recognised the difficulties in getting those projects properly administered and evaluated, and the limited long-term impact of these types of cooperation projects in the receiving countries. Instead of having the budget for overseas university cooperation spread over too many locations, the idea arose to concentrate the limited means to a small number of priority university campuses in the developing countries. Therefore, as from 1996, VL.I.R. changed drastically its policy and terminated most projects of the type "Own Initiatives of the universities". These are individual projects set up by different Flemish universities at their own initiative. Instead, VL.I.R. selected 10 universities in the developing countries (5 in Africa, 3 in Asia and 2 in Latin America), where future overseas university cooperation will be concentrated.

In contrast to the 3-4 years duration of the previous projects ("own initiatives of the universities"), the duration of the new cooperation projects with the priority universities was

extended 3 times to 12 years. The annual budget per university was fixed to an average of 30 million Belgian Francs per year. The individual professor/scientist can still play his role in the institutional university cooperation by participating in one of the many projects funded at the priority partner institutions. The average number of sub-projects per institutional partner ranges between 8 and 12. By having more projects in a university, different professors/scientists of Flemish Universities are encouraged to cooperate with several professors/scientists of the overseas partner institutions. This approach has certainly contributed in getting interdisciplinary training and research going among the Flemish universities.

So far, the Institutional University Co-operation has been implemented at 10 priority university campuses in Africa (University of Nairobi, Kenya; Sokoine University of Agriculture, Tanzania; University of Dar es Salaam, Tanzania; University of Zambia, Zambia; and the University of Harare, Zimbabwe), Asia (Can Tho University, Vietnam; Hanoi University of Technology, Vietnam; Network of the Saint Louis University and Benguet State University, the Philippines) and Latin America (University of Cochabamba, Bolivia; Escuela Superior Politécnica del Litoral, Ecuador). Although the main part of the annual budget for overseas project development cooperation is consumed by the Institutional University Co-operation, there is still a budget of 100 million Belgian Francs for the funding of individual projects ("Own Initiatives of the universities"). However, this budget item, as all other budget items for the State Secretariat of Development Co-operation, is subject to the restriction that 50% of all means should be allocated to projects in Sub-Saharan Africa.

In addition to the funding of a limited number of carefully selected partner universities in the developing world and a limited number of "Own Initiative of the universities" type of projects, VL.I.R. controls also the development of postgraduate level training initiatives in Flanders. Over the years, VL.I.R. gave the green light to the establishment of 4 International Training programmes (short-courses) and 13 International Courses with duration of 1 to 2 years. The International Course Programmes (ICP) follow the same pattern as the regular academic programmes. Five of the 13 ICPs organised by VL.I.R. are truly interuniversity courses, whereas the remaining 8 ICPs are courses organised at one university. It is VL.I.R.'s policy that with time all ICPs become interuniversity courses, i.e., organised by different universities in Flanders, so as to guarantee the interdisciplinary approach and to make sure that postgraduate training is based on a wider group of prominent researchers. Furthermore in the long term, VL.I.R. aims to transfer fully developed and successful ICPs to the developing countries, so that the available funding for postgraduate training programmes can be used to set up new ICPs and to allow existing ICPs to evolve to full-fledged doctoral programmes.

2. Brief history of the ICP in irrigation engineering and hydrology

One of the interuniversity ICPs is in Water Resources Engineering, being organised by the Katholieke Universiteit Leuven (K.U.Leuven) and the Vrije Universiteit Brussel (V.U.B.). In the following sections, the history, and the changes in the programme's philosophy, structure, study programmes and organisation are highlighted, illustrating the evolution of the Interuniversity Programme in Water Resources Engineering (IUPWARE) since its inception more than 18 years ago.

IUPWARE arose in 1994-95 from the integration of two postgraduate programmes, the ICP in Irrigation Engineering being organised by the Katholieke Universiteit Leuven (K.U.Leuven) and the ICP in Hydrology organised by the Vrije Universiteit Brussel (V.U.B.). Both programmes operated successfully since their formation in the early 80's. Although both programmes were organised independently and run by two different universities, they had a lot in common. They were set up for the same purpose; had similar objectives and programme structure; and the training thrust of both programmes was related to

water resources. The reasons why both ICPs were established almost simultaneously could be best described as follows:

- The awareness that training capacity and facilities at academic level in the field of irrigation and hydrology in many developing countries are largely insufficient, often non-existing;
- The increasing demand for institutions/organisations/universities to organise sandwich courses in the field of irrigation engineering and management, surface water and groundwater hydrology for developing countries. Over time, this placed time and financial burden on the staff of both institutions;
- The desire of both institutions to internationalise some of its programmes, and the wish to improve its international image;
- The pressure from the society to integrate in a better and more effective way the competence and experience in the field of irrigation at Katholieke Universiteit Leuven and in hydrology at Vrije Universiteit Brussel ;
- The readiness of the Belgian Administration for Development Co-operation (BADCO) to finance international postgraduate programmes which are directed to priority problems of developing countries; and
- The increasing pressure from inside the institutions to increase the share of soft (project) money with respect to the hard (government funding) money so as to assist in modernising infrastructure for teaching, research and the generation of new employment for junior faculty staff.

In addition both ICPs had the following characteristics and needs in common:

Both study programmes were primarily organised for young academicians and engineers from the developing countries;

The programmes, lasting 2-years, were taught in English by university staff and international visiting staff, and led to the degree of Master of Science in Irrigation Engineering or Hydrology;

The trainees to the ICP in Irrigation Engineering were a mixture of civil and agricultural engineers, whereas the trainees to the ICP in Hydrology had a first degree in engineering, geology or geography;

The main aim of the first year was to bring the trainees coming from different continents and having different backgrounds to the same level of understanding in a number of basic courses;

Courses in the 2nd year were mainly applied courses in the field of irrigation or hydrology;

Both study curricula addressed primarily in a quantitative way the engineering aspects of irrigation and hydrology, and paid little attention to the socio-economic, cultural, legal and institutional-related aspects. In the developing countries, these non-engineering factors are the primary bottle-necks why irrigation schemes and hydrology projects do not perform as anticipated at design stage; and

In addition, both programmes did not pay attention to the interaction between irrigation and hydrology on one hand, and the impact of engineering designs in the field of irrigation and hydrology on the environment on the other.

In summary, the programmes of both ICPs was straightforward, very classic in concept and structure, and formal in the way courses were taught. Most lectures were given ex cathedra, with few practical sessions and home tasks. Instead of offering the trainees hands-on techniques for solving common problems, typical for the developing countries in the field of hydrology and irrigation, the trainees received an excellent academic education in the theory and practice of hydrology and irrigation. Some minor improvement in the way of teaching was achieved by the introduction of computers and software tools in the middle of the 80's. By lack of vision and incentives and the fact that both programmes recruited relatively well internationally, both ICPs remained mainly purely disciplinary and academic-oriented postgraduate training programmes. In the ICP in Hydrology the main emphasis

was placed on understanding the hydrology of complex systems and the interaction between surface water and groundwater bodies. Little emphasis was placed on studying the impact of human interference on the quality of the earth's water resources. Similarly, in the ICP in Irrigation engineering the main thrust of the programme was on the engineering aspects of irrigation at field and project scale. The study programme poorly focused on teaching the interaction between the irrigation processes and other disciplines such as the socio-cultural and socio-economic aspect of the indigenous communities operating and farming the irrigation schemes, nor paid much attention to the interaction between the irrigation scheme and the surrounding environment. Further both programmes paid little attention to incorporating in the different courses tools for analysing in a quantitative way the impact-effect relationship of human interference in engineering designs of irrigation and water resources projects.

3. The educational and training concept of IUPWARE

As indicated earlier, the ICP in Irrigation Engineering (K.U.Leuven) and the ICP in Hydrology (V.U.B.) were merged as from the academic year 1994-1995 for the following reasons:

- to generate the basis for an interdisciplinary training programme covering the field of hydrology and irrigation, the interaction between both disciplines and aspects of water quality management;
- to optimise the restricted volume of training resources aiming at the same time at an improvement of the study programmes, i.e., making the programmes more appropriate to conditions in the developing and industrial countries and providing the trainees more hands-on training;
- to anticipate the eventual decline in government funding, which due to the reduced number of grants from BADC, resulted in a direct reduction of number of attendants;
- to anticipate to the general decline of interest in irrigation matters by international donors and overseas graduates, and the growing interest of the society and trainees in water quality environmental problems.

The integration of the two postgraduate programmes resulted in a new interuniversity programme for postgraduate training in Water Resources Engineering (WRE). The main objective of this interuniversity programme was the organisation of a 2-year advanced academic study programme in WRE for young academicians and engineers of developing countries leading to the degree of Master of Science. At the same time it was hoped that by bringing together the two ICPs would result in a pooling of expertise in water resources related issues within K.U.Leuven and V.U.B forming a solid foundation for post-doctoral training and continuing education, overseas project development and consulting activities. The merger of the two ICPs resulted in a more attractive, effective and interdisciplinary study programme, an increasing number of students, and a reduction in the organisational costs.

The 1st year of the ICP in WRE integrated the basic courses of the previous ICPs in Irrigation Engineering and Hydrology, with the objective of bringing trainees with different educational backgrounds to the same level in mathematics, statistics, operational research, hydraulics, surface water and groundwater hydrology, irrigation, and water quality and treatment. Whereas the 1st year curriculum of the newly ICP is common for all participants, offering a prerequisite course in basic calculus, 10 subjects and 6 workshops, the 2nd year offers three curricula in Hydrology, Irrigation and Water Quality Management. The structure of the three curricula is similar, consisting of 7 courses, seminars, an integrated project design and a thesis research project. The interaction between the three curricula is limited to one course, the seminars and the integrated project design. All other courses in the 2nd year are topic specific, i.e., related to hydrology, irrigation or water quality. In contrast to the previous replaced ICPs, in the new ICP in WRE, extensive use is made of microcomputer applications as to achieve a more problem-oriented and interactive training of the participants.

The new programme is still focusing on the engineering aspects of water and land resources (resources that are often difficult to define, control, manage, negotiate and adjudicate) but it is also addressing the negative side effects of water and land resources development. The new programme makes intensive use of mathematical and operational techniques and new technologies. Notwithstanding these positive changes, the programme still remains too academic, discipline-oriented, i.e., the interaction between the options and the individual courses within the options are too limited to have a full interdisciplinary programme. Further it was noted that insufficient use in different courses was made of numerical modelling, being nowadays considered as the most rational and systematic method of quantifying many of the environmental impacts caused by human interference on the land and water resources.

While numerical modelling does not give all the answers, it helps to find answers to the short-, medium- and long-term impact of alternative designs and solutions. Numerical models can best address 'what if questions', for example:

- What happens if the sewage to be discharged through a marine outfall is primary, secondary or tertiary treated?
- What happens if the tailwater is extended by 100m, 200m, or 300m?
- What happens if groundwater levels are lowered by 1m, 5m or 10m?

The point is that more than ever before engineers in the field of water resources should thoroughly be prepared to cope with present and future problems, which mainly will emerge from the conflicting demands of the fast growing society for the scarce natural resources. Today it is well recognised that future productivity increase will have to be achieved while at the same time, conserving and enhancing the natural resources base on which we all depend. The truth is, we have to feed nearly six billion people worldwide, whereas as time passes the water is becoming scarcer and demand for it is increasing in every sector of life. This result in a great deal of competition for water from agriculture, industry, domestic uses, forestry, etc. Therefore, on one side there is big demand of water in every sector, while on the other side its overuse, the lack of maintenance of water delivery systems and the contamination of the surface water and groundwater resources have caused a host of socio-environmental and economic problems.

In recognition of this, the steering committee of IUPWARE being in charge of the short, medium and long term programme objectives and the organisation and daily operation of the MSc in WRE, recently decided to introduce as from next academic year (1999-2000) the following modifications in programme structure, particularly in the programme structure of the 2nd year. Changes in the 1st year programme have been limited to a reduction in study load for the trainees, an upgrading of the workshops, and integrating in the different basic courses as many links to water resources problems as possible, as to make those courses more meaningful. Measures are taken as to assure that the lecturers of the basic courses make a sound balance between theory and practice, and that practice is related to a variety of water resources problems, typical of the developing countries. The foregoing undoubtedly will help to convince the trainees about the purpose and the relevance of the basic courses. Further, making in the 1st year a link to the courses in the 2nd year and the field of practice and letting the students work in teams will contribute in developing in the trainees' mind a holistic and multidisciplinary way of thinking and functioning.

In the 2nd year programme far more reaching changes have been proposed and will be introduced, as indicated above, from next academic year in order to prepare the graduates better for the challenges they will face in their professional career. Instead of splitting the students from the beginning of the academic year in different modules, all students of the 2nd year, with their different backgrounds and expertise, will be kept together and obliged to take 5 common courses. In those courses strong emphasis will be given to the use of mathematical modelling and new technologies with application to the hydrologic cycle,

hydrologic transport, and the management of water use and re-use. To keep balance between theory and practice, the trainees will have to work in team on an integrated project design, in which all the different aspects of water resources engineering are presented in a real-life context. In addition to the compulsory common courses and the integrated project design, the trainees will have to choose between one of the following four modules: hydrology, irrigation, water quality management and aquatic ecology. Each module is similarly structured, consisting of two working courses on the engineering and technological aspects of the module and a thesis research project. Also in the thesis, students will be requested to use intensively mathematical models. Furthermore, lecturing staff will be urged to emphasise in courses and workshops the holistic and multidisciplinary dimension of problems and solutions. The proposed measures will not only result in making the WRE MSc programme more academic and professional, but also lead to considerable optimisation of local and visiting lecturing staff, organisational and related costs.

4. Conclusions

IUPWARE today is the result of a continuous evolutionary process that started since the inception of the former ICPs in Irrigation Engineering and Hydrology, two international postgraduate programmes organised by the K.U.Leuven and the V.U.B., primarily for students of developing countries. A number of factors led to the merger of the two ICPs and the continuous adjustment of objectives, goals, content and structure of study programme. These factors include regular internal and external evaluations; the fact that the capacity and competence of many overseas undergraduate programmes are improving; the increase in the magnitude and complexity of water related problems; the decline in government funding and the taking over of the organisation of ICPs by the Flemish Interuniversity Council (VL.I.R.) from the Belgian Agency for Development Co-operation (BADDC).

After 18 years of operation and regular programme adjustments the authors are convinced that IUPWARE has reached a balanced and sustainable status. The 2-year Master of Science postgraduate training programme prepares in an academic and professional way its trainees for the many and complex water challenges the society will face in the 21st Century with increasing frequency. The present interdisciplinary programme status is not only the result of changes in number of courses and course structure, but also the consequence of a growing interaction between staff, students and the professional world, and change in the way knowledge and expertise are transferred. Realising that the conditions for IUPWARE, and the society as a whole, are far from static, the steering committee must remain alert and dynamic, in order that the MSc programme keeps its present status of performance and competitiveness.

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