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ESTABLISHING A EURO-ASIA NETWORK IN DESIGN AND MANUFACTURE THROUGH EU PROJECTS

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ABSTRACT
In an era of rapid economic growth and industrial development in developing countries in Asia, engineering education systems in these countries are under increasing pressure to meet the demands of the local labour markets. At the same time there is a lack of interest from students in engineering in Europe. With support from the Asia-Link Programme of European Commission, three projects on engineering design and manufacture, led by the University of Strathclyde, have been undertaken by eleven Institutions in nine countries in both Europe and Asia. These projects aim at establishing a European and Asian (EUROASIA) network in engineering design and manufacture, contributing to the demands of today's multinational engineering industries, and promoting local development through engineering education for both Asia and Europe. One project has been successfully completed, and the other two projects are still ongoing. Overall, this network in engineering design and manufacture has been successfully built up; the proposed deliverables and achievements have been made; and the impact in the engineering sectors of Asian partner countries is positive and remarkable.

Keywords: Asia link, engineering design, higher education, manufacture, network

1 INTRODUCTION
In Europe, the higher education in Engineering Design and Manufacture has been well advanced, but in most regions of Asia, it is not. To learn advanced experiences in engineering and science, economy and social science from other developed countries, and to meet local labour market needs, an increasing number of students in Asia (in particular China [1] and Indian), have been going abroad to receive higher education or further training in Europe, USA and other developed countries. To strengthen global engineering education and to develop trans-national production and economy, establishing a global network in engineering design and manufacture is necessary and timely for higher education institutions.

It is realised by the European Union (EU) that higher education is an area of huge potential for mutually beneficial cooperation between Europe and Asia. Set up in 2002, the Asia-Link Programme of the EU provides funding and support for cooperation and networking between the higher education institutions in Asian countries and the European Union. The Asia-Link Programme [2] is one of series of Asia-wide programmes to strengthen co-operation between the European Union and Asia (such as "Asia Invest" [3], "Asia Urbs" [4], "Asia Pro Eco II" [5], "Asia IT & C" [6]).

In the Asia-Link Programme, with support by the European Union, the University of Strathclyde has been successfully leading three projects in engineering design and manufacture [7]. These projects aim to provide a framework of engineering design and manufacture for further development of EU-Asia

cooperation in higher education; to enhance mutual awareness and understanding; to promote Europe as a study and research centre of excellence; and to help strengthen Europe's economic and cultural presence in Asia, and that of Asia in Europe. At the first phase of the Asia-Link Programme, the completed project "Promoting and Assisting Engineering Design Education in China" (PAEDEIA) [8] has achieved its proposed objectives. The other ongoing two projects, "Knowledge Transfer On Ship Design, Production and Operation - Towards Safety, Efficiency and Low Environmental Impact" (KTShip) [9] and "A Framework Approach to Strengthening Asian Higher Education in Advanced Design and Manufacture" (FASTAHEAD) [10], have been running well, as proposed.
In this paper, after brief introduction of the background and aims of these projects in this section, the three Asia-Link projects led by the University of Strathclyde are described, and then the EUROASIA network setup through these projects is then introduced. Following a discussion of the life cycle of a proposed project, the main outcomes of these projects are presented, and then recommendations and summary are finally made.

2 ASIA-LINK PROJECTS AT THE UNIVERSITY OF STRATHCLYDE

2.1 Objectives

- To strengthen European links with Asian higher education and build firm partnerships based on professional staff relationships;
- To help institutions in both Europe and Asia to achieve their international strategic objectives;
- To increase student flows between Europe and Asia;
- To provide ways of sustaining the training of Asia students with European style and system;
- To expand the awarding of European qualifications in Asian countries;
- To attract skilled Chinese to experience living and working in Scotland
- To strengthen bilateral links and cooperation in research and higher education in technology and science;
- To attract increased tourism to both European and Asian countries;
- To increase trade between Europe and Asia;
- To expand connections between businesses in Europe and Asia;
- To obtain governments and companies findings for trans-national research and high education.

2.2 Projects

Funded by the Asia-Link Programme of the European Commission, the University of Strathclyde has been implementing three Asia-Link projects since 2002. Concrete project activities have been designed to address three main programme remits: namely human resource training, curriculum development and education system study. Eleven Universities in Europe and Asia from the UK, France, Denmark, Malta, Greece, China, Pakistan, Thailand and Bangladesh are involved in these projects. Through these projects, regional and multilateral networking between higher education institutions in Europe and developing countries in Asia has been promoted. The projects have focused on the cooperation between universities in Europe and Asia through the delivery of short courses and development of an MSc course, split training of PhD students, and organisation of international conferences. All these activities have been designed to establish a long term partnership and knowledge transfer from European institutions to their Asia counterparts as well as promoting the higher education opportunities in Europe.
The first Asia-Link project is entitled "Promoting and Assisting Engineering Design Education in China" (PAEDEIA). This project has achieved its proposed targets and deliverables. Three short courses were developed in the topics of Advanced Ceramic Material Design and Manufacture [11], Advanced Product Development [12], and Advanced Mechatronic System Design [13]. Seven Ph.D. students from China have been successfully recruited and trained through Split Training at the Universities in the UK, France, and Denmark. Two international conferences were held successfully in April 2004 and November 2005, respectively, i.e., the Europe-Asia Symposium in advanced Engineering Design and manufacture for globalisation (EASED) 2004 [14, 15], and the Seminar on China-Europe Engineering Education (CEEE) 2005 [16].

The second project is entitled "Knowledge transfer on ship design, production and operation - towards safety, efficiency and low environmental impact" (KTShip). Teaching modules and curricula developed within this project are disseminated to other maritime education organisations in the two countries. Postgraduate (PhD) students funded by the project are trained with European academic experience. These students, in turn, contribute to and enhance teaching at their home universities. Technical results of their research contribute to the development of local maritime industries and support governmental policymaking and legislation.
The third project is entitled "A Framework Approach to Strengthening Asian Higher Education in Advanced Design and Manufacture" (FASTAHEAD). This is a much larger project and is aimed to establish a higher education cooperation framework for both European and Asia institutions. The target groups are postgraduate students, engineers and teaching staff in Bangladesh, China and Pakistan. It is to develop an innovative multidisciplinary postgraduate course entitled "Advanced Design and Manufacture"; split train Asian Ph.D. students; train postgraduate students, teaching staff, engineers, and practitioners; compare the education systems of partner institutions; and organise a conference on advanced Design and manufacture. This thirty-six-month project started in January 2006, and the implementation of project activities has been ongoing as planned.

3 NETWORK VIA THE ASIA-LINK PROJECTS

3.1 Network establishment

Through these projects, a good network including leading academic members of staff and industrialists from a number of institutions, firms and beyond have been established for the long term benefits. Fig.1 shows the network formed through the implementation of the Asia-Link projects led by the University of Strathclyde.
In the course of implementing these projects, local governments of these Asian countries, China, Pakistan, Bangladesh and Thailand, have always welcomed and supported the project teams. Through conferences, seminars, open days and training courses, the project partners set up their network not only with local governments in their countries, but also with various individuals from university students to professors, from industrial engineers to senior managers.

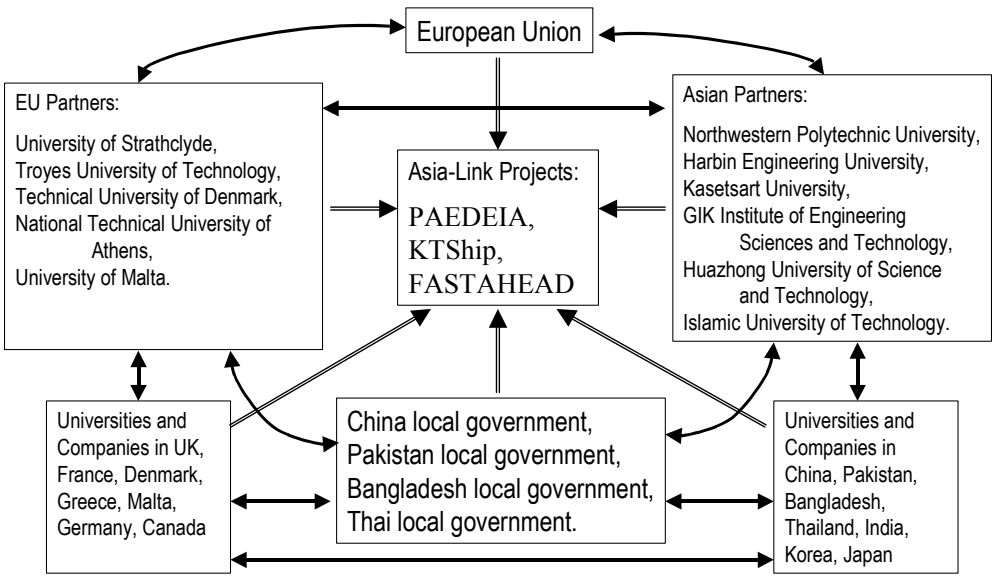

Figure 1. Network formed through implementation of the Asia-Link projects led by the University of Strathclyde

All the project partners are leading Universities in their countries and they are briefly introduced as follows:
The University of Strathclyde (UOS) has a good track record for research and teaching in engineering design and manufacture at both postgraduate (including PhD) and undergraduate levels. Research and

education on computer-aided design (CAD) in the University has an international reputation. The Department of Naval Architecture and Marine Engineering in the University of Strathclyde is one of the premier providers of teaching and research in Naval Architecture and its related disciplines. NA-ME is a joint department of the Universities of Glasgow and Strathclyde; as a result our facilities for both teaching and research are unrivalled in Europe. In addition, UOS has established strong links and trust with all partner institutions which is vital to the success of a joint multinational project such as this one. Therefore, UOS is well qualified and positioned to lead the Asia-Link projects.

Northwestern Polytechnic University (NPU) has successfully carried out their tasks for the Asia-Link projects. In 2004, NPU, UOS et al. have successfully organized an International Symposium, EASED 2004. NPU and UOS have also organised two successful training courses at NPU. Thus NPU has played roles of local marketing and student selection in the western part of China. Moreover, higher education on digital manufacture and automation of NPU has national reputation in China. NPU has used its expertise to design and deliver relevant modules.

The University of Malta (UoM) is a new and dynamic partner and has strong expertise in Design Methodology and Management, Manufacturing Systems, and Robotics/Automation. Hence, UoM has contributed to the Asia-Link projects with their valuable expertise in developing related modules.

The Troyes University of Technology (UTT) has an expertise on mechanical systems engineering, material science and technology, information systems engineering and industrial systems engineering. UTT has added a new dimension to the Asia-Link projects by introducing advanced information technology to make design process better, faster and cheaper. Based on their expertise and experience of design and manufacture, UTT has joined with other partners to lead / develop related modules.

Technical University of Denmark (DTU) is a modern technological university which operates at a high international level in a wide array of activities in fields such as biotechnology, communications technology, nanotechnology and development of technologies for sustainable energy. It can offer various degrees e.g. B.Eng., M.Sc., Ph.D. DTU has developed some modules, co-organised international conferences, and contributed to open days.

Huazhong University of Science & Technology (HUST) ranks as a Chinese leading university in design and manufacture. HUST has strong skills and expertise on CAD, manufacturing automation, CNC, and materials processing. Helped by several campus-based spinout companies, HUST has large pool of students interested in design and manufacture. Their practical experience and local access to manufacturing industry in China are very useful to help to develop relevant modules of the MSc course for the project. HUST has played a local marketing and student-selecting role in the Eastern part of China. HUST has also designed some related modules for an MSc course.

Islamic University of Technology (IUT) is a prestigious institution for higher studies in Bangladesh. About seven hundred students are pursuing undergraduate and postgraduate studies in engineering and technical education and the total number of teachers is one hundred. IUT has played marketing and students selecting role in Bangladesh. IUT's main role is to extend the project coverage and test this reach-out process to this country, which needs considerable support in design and manufacture.

Ghulam Ishaq Khan Institute of Engineering Sciences and Technology (GIKI) is a nation's excellence in the field of engineering sciences and technology in Pakistan. GIKI develops appropriate curricula and teaching practices, acquires talented faculty and provides an environment conducive to teaching and learning. GIKI has extended the project scope and impact to another eligible country.

T**he National Technical University of Athens (NTUA)** is the oldest and most prestigious educational institution of Greece in the field of technology, and has contributed unceasingly to the country's scientific, technical and economic development since its foundation in 1836. NTUA has an expertise in ship design and has made good contributions for the second project.

Harbin Engineering University (HEU) is defining her distinctive position in the nation's development strategy by specializing in shipping industry, ocean exploration and nuclear application. By also leading a series of reforms in teaching, scientific research and information management systems, the University is expanding her role as China's premier comprehensive international university now and into the 21st century. HEU has played a role of local marketing and student selection, and has made contributions for the second project.

Kasetsart University (KU) was established in 1943. The University's teaching and research areas cover science, arts, social science, humanity, education, engineering and architecture. It has established 7 campuses scattered to cover all regions of Thailand. KU has played a role of local marketing and student selection, and has made contributions for the second project.

3.2 Network expansion

Based on networking of the project partners, network to non-partners of other universities and companies in the regions has expanded more and more during the implementation of the project activities. These institutions form an extensive network for cooperation, as they have participated in various activities of the project and benefited from these activities. Some exemplar member universities of the network established in the first project are cited as follows:

(1) In Europe:

- UK – Loughborough University, University of Derby, University of St Andrews, Nottingham Trent University, Cranfield University.
- Germany – University of Stuttgart.
- France - IFMA and University Blaise pascal, Institut National des Sciences Appliquées de Lyon, Université de Technologie de Compiègne, Institut National des Sciences Appliquées de Toulouse, Université de Technologie de Belfort-Montbéliard.
- Denmark – Technical University of Denmark.

(2) In Asia:

- Japan – Waseda University, National Institute of Advanced Industrial Science and Technology.
- India – Indian Institute of Technology.
- China – more than 50 universities, such as Qinghua University, Huaqiao University, Dalian University of Technology, Xi'an Institute of Technology, Harbin Institute of Technology, Chongqing University, Tianjin University, Hebei University of Technology, Xidian University, Wuhan University of Technology, North China Institute of Technology, Beijing Institute of Technology, University of Jinan, Henan University of Science and Technology, Shanghai University of Engineering &Science, Jilin University, Economy and Management academy province of Jilin, Nanchang Institute of Aeronautical Technology, Shenzhen Polytechnic, Shenyang Institute of Automation in Chinese Academy of Sciences.

3.3 Network continuation

Furthermore, a number of students have participated the activities of these projects, although they cannot play important roles in cooperation for the time being. In view of long term, they will have good potentials for networking and cooperation in the future as they all joined a web-based network entitled ENgineering DESign (ENDES). The split-training PhD students will play very important roles in cooperation between institutions in Asia and Europe after they graduate.

Importantly, through the established internet, the network have been continuing. The members can exchange their experience, ask questions and get answers. If people are interested in becoming new members, they can register or contact to related persons.

4 IMLEMENTATION OF ASIA-LINK PROJECTS

4.1 Life cycle of projects

Figure 2 shows the general methodology and its life cycle of Asia-Link projects led by the University of Strathclyde. These projects have been designed to cover the total life cycle with an aim to create longer impacts. The Activities range from labour market and survey, through plan and activities implementation, to impact and service. Together with other Asian universities, the University of Strathclyde has always collected information to understand the demand of Asian labour market, especially in China. Survey based on questionnaire design, visiting and the internet search has been done at the early stage of each project to obtain information about labour market and higher education demand. This has timely updated all project staff with latest Asia market information. Following a specification summarising up the survey results, a sound strategy and a detailed plan are made. After EU approval of the plan, each project activity of these projects is then implemented.

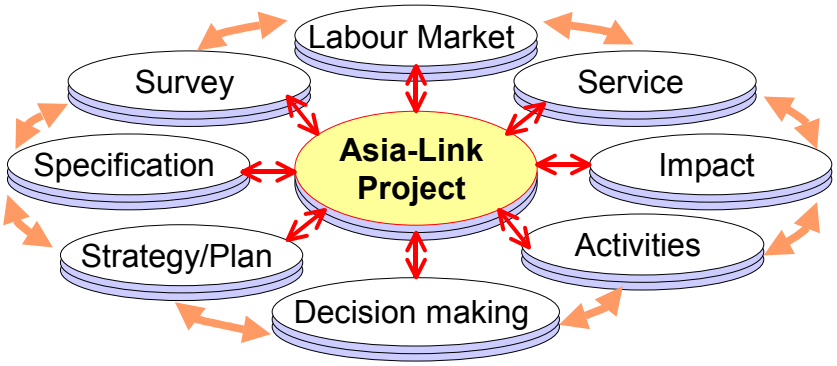

Figure 2. Life cycle of an Asia-Link project led by the University of Strathclyde

4.2 Impact of the projects

The impact of these projects has consecutively been seen after implementing a series of project activities. The European partner Universities have been made more and more aware and known by the students in Asia. The global network in engineering has been strengthened and expanded more and more. The main activities include:

a. Delivery of training courses in Ceramic Material Design and Manufacture, Product Development, Mechatronics System Design to Chinese teaching staff, engineers, and students;
b. Organisation of international conferences and seminars, the Europe-Asia Symposium in advanced Engineering Design and manufacture for globalisation (EASED) 2004 in Xi'an, the 2005 Seminar on China-Europe Engineering Education (CEEE 2005) in Chongqing, The AsiaLink-EAMARNET International Conference on Ship Design, Production and Operation 2007 in Harbin.
c. Organisation of Open days in Xi'an, Chongqing, Wuhan, Beijing, Harbin, China; Pakistan; Bangladesh; and Thailand.
d. PhD students from Asian partner Universities obtaining split trainings in European partner Universities.

Those teaching staff, engineers, and students who participated in and benefited from the projects activities have joined labour force in design, production, research and development in Asia. With advanced technology and methodology in engineering design and manufacture learnt from the projects, they have played more and more important roles in their services. Moreover they are all active member of the internet based network established via these projects.

5 OUTCOMES OF THE PROJECTS

Until now, the first Asia-Link project has been completed, while the other two projects are still ongoing. Overall, the expected deliverables and results have been successfully achieved.

5.1 Achievements

Taking the first project as an example, in relation to the overall strategy of the project and the objectives proposed, the main achievements are listed as follows.

- Promoting and creating regional and multilateral networking between higher education institutions in Europe and China which is the overall objective for the Asia-Link programme. The project website network of ENgineering DESign (ENDES) has been developed, and the registered individual members in our network have been more than 300. UOS and NPU, UOS and CIT (the Chongqing Institute of Technology) have signed or extended their cooperation agreements, respectively. DTU and UTT have jointly applied for and carried out a "France-Denmark" project. UTT, as a member of University of Technology Group in France, has jointly set up a new campus in Shanghai with Shanghai University.
- Advancing the knowledge and skills of teaching staff and postgraduate students. Altogether,

through three training courses, a total of more than 210 industrialists, postgraduate students, teaching staff and researchers attended advanced training courses. In the training course on Mechatronic System Design, 36 participants on average including NPU teaching staff and postgraduate students attended the course had learnt the latest skills and methods in advanced Mechatronic System Design. These participants are now equipped with the latest knowledge and skills to apply or introduce the knowledge learnt from the course to their work, teaching, or research later on.

- Designing and delivering suitable short and intensive training programmes. Three two-week training courses on Ceramic Material Design and Manufacture, on Product Development, and on Mechatronic System Design were successfully designed and delivered. These teaching materials have been tested and further developed for MSc modules for both European market as well as for Asia partners.
- Enhancing and exchanging the skills and knowledge between members of staff of China's and European institution. At the 2005 China-Europe Engineering Education (CEEE 2005), 46 participants, teaching staff of Universities from Europe and China, had extensive exchanges in engineering education.
- Improving mobility of NPU and HEU postgraduate students by providing training opportunities in research degree. Ph.D. split training has been ongoing. Eight Ph.D. students, in total, have been receiving their training at UOS, UTT and DTU and eight more to join European partner institutions.
- Introducing Chinese students to a wider choice of postgraduate training opportunities in the UK, France and Denmark. The Universities in the UK, France, Denmark, and China related to postgraduate engineering education have been published on the project website. The students have access to information on a huge range of choices and can choose the most suitable study programmes from the project website. This has also been enhanced by information sessions held in China. Through the Open Days, about 400 students in China have received information from the CDs distributed about the higher education opportunities in Europe, universities conditions and admission requirements of UOS, UTT, DTU and NPU.
- Reviewing project progress, disseminating collaboration results, and discussing the further collaboration activities to sustain future collaboration. Besides communications by email, telephone, tele-meeting and fax, several project meetings were held to face-to-face review and evaluate the project progress. A new Asia-Link project enhancing and indicating further co-operations between UOS, NPU, UTT and four new partners started from 1st January 2006.
- Promoting the split Ph.D. training for sustainable collaboration. The split Ph.D. supervisions between European Partner Universities and NPU for the seven Ph.D. students were based on on-going projects which will form the basis for further collaboration and setting up co-operative research projects.
- Exchanging the pedagogical views of the East and the West. Through the CEEE 2005 and training course delivery in China, teaching staff of the 4 partner institutions and other 31 universities in China including Hong Kong had exchanged and shared their teaching and research philosophies, pedagogies and experience.
- Exchanging the research results of the project partners with other institutions to seek potential research collaboration between partners or with other institutions. At the CEEE 2005, some universities in China showed their interests in cooperation with UOS, UTT, DTU and NPU.
- Promoting the network of engineering design via the project website. Network on the project website was established, and most of the participants at the Open Days and the CEEE 2005 showed their interests in joining it.
- Increasing the project impact by presenting the findings and experience of the project. Four papers indicating the project results and findings were published at the CEEE 2005 and the CMES 2005. The organisation of the CEEE 2005 itself also increased the project impact.
- Further identifying and verifying higher education and training programmes in engineering fields. By exchanging with 140 participants at the EASED 2004, the project team had learnt the first-hand knowledge of China's engineering design and labour market demands.
- An extensive market survey has been carried out in FASTAHEAD project and market needs have been confirmed and further analysed. The report is now available at the project website.

5.2 Feedbacks

Benefited from participation of a number of project activities, the target groups always have expressed their high commendation and appreciation of the benefits brought by the project activities. “Chinese universities really need learning from and cooperation with European universities. Your Asia-Link projects are very helpful in promoting engineering education in China.” said Prof. Jiang Shao-Jian of Central South University at the CEEE 2005. The new teaching style instriduced by UOS into NPU has been highly appreciated as indicated by Professor Li-Tong Zhang – an Academian member of Chinese Academy of Engineering, interactive teaching and learning piloted at UOS and introduced to NPU “ is very interesting and effective way of learning”.

Almost all feedbacks from the participants at each of the training courses showed that “the contents of the training course are really their needs”. Most of them hoped such training courses should be organised regularly to enhance their skills. When asked if they advised their colleagues or others to attend such training courses next time, they sated that it was “strongly recommend”.

Split PhD students from the Asian partner Universities benefited from the project and appreciated the difference of PhD training and the benefits they have gained. These students will be excellent members of network between Europe and Asia later on.

The following lessens have also been learnt. Communication between Asia Partners and European counterparts can be a barrier both in terms of language and more importantly working style. Deadlines may be set, but efforts are required to push really hard to achieve the deliverables on time. Appreciation of the importance in the whole academic community on education needs to be improved as academics may consider research is of higher priority.

6 CONCLUSIONS

Three Asia-Link projects have been led by the University of Strathclyde, UK, and a network hundreds of universities and firms in both Europe and Asia have been established, based on the origin-network of the project among eleven Universities partners. The network has been continuing through the well developed website which is updated timely to incorporateof new data and new members. This network is very useful for collaboration in research and higher education, trade and business, engineering and economics between Europe and Asia.

It is anticipated from these projects that co-operations between these Universities and Companies will continue and expand both within these project and beyond. Higher education in Advanced Engineering Design and Manufacture is a field of potential for mutually beneficial cooperation between Europe and Asia. By implementing these EU’s Asia-Link projects, it is experienced that it is practical and useful to promote higher education in the sector by means of joint development of modules, joint training of postgraduate students, and joint organisation of international conferences. For students and staff in a developing country, a combination of e-learning with local face-to-face lecturing is useful and economical for them to access advanced higher education by European Universities.

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