
Global Networks in Engineering Education and the Ryerson Centre for Engineering Education*

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Networking and collaboration between universities and engineering schools is becoming increasingly important as educators seek to share ideas, expertise, and resources, and actively develop relationships that will provide opportunities for faculty and student exchanges. The UNESCO International Centre for Engineering Education (UICEE) was established, in part, to promote collaboration amongst nations through education, science and culture. More explicitly, one of the major goals of the UICEE is to facilitate the transfer of information, expertise, and research on engineering education, and to act as a conduit for the transfer of teaching materials used in engineering education from developed to developing countries. To accomplish these goals, the UICEE is actively promoting the development of a worldwide network of satellite engineering education centres to facilitate collaboration and the sharing of strengths in all aspects relevant to high quality engineering education. Recently, an agreement was reached to establish the *Ryerson Centre for Engineering Education* (RCEE) as a satellite centre of the UICEE and this paper describes the current stages in the Centre's development and the types of outreach programmes embodied in the Centre's activities.

INTRODUCTION

Ryerson Polytechnic University (Ryerson) in Toronto, Canada, was established with a full university charter in June 1993 and evolved from its predecessor educational enterprises: Ryerson Institute of Technology (1948-1963) and Ryerson Polytechnical Institute (1963-1993). At the present time, Ryerson Polytechnic University comprises five academic faculties, which offer 38 full-time programmes leading to Baccalaureate degrees.

Ryerson also boasts the largest Continuing Education Faculty in Canada and annually registers more than 40,000 students in courses leading to certificates and/or diplomas in many fields and disciplines relevant to the applied professional academic focus of the university's mandate. The Faculty of Engineering & Applied Science, in addition to overseeing degree programmes in Computer Science, Architecture, Chemistry and Biological Sciences, is also responsible

for degree programmes in Aerospace, Chemical, Civil, Electrical, Industrial and Mechanical Engineering. The engineering programmes are accredited by the Canadian Engineering Accreditation Board.

In July 1999, a Memorandum of Understanding between the UNESCO International Centre for Engineering Education (UICEE), and the Faculty of Engineering and Applied Science (FEAS) of Ryerson was signed. Its main purpose was to establish and develop a North American satellite centre of the UICEE to be known as the *Ryerson Centre for Engineering Education* (RCEE). This paper briefly outlines the initial stages of development of the RCEE consistent with the guidelines provided in the memorandum of understanding.

Generally, the satellite centre is intended to provide a focus for the development of academic and research related activities in engineering education across North America, and where appropriate, to work with the UICEE to advance the globalisation of engineering studies.

The RCEE is one of an increasing number of satellite centres that include: the Caledonian Centre for Engineering Education (Glasgow Caledonian

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University), the Centre for Engineering Educational Development (Technical University of Denmark), the Chalmers University of Technology, Sweden, and the South Asian Centre for Engineering Education which is located at Anna University in Madras, India (see Figure 1). With the UICEE as the hub, the network of satellite centres will form a formidable communications network the intention of which is to share and exchange information on new, novel, and successful means to deliver engineering education that enhances the learning environment for students.

The logo of the RCEE is shown in Figure 2. The logo will be used in the promotion of the Centre and its activities.

THE MISSION OF THE CENTRE

The challenges inherent in the development of the RCEE embody the establishment of activities that reflect and complement the mission, aims, and goals of the UICEE. The primary mission of the UICEE is:

to contribute to peace and security by promoting collaboration among nations through education, science, and culture in order to further universal respect for justice, for the rule of law, and for human rights and fundamental freedoms which are affirmed for the peoples of the world, without distinction of race, sex, language, or religion, by the charter of the United Nations.

In general, the UICEE is established to facilitate the transfer of information, expertise, and research on engineering education, and to be the conduit for the transfer of teaching materials utilised in engineering education from developed to developing countries. The UICEE and the satellite centres are a formidable international cooperative network.

As one of the satellite centres, the RCEE has been established to collaborate in the exchange of scholars, as appropriate, to take forward academic and research activities in engineering education, to work with the network to develop and promote seminars, workshops, conferences, and other academic meetings as appropriate, and to support the production of publications, books, and software for engineering education; and, given RUP's strengths in the effective integration of multimedia courseware in engineering education, to provide a focus for academic and research activities related to the effective integration of the new media technologies into technology-enabled engineering education. It is in this context that the fundamental role of the RCEE will be to act as the umbrella under which all international collaborative engineering programmes of the university will be consolidated.

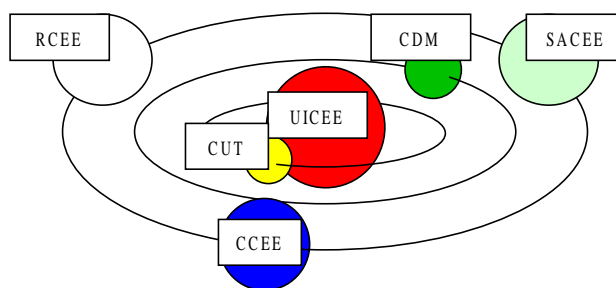


Figure 1: The UICEE and the current established satellite centres.

Note:

CCEE: Caledonian Centre for Engineering Education, Glasgow Caledonian University, Scotland, United Kingdom

CDM: Centre for Engineering Educational Development, Technical University of Denmark, Kgs. Lyngby, Copenhagen, Denmark

CUT: Chalmers University of Technology, Göteborg, Sweden

RCEE: Ryerson Centre for Engineering Education, Ryerson Polytechnic University, Toronto, Canada

SACEE: South Asia Centre for Engineering Education, Anna University, Chennai, India



Figure 2: Logo of the RCEE.

INFRASTRUCTURE

To attempt to achieve the goals of the RCEE it is important to develop a sound organisational infrastructure, to seek the advice and counsel of noted international educators and to secure an adequate resource base to sustain the centre's activities. The RCEE will be organised along the lines illustrated in Figure 3. The RCEE, through the office of the Dean of the Faculty of Engineering and Applied Science (FEAS), will interact with the UICEE and the other satellite centres to further the mission of the UICEE for the mutual benefit of each and all partners, their

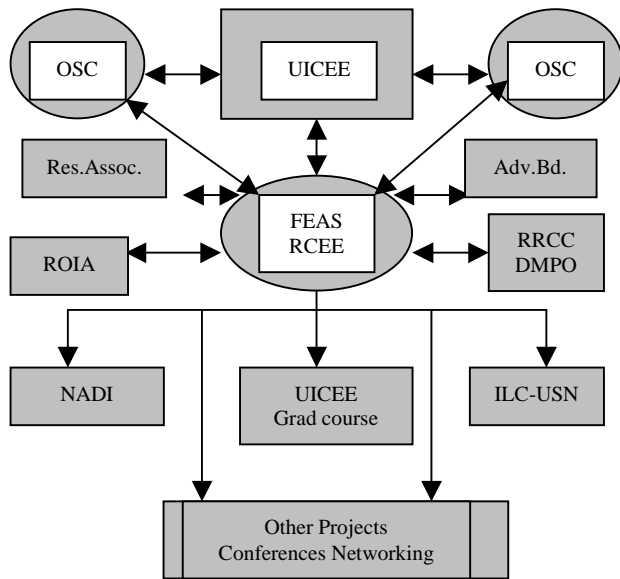


Figure 3: Organisation chart for the Ryerson Center for Engineering Education (RCEE).

Note:

UICEE: UNESCO International Centre for Engineering Education

FEAS: Faculty of Engineering & Applied Science

OSC: Other Satellite Centers

Res.Assoc.: Research Associates

Adv. Bd.: Advisory Board

ROIA: Ryerson Office of International Affairs

RRCC: Ryerson Rogers Communication Center

DMPO: Digital Media Projects Office

NADI: North American Design Institute

ILC-USN: Interactive Learning Connection-University Space Network

faculty, staff, students and programmes in engineering education.

Within Ryerson, the RCEE will interact with the Office of International Affairs (OIA) who will provide information packages to potential visitors from abroad wishing to spend time on the Ryerson campus as part of the exchange programmes for faculty, staff and students. It is also envisaged that the Ryerson Rogers Communication Center (RRCC) and the Digital Media Projects Group (DMPG) will be actively involved in the RCEE, especially in developing multimedia courseware for effective delivery of Internet-based courses. In fact, the DMPG is currently involved in a new venture with the RCEE. This activity is described in greater depth later in this paper.

It is anticipated that faculty members and students who become actively involved with projects of the Centre will be appointed as associates of the Centre. The establishment of a strong and active Board of Advisors will be a key ingredient to ensure successes in developing and sustaining the Centre as a vital entity of the university. The appointment of key

personnel to the advisory board will facilitate systematic and successful development of the RCEE and the potential for good success in acquiring the necessary resources for sustainability. Integration of two successful projects, NADI and the ILC-USN, has been done. More detail on this integration is given later in the paper, as well as information on the development one of the graduate courses proposed by the UICEE as part of an international advanced programme of study in pedagogy for engineering educators.

ACTIVITIES WITHIN THE CENTRE

Consistent with the aims and objectives of the UICEE, and reflecting the unique strengths of Ryerson in the areas of development of internet-based learnware, the following actions have been taken:

First, in 1995, Ryerson was a major player in the establishment of the North American Design Institute (NADI). In collaboration with two Mexican Universities, (the Universidad de Guadalajara and the Instituto Tecnológico y de Estudios Superiores de Monterrey, Campus Monterrey); two U.S. Universities, (Santa Clara University and the University of Detroit Mercy), and Simon Fraser University in Burnaby, British Columbia, NADI is a unique exchange programme in engineering design which prepares students studying design to better understand product design in the context of cultural, health, safety, environmental and other international regulatory policies across North America [1]. Since the inception of this project, more than 180 students have benefited by being provided with opportunities to study and work abroad, thereby gaining value-added learning experiences reflecting the languages, cultures, and regulatory differences of the host country and universities. The NADI programme is designed to provide opportunities for students to study innovative engineering design from a holistic perspective emphasising collaborative, multinational, multidisciplinary and multicultural aspects of design and to prepare graduates for design related work throughout North America. Full details and information on NADI can be found on the web-site www.ryerson.ca/nadi/.

Ryerson and the FEAS were also a founding partner of the Interactive Learning Connection-University Space Network (ILC-USN) and its web-based courseware in spacecraft systems design. This is an Internet-based course that involves the interactive delivery of engineering design education between several North American universities [2]. Independent assessments have shown that students are stimulated, better motivated and achieve higher grades than

students taking similar courses using traditional pedagogy. The programme structure encourages interdisciplinary interaction between students and faculty, not only within individual universities, but also among institutions and industries.

It has been demonstrated that, through the sharing of financial, capital, material, and intellectual resources, educational enterprises will not only be able to enhance the quality and richness of the learning experiences for students, but also be able to accomplish educational and learning goals more efficiently and cost-effectively. Consistent then with the mandate to provide a focus for collaboration in engineering education and research across North America, these projects, NADI and the ILC-USN, have been integrated into the RCEE, making engineering design and research one of the focal points of this Centre. The excellent quality of the students' design solutions can be seen on the web-site www.ilc-usn.net.

Second, the RCEE, as the first North American satellite centre of the UICEE, will work with the UICEE in organising and hosting future conferences sponsored by the UICEE and mutually agreeable to the UICEE and the network of satellite centres. In this regard, tentative agreements have been reached for the RCEE to organise and host the Asia-Pacific Conference on Engineering Education in 2003.

Third, one of the recent initiatives proposed by the UICEE is the development and implementation of graduate courses in engineering education with the objective of facilitating academic teaching staff development. It is envisaged that these courses might be offered using distributed learning technologies and pedagogy; for example, the Internet and/or satellite transmissions. Ryerson, through the FEAS and the RCEE, has significant strengths and experience to offer in the design and operation of distributed learning networks and course (curricula) development. Consequently, it is proposed that one of the major areas of activity that the RCEE can offer in supporting the UICEE in graduate education will be to incorporate resident expertise to develop courseware in instructional design, educational technology and computers in engineering education.

Through the Ryerson Rogers Communications Centre (RRCC), and the Digital Media Projects Office (DMPO), courses, workshops and seminars are currently available to Ryerson faculty, staff, students, and visitors in the areas of instructional design, HTML authoring, WEB-CT, Visual Basic and JAVA language programming and other related topics. It will be a goal of the RCEE to integrate these strengths into its programmes and to appropriately offer these to the international community.

At the recent 3rd Annual UICEE Conference on Engineering Education, a two-day workshop on a proposed Masters degree programme in Engineering Pedagogy was convened [3]. One of the outcomes of the workshop was that Ryerson, through the RCEE, would coordinate the development of one of the proposed courses: GCEE-07: *Educational Technology and Computers in Engineering Education*. Initial planning sessions have been held with the DMPO personnel at Ryerson and the salient elements of the course have been defined. A visual presentation of the status of the development of the GCEE-07 course was given at the 2nd Global Congress on Engineering Education, which was held at the Hochschule Wismar, in Wismar, Germany, from 2 to 7 July 2000.

The course will focus on the new and multimedia technologies for instructional purposes. The emphasis will be on the web-based technologies, and the course will have a hands-on, practical orientation. The course will be designed for two complementary modes of delivery: on-site, face-to-face in real-time for students who are able to attend instructional sessions on the Ryerson campus; and through distance delivery using web CT so that students can access the course asynchronously, at their own time and pace, irrespective of geographic location. The course topics are given in Table 1. Each unit will correspond to the equivalent of four hours of instruction and the main skills required to design and implement an interactive, effective, instructional web-site will be covered.

It is not intended to go into any greater depth on this course at this time. It is planned that the course will be fully developed for Internet delivery by September 2001. The modules are being developed by several authors, each having significant expertise in their subject matter. This is similar to the development of the Spacecraft Systems Design Course as part of the ILC-USN initiative described earlier. The planned development of the GCEE-07 course is shown in Figure 4. Further details will be provided on the RCEE web-site as the development progresses.

Table 1: GCEE-07 course topics.

Units	Topics
1.	Course & Technology Introduction
2 to 5	Web Page Creation
6	Distance Learning Concepts, Technologies & Computer-Aided Instruction
7 & 8	Graphics & Animation
9	Java Script & Use of Java Applets
10	Audio & Video
11	Course Management Software
12	Issues Associated with Electronic Publishing

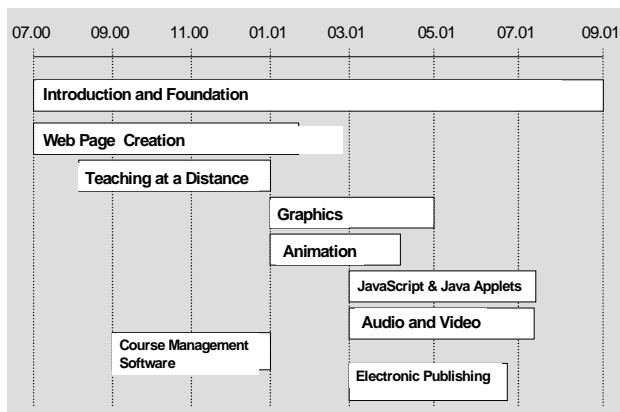


Figure 4: Tasks and timelines for course development.

Fourth, working with the UICEE, it will be a major goal of the RCEE to establish linkages with universities and colleges in the developed and developing world to facilitate the exchange of faculty, staff, and students in all areas of mutual interest and benefit. Integral to this activity will be the transfer and exchange of knowledge and expertise related to all areas of engineering education.

Fifth, the RCEE will continue to promote the aims, goals, and activities of the UICEE to the Ryerson engineering community as well as to the broader North American engineering community. The RCEE will encourage full participation by North American engineering educators and students in UICEE-sponsored events as well as contributions to UICEE publications and engineering education programmes.

This networking in North America will use as its basis Ryerson's existing partners in NADI and the ILC-USN, as well as the North American members of the UICEE. The current list of the partner organisations includes: ITESM (campus Monterrey) and the Universidad de Guadalajara in Mexico; Indiana University-Purdue University-Indianapolis (IUPUI), Santa Clara University, and the University of Detroit Mercy in the United States; Simon Fraser University, Royal Military College, Queen's University, York University and Ryerson in Canada. In addition, other partners include the Centre for Research in Earth and Space Technology (CRESTECH) and the Centre for Information Technology of Ontario (CITO), both of these organisations being Ontario Centres of Excellence.

BUDGET AND RESOURCE REQUIREMENTS

The budget, resource requirements, and commitments will be defined on an annual basis following consultations with the Advisory Board. The resources will include *in-kind* contributions by Ryerson's partners, as well as securing resources from alternate sources,

including contributions from private sector organisations who will support the activities of the RCEE. It will be a major activity of the RCEE's Director and other personnel to actively seek corporate support for the Centre's activities.

STRUCTURE

The RCEE's day to day operations will be overseen by a Director who will report to the Dean of Engineering and Applied Science. The Director will seek the advice of the Advisory Board having the following proposed membership:

- Director of the UICEE, Prof. Z.J. Pudlowski, ex. Officio
- Dean of FEAS, Prof. D.O. Northwood, ex. Officio
- Director of the RCEE: Prof. W.E. White
- Assoc. Dean for Undergraduate Programmes, Student Affairs, and International Affairs, FEAS
- Ontario Colleges of Applied Arts & Technology representative
- Representative from business and industry
- Representative of other North American UICEE member institutes
- Representative from the Canadian Council of Professional Engineers (CCPE)/ Canadian Engineering Accreditation Board (CEAB).
- Representative of the Centres of Excellence

In addition to the Advisory Board, it is planned to appoint associates to work with the RCEE and actively participate in RCEE-sponsored projects. A web-site is being developed which will provide up-to-date information on the centre and its activities. The address will be www.ryerson.ca/rcee/ and it is expected that the site will be accessible in September or early October 2000. Readers are encouraged to peruse the web-site and especially the links to the interactive, Internet-based distributed education projects to examine first-hand the quality of the students' works.

SUMMARY

The Ryerson Centre for Engineering Education has been established to coordinate and be a focal point for all international, collaborative engineering education projects of Ryerson and to be a part of the UICEE's network of satellite centres.

As a satellite centre of the UICEE, the RCEE will take forward the mission, aims, and objectives of the UICEE and, in particular, work with the UICEE and the worldwide network of satellite centres to facilitate the transfer and exchange of information on engineering education on a global scale.

The RCEE will continue to develop and establish activities consistent with furthering the goals of the UICEE related to the globalisation of engineering education.

The RCEE will promote the exchange of faculty, staff, and students with the UICEE and the other centres to further academic and research activities in engineering education.

The RCEE will work with the UICEE and the other centres to develop, organise, and promote seminars, conferences, workshops, and other academic meetings designed to further the goals of the UICEE in engineering education.

The RCEE, because of its strengths in the new media, information, and communications technologies, will take a leading role, as required, in developing activities, seminars, courses, and instructional materials using the new pedagogies to create stimulating, interactive learning environments for students on a global scale.

Finally, the RCEE will undertake other responsibilities, as appropriate, to move engineering education into the new century and the next millennium consistent with its mandate and the mission of the UICEE.

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2. White, W.E. and Brimley, W., Globalisation of engineering design education through enabling Internet technology. *Proc. 1st Annual UICEE Conf. on Engng. Educ.*, Melbourne, Australia, 91-95 (1998).
3. UICEE Workshop on the Development of Graduate Courses in Engineering Education, held in conjunction with the *3rd Annual UICEE Conference on Engineering Education* at the University of Tasmania, Hobart, Tasmania, Australia, 7-8 February 2000.

BIOGRAPHIES

For over 20 years, Dr Northwood has been actively involved in science and engineering education, management, consulting engineering, and research in many fields of materials engineering. Since 1997, Dr Northwood has been Professor and Dean of the Faculty of Engineering and Applied Science at Ryerson Polytechnic University. Prior to this, Dr Northwood spent 21 years at the University of Windsor where he held various positions including Associate Dean



Research, President of the Industrial Research Institute, Director of the Office of Research Services and Head of both the Engineering Materials, and Mechanical and Materials Engineering Departments.

Dr Northwood has published widely with 207 papers in international refereed journals and 187 papers in refereed conference proceedings. This work has been recognised by the election as Fellow of ASM International (USA), Institute of Materials (UK), Institute of Metals and Materials Australia and the Institution of Engineers Australia. Current research interests include: degradation of building materials; wear-resistant surface coatings; metal hydrides (MH) for use in rechargeable Ni-MH batteries.



Dr White is currently Director of the Ryerson Centre for Engineering Education and a Professor in the Department of Mechanical Engineering at Ryerson Polytechnic University in Toronto, Canada. Formerly, he was Dean of the Faculty of Engineering and Applied Science at Ryerson. Dr

White has more than 30 years experience as an educator, practicing engineer, engineering consultant to industry, researcher, manager, and academic administrator. He has over 60 publications in refereed journals and conference proceedings, and has written more than 100 technical reports. He is a registered professional engineer and is a member of several technical societies, including ASM-International, NACE-International, ASEE, ASME, CSME, among others. In 1995, Dr White was elected a Fellow of ASM-International. Dr White's professional expertise is in Materials and Corrosion Science and Engineering.

More recently, Dr White has been actively involved with the media in education group at Ryerson Polytechnic University and is an active proponent of Internet learnware designed to create stimulating interactive learning environments for students. Dr White is married and has two daughters. Outside his professional life, he is an active musician as part of the Oshawa Temple Band of the Salvation Army, and he participates fully in church affairs.