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An Analysis of Best Practices Cooperative Education
in the U.S. with the Purpose of Addressing Various
Armenian Engineering Education Problems

Sona Tadevosyan White

A thesis submitted to the faculty of
Brigham Young University
in partial fulfillment of the requirements for the degree of
Master of Science

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ABSTRACT

An Analysis of the Best Practices of Cooperative Education in the US with the Purpose of Addressing Various Armenian Engineering Education Problems

Sona Tadevosyan White
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This research shows that the expansion of cooperative education programs and university-industry partnerships can help to address some of the problems that engineering education in Armenia is facing today. These problems include lack of connections between universities and industry, outdated curricula, shortages of funding for university staff and facilities, and limited success in helping students qualify for job-related demands of the global economy. In order to identify requirements for developing effective cooperative education programs in Armenia, this study analyzes the characteristics and features of highly successful cooperative education programs in the United States that might be applicable to the requirements of Armenian engineering education programs. The lessons learned from international best practices of cooperative education in this research, provide guidelines that can be used to expand cooperative education programs in Armenian engineering education.

Keywords: Sona Tadevosyan White, cooperative education, engineering education, Armenia

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1 INTRODUCTION

1.1 Challenges Facing the Armenian Engineering Sector

Information Technology plays a very important role in the Armenian economy.¹ In fact, the Government of Armenia in 2000 declared development of Information and Communication Technologies (ICT) to be one of the country's priorities for economic development.² The ICT sector, including the engineering services segment, is one of only a few competitive sectors of the country³. Consequently, it is important for Armenia to do all it can to support the growth of this sector, including investing in the development of an education system capable of producing a strong technical workforce with skills adapted to the demands of the global marketplace.

During the last 15 years, Armenia has made good progress in developing a technical workforce by providing new training programs in areas such as software development, programming, and chip design.⁴ Less progress has been made in developing a strong engineering workforce, mainly because of continuing weaknesses in the engineering education system.⁵ These weaknesses result from reduced funding levels for R&D, a lack of support for staff and

¹ "National Human Development Report, Armenia", UNDP, 2001

² *IBID.*

³ In February 2008, the engineering sector was selected by the USAID-funded Competitive Armenia Private Sector Project as one of Armenia's four most promising sectors in terms of its growth prospects. See http://caps.am/index.php?cat_id=212

⁴ *Armenia Information Technology: Software and Services*, Enterprise Incubator Foundation, 2009 Industry Report. Retrieved on 11-12-2011 from <http://caps.am/UserFiles/File/EIF-ENG.pdf>

⁵ *Armenian Engineering Workforce Survey*, p. 22. Competitive Armenia Private Sector Project report, July 2008, Retrieved from http://caps.am/index.php?cat_id=203 on 11-12-2011

curriculum development⁶, and few and weak linkages between universities and industry.⁷ As a result of these factors, academic engineering education programs currently are not aligned very closely with the needs of the local or international marketplace and are therefore failing to prepare a workforce ready to contribute to the development of a globally competitive Armenian engineering sector.⁸

In spite of these challenges, the engineering sector in Armenia has been growing, although sadly companies still are encountering problems recruiting qualified university graduates and a substantial number of engineering positions are going unfilled.⁹ A principal reason why Armenia graduates are having a difficult time finding jobs is because the current system of engineering education focuses on theory and fails to help students acquire the applied skills and on-the-job experience that would enable them to perform effectively in a work environment.¹⁰ According to recent surveys, about eighty percent of companies are dissatisfied with the practical knowledge of graduates and more than half of surveyed executives find graduates' theoretical knowledge, even in basic sciences, insufficient.¹¹ This suggests there is a need for urgent reform of the system of engineering education in Armenia. This research project specifically focuses on one specific reform that may help produce engineering graduates that are better prepared for the demands of the workplace, namely restructuring engineering education programs to provide more opportunities for students to gain practical work experience as part of their engineering education. This type of practical experienced based pedagogy is called cooperative education.

⁶ *Information Technologies Workforce Supply Assessment, 2006*, Competitive Armenian Private Sector (CAPS). Retrieved from http://www.caps.am/publications/IT_Workforce_supply_assess.pdf

⁶ National Competitiveness Report of Armenia, Economy and Values Research Center, Yerevan, Armenia, 2010, Retrieved from <http://www.ev.am/media/documents/ACR/ACR2010/ACR2010.pdf> Pg 61-62

⁷ *IBID.*

⁸ *IBID.*

⁹ *Armenian Engineering Workforce Survey*, op. cit. p. 22.

¹⁰ *IBID.*

¹¹ *Survey of Armenian Engineering Companies*, Economy and Values Research Center, Yerevan, Armenia, 2010

Recent examples indicate that engineering education in Armenia can benefit greatly from the introduction of cooperative education programs.¹² One such example is a partnership between Synopsys Armenian and SEUA.¹³ As a result of this cooperation a new Synopsys University Program was established that produces more than 60 high quality VLSI and EDA specialists each year. This example along with several others that have recently been introduced in different departments in the State Engineering University of Armenia (SEUA) have already proved that they not only promote university-industry linkages that provide valuable resources to the university but also help students in engineering departments acquire on-the-job experience, which is essential in this sector to provide new hires with the practical skills demanded by employers. In the future, additional cooperative education programs could continue to play a vital role in upgrading engineering curriculum, training methods, research skills, and job training.

1.2 Armenia's Competitive Position in the Global Marketplace

In today's fast-paced, challenging global business environment, countries around the world are struggling to help their businesses carve out positions in various industry sectors and compete successfully against companies in other countries.¹⁴ For example, we see China as a world production center, India as an Information Technology (IT) center, Germany as a center of excellence for automobile manufacturing, Japan as a global supplier of electronics, and the Middle East as a prime supplier of oil and petrochemical products. Each country has already

¹² Source: SEUA, <http://www.seua.am>

¹³ Synopsys University Program, Synopsys Corporation. Retrieved from <http://synopsys.com/Community/UniversityProgram/Pages/default.aspx>

¹⁴ Porter, Michael, "The Competitive Advantage of Nations", Free Press, New York, 1990.

found its niche in the world market and is trying to maintain it through continuous innovation and investments in new technologies and skills.

In Armenia, a small, landlocked country located in the crossroads of Europe and Asia with a population of less than 3 million, it is difficult for local producers in many industries to compete in the global marketplace.¹⁵ The combination of scarce natural resources and high transportation costs makes it almost impossible for companies to compete in many industry segments. Fortunately, Armenia, who had developed strong capabilities during the Soviet era, in science, research and development (R&D), and high tech manufacturing, decided after independence in 1991 to shift the focus of its economy from major manufacturing operations to the software and services segment, which did not require open roads and low transportation costs.

Today, the Armenian IT industry is one of the most dynamic and promising sectors of the economy.¹⁶ In 2006, the share of the sector in Armenia's GDP was 1.3%, which is comparable to that of India (1.4%) and Germany (1.3%). Around 63% of the industry's output is exported to over 20 countries, mainly to the USA, Europe, and the Commonwealth of Independent States (CIS). There are over 160 IT companies in Armenia with a total workforce of over 4,690.

The Armenian IT industry enjoyed spectacular growth during the last 10 years.¹⁷ From 2003 to 2009, the IT industry's contribution to total exports rose from 3.6% to 5.6%, and domestic sales and revenues increased from \$42 million in 2008 to \$59 million in 2009. In 2009, the total workforce in the IT sector reached around 5,200 specialists. Even though there was

¹⁵ *National Competitiveness Report of Armenia*, op.cit., for a analysis of Armenia's competitive position in different industry sectors.

¹⁶ *Armenian Information Technology Industry Report, 2008*, Enterprise Incubator Foundation, Yerevan, Armenia. Retrieved from <http://www.eif.am/files/344/Armenian-IT-Industry-Report-/EIF-ArmenianITIndustryReport-2008-ENG.pdf>

¹⁷ *Evaluation of the Competitive Armenia Private Sector Project (CAPS)*, Management Systems International, Washington, D.C., 2010. Retrieved from http://pdf.usaid.gov/pdf_docs/PDACR145.pdf

strong growth in the IT sector as a whole, the availability of up-to-date, practical IT vocational and university programs is still inadequate in Armenia which have made it difficult to produce engineering graduates with the skill sets and knowledge that companies are seeking to enable them to compete in a rapidly changing global marketplace.¹⁸

1.3 Historical Background of Engineering Education

Historically Armenia's human capital has been one of its best resources.¹⁹ During the Soviet era Armenia's labor force was generally highly educated and well trained, particularly in engineering and technology.²⁰ The country has a long tradition of excellence in science, technology, and education and a high ratio of scientists and engineers in R&D per population. During the period in which Armenia was incorporated as part of the Soviet Union, the country's capabilities were oriented to a significant degree toward supporting the Soviet military-industrial complex. Research activities, as well as education in science and engineering were well financed.²¹ A number of industrial facilities operated throughout the country, providing goods for local consumption and for more distant markets within the Soviet Union. During this period, Armenia was an important center for mechanical engineering and played an important role in the production of machine tools that were exported to more than 50 countries. Armenia's mechanical

¹⁸ *IBID*

¹⁹ *Armenian Information Technology Sector Software and Services 2010 State of Industry Report*, Enterprise Incubator Foundation, Yerevan, Armenia. Retrieved from <http://www.eif.am/files/557/Armenian-IT-Industry-Report-/EIF-ArmenianITIndustryReport-2010-ENG.pdf>

²⁰ Gelbard, E. (2005). *Growth and poverty reduction in Armenia: achievements and challenges*, International Monetary Fund.

²¹ Science, N. R. C. C. o. and T. i. Armenia (2004). *Science and technology in Armenia: toward a knowledge-based economy*, Joseph Henry Pr.

engineering complex employed 24% of the industrial workforce and produced 15% of the country's gross domestic product.²²

Following the collapse of the Soviet Union and the restoration of the independence of the Republic of Armenia in 1991, the engineering sector suffered a dramatic decline as the command economy of which it was a part collapsed and its share of the Soviet defense industry market vanished. With plant closures and dramatic cutbacks in funding for higher education and science, many Armenian researchers and practitioners gave up their technical careers for new sales and business-related jobs.²³

In spite of massive disruptions in the structure of the economy, Armenia has managed to retain strong capabilities in the areas of science and technology education, research, and development.²⁴ Armenia currently has over 75 Science Institutes and R&D Institutes, including the 41 Institutes of the Academy of Science. According to the National Statistic Service, the percent of specialists employed in physical, mathematical and engineering science is 17.9 % of the total workforce. Specialists in the field of physics and engineering constitute 11.9% of the employed population. If the education system were aligned more completely with the rapidly changing needs of industry and the global marketplace, these numbers would be even higher.

²² Enterprise Incubator Foundation (EIF) 2007 Armenian IT Sector - Industry State Retrieved from <http://www.eif-it.com/index.php?page=res&category=1>

²³ *IBID.*

²⁴ *Statistical Yearbook of Armenia 2006.* National Statistical Services, Yerevan, Armenia. Retrieved from www.nss.am

1.4 Problems that Armenian Engineering Education is Facing Today

From a review of recent studies²⁵ on Armenian economic development, it is apparent that there are three main factors that directly affect the quality of engineering education: 1) the extent to which engineering course content and instruction is geared to current market needs, 2) the extent to which teacher education, faculty development, and R&D activities are keeping pace with changing technologies and market requirements, and 3) the nature of connections between universities and companies.

A study of the engineering workforce in Armenia conducted in 2008 indicated that university-level engineering programs are not doing a particularly good job preparing students for jobs with local engineering companies, most of which are low-tech businesses providing manufacturing or production, quality control and repair services to local manufacturing and mining enterprises.²⁶ About a quarter of the 82 companies included in this survey reported that they had vacant engineering positions—190 vacancies in all, or an average of 9 per company. Mechanical and electrical engineers were both in short supply. Managers that were interviewed in this study indicated that they were unable to fill their vacancies because job applicants either lacked the required skills or were uninterested in the type of work offered.²⁷

On the other hand, during this same period university engineering departments were reporting that only 59% of their recent engineering graduates were able to find jobs in their engineering specialties, in spite of the fact that local employers were reporting that they had a

²⁵ Shahverdyan, Anush, The Gap Between Higher Education and Industry, Research article published in the Proceedings of the Seventh Worldwide Forum on Education and Culture, December 2008. Retrieved from <http://web.caps.am/files/anushE.pdf>

²⁶ “Armenian Engineering Workforce Survey”, produced by Ameria CJSC for the USAID-funded Competitive Armenia Private Sector Project, 2008. Retrieved on 9-15-2011 from <http://www.caps.am/data.php/601.DOC>

²⁷ *IBID*, p.4

variety of job openings for which they were unable to find qualified candidates.²⁸ Recent engineering graduates were discovering that the four-year education they had received mainly covered either basic science, theoretical concepts, or outdated technology and had not prepared them with the skills they needed to qualify for existing employment opportunities in their fields of specialization.

The second major problem in higher engineering institutions in Armenia is inadequate staff development and weaknesses in teacher qualifications²⁹ The IT Workforce Assessment conducted by Competitive Armenian Private Sector Project shows that more than 73% of staff members at IT Departments think that the current level of skills and competencies of faculty members need to be improved. In addition, about 77% of surveyed faculty members indicated that the current number of staff is not sufficient and that even more faculty and staff will be needed in the future. Faculty development efforts are exacerbated by difficulties in attracting new faculty members. The deterioration of economic conditions in Armenia in the post-Soviet era forced the government to severely reduce funding to the education sector. This led to reductions in faculty wages as well as limited funding for research programs and facility upgrades. At the same time that employment conditions for existing faculty were deteriorating, new opportunities were opening up for younger professionals trained in technical disciplines to get higher paying jobs with IT companies. Consequently, the incentives to stay and teach at academic institutions rapidly became less attractive³⁰.

²⁸Agency, U.S.A.I.D. (2006). "Information Technologies Workforce Supply Assessment." 2010, from http://caps.am/publications/IT_Workforce_supply_assess.pdf.
IT Workforce Assessment, Report prepared by the Competitive Armenia Private Sector Project, 2007, P. 4.
Retrieved from http://caps.am/index.php?cat_id=203

²⁹ *IBID.*

³⁰ *IBID.* pg. 4

In 2006, the IT workforce supply assessment conducted by the Enterprise Incubator Foundation reported that the average age of faculty members in engineering faculties of the leading Armenian universities was 57.³¹ Younger graduates who had received training in high demand areas such as software programming and application development found that new opportunities were opening up with private IT companies that were offering higher salaries and better opportunities for professional advancement. This combination of low academic wages and aging faculty made it increasingly difficult for Armenian universities to offer the type of training that engineering students need to qualify for jobs in emerging growth sectors, such as providing outsourced engineering services to global customers.³²

The third weakness of Armenia engineering education is the limited number of connections between industry and universities³³. Even though several Armenian universities have developed university-industry partnerships in the IT area in recent years, the engineering departments of these universities have been far less successful thus far in developing similar partnership programs.

Currently, the leading example of a university-industry partnership is the program that has developed involving the State Engineering University of Armenia (SEUA) and a multinational company called Synopsys.³⁴ This program has involved establishing a laboratory in the Interdepartmental Chair of Microelectronic Circuits and Systems to train specialists to carry out both scientific and practical activities in the spheres of computer aided design of modern integrated circuits. This initiative has been helping to train very strong specialists in circuit design. Other examples of university-industry cooperative programs have been established in the

³¹ *IBID* pg. 4

³² EIF Armenian IT Industry Report 2008 pg 34

³³ *The Gap between Higher Education and Industry*, op.cit.

³⁴ Synopsys University Program, Synopsys Corporation. Retrieved from <http://synopsys.com/Community/UniversityProgram/Pages/default.aspx>

IT sector include: a web technologies laboratory established in 2005 by Lycos Europe, the Enterprise Incubator Foundation, and Sourcio at the State Engineering University of Armenia and Yerevan State University (YSU); and a Sun Educational Laboratory formed by Sun Microsystems, EIF, and USAID at SEUA, YSU, and Slavonic in 2008.

Unfortunately, the scope of existing university-industry partnerships is still limited to selected segments of the IT sector. Similar programs have not yet been developed to support university-industry partnerships in the engineering services segment of the IT industry that would provide students with practical, on the job experience in various engineering specialties as part of their academic programs.

1.5 The Potential Role of Cooperative Education in Improving Engineering Education in Armenia

The development of cooperative education programs in Armenia could help solve many of the problems faced by the universities that are providing engineering education. At the same time, these programs could help solve problems facing companies that need to hire skilled engineering professionals with modern IT skills in order to compete in the global marketplace. Cooperative education programs could help by addressing the problem of aligning the educational system with the needs of the local or international marketplace, including providing students with productive work opportunities and supporting staff development and curricula reform through arrangements that enable faculty members to stay abreast of industry developments. Currently the system of engineering universities in Armenia provides students with a strong theoretical foundation in math and science but very little training that prepares them for the requirements of the job market. Developing cooperative education programs will help students during their last years of study to gain more practical experience in different

engineering disciplines directly from the industry rather than just from their studies and laboratory exercises. According to Ricks (1996) cooperative education helps build strong relationships between industry and educational institutions.³⁵ This experience will not only help engineering students gain practical, applied experience in the workplace but will help them obtain jobs upon graduation.

1.6 Research Objective

The objective of this research is to investigate options for improving the system of engineering education in Armenia by applying lessons learned from successful cooperative education models and best practice examples. The research will help answer the following questions:

1. What are the main problems that Armenia is facing in reforming its system of engineering education?
2. What are the benefits of cooperative education to universities, companies, and students that might help address current weaknesses in Armenian engineering education?
3. What defines best practices in cooperative education and what are the most effective models?
4. Are there specific cooperative education programs in the U.S. that provided best practice examples and guidelines that could help leading Armenian engineering education departments such as the State Engineering University of Armenia (SEUA) design and implement effective cooperative education programs?

³⁵ Ricks, F. (1996). Principles for structuring cooperative education programs. *Journal of Cooperative Education*, 31(2), 8

5. What steps should be taken to introduce new cooperative education programs to support educational reform in Armenian universities such as SEUA?

This research provides recommendations for improving the system of engineering education in Armenia based on an analysis of best practices in cooperative education in the US. It provides detailed information on effective models for structuring learning experiences for students engaged in engineering and other technology education programs that will provide them with the types of training and experience that will enable them to prepare more effectively for the requirements of the job market and secure better jobs once they graduate. The outcomes of this research include recommendations for strategies that selected Armenian universities and technical institutes can employ to upgrade their curriculum, facilities, and programs.

1.7 Methodology

The research methodology employed in this study draws upon data derived from several sources, including a focused literature review, an analysis of research data from research studies that the author was involved in designing and managing in Armenia, and case study analyses of cooperative education programs that are based primarily on online program descriptions and evaluations.

The literature review section focuses on studies and publications that examine the historical development of cooperative education programs in the U.S., the reasons they were developed and the problems they were designed to solve, their principal characteristics and how they have evolved, their principal benefits and drawbacks, and current best practices, models, and program designs. It also includes a review of documents that focus on the recent economic history of Armenia, including the changes that have occurred in the engineering industry and the

system of engineering education after the break-up of the Soviet Union and during the past two decades since the country achieved independence.

The research findings of this study also draw upon an analysis of data generated as part of the research agenda of the USAID-funded Competitive Armenian Private Sector Project (CAPS).³⁶ The author worked as part of the CAPS project team from 2006-2008 and during this time helped design and manage the research tasks that were carried out as part of the engineering services component of the CAPS project. The CAPS's studies include data on the historical development and current scope of the engineering industry and engineering educational system in Armenia, including the problems and challenges that Armenian universities are currently facing in rebuilding their engineering and technical educational capabilities. These studies also examine engineering workforce development issues, including challenges that the current engineering education system faces in preparing graduates with the skills, knowledge, and experience needed to meet the demands of the engineering industry in Armenia for skilled professionals and technicians that will enable them to compete in the global marketplace

Finally, the study examines case study examples that provide insights into the organizational and operational practices of leading cooperative education programs in the United States. The analysis focuses on identifying “best practice” examples of how leading U.S. cooperative education programs have structured and implemented their programs to achieve outstanding success with respect to these core performance standards. Based on the findings from this research, recommendations are made on the feasibility of implementing new cooperative education programs in Armenian universities and technical institutes by applying

³⁶Note: See www.caps.am for a description of the CAPS project and publications that were produced under various project components.

lessons learned from U.S. best practice examples derived from the assessment of leading U.S. co-op programs.

2 LITERATURE REVIEW

2.1 The Nature of Cooperative Education

The origins and evolution of engineering cooperative education programs are well documented in the literature on technical education. According to Reeve³⁷, the concept of cooperative education began in the United Kingdom (UK) in the late 1800s, in the United States of America (USA) in 1906 and in Canada in 1957.

The first cooperative education program in the United States was developed at the University of Cincinnati by Herman Schneider. Schneider, who was an engineer, architect, and educator, concluded during his undergraduate studies at Lehigh University that traditional classroom education was not particularly effective for technical students.³⁸ He observed that several of the more successful Lehigh graduates had worked to earn money before graduation. Later on when he joined Lehigh University as an instructor in Civil Engineering, he began to consider how engineering education could be changed to make it more practical. He designed an experimental program that aimed to provide students with an opportunity to learn their craft in a work setting, while also giving them opportunities to earn money to help cover the costs of their studies. In addition, Schneider felt that his program would enable students to make professional contacts

³⁷ Reeve, R.S. (2004), "The internationalization of cooperative education", *International Handbook for Cooperative Education*, edited by R. Coll and C. Eames, Boston, Mass: World Association for Cooperative Education, Inc., 189-206.

³⁸ Smollins John-Pierre, "The Making of the History: Ninety Years of Northeastern Co-op", *Northeastern University Magazine* 24 (5), May 1999, Retrieved on 6-30-2011 from <http://www.northeastern.edu/magazine/9905/history.html>

that could lead to employment opportunities after graduation. Schneider received little support for his ideas at Lehigh University but was later provided with an opportunity to test his program at the University of Cincinnati, where he launched what is now recognized as the earliest cooperative education programs in 1906. His original ideas and basic objectives have remained at the core of cooperative education programs that have subsequently developed in other universities in North America and around the world.

During the initial years after the launch of the Cincinnati program, cooperative education programs spread slowly to other universities. Three years after Schneider started his program at Cincinnati, Professor Hercules W. Geromanos the dean of the Evening Polytechnic School at Northeastern University in Boston, Massachusetts read about the University of Cincinnati's program and became convinced that 'Co-op' was equally applicable to Northeastern students. As a result, he developed a similar program in 1909 in the College of Engineering which subsequently became the second cooperative education program in the country. Within 10 years, the number of students enrolled in the Northeastern University co-op program had grown from 8 to 407 and the Cooperative School of Engineering became the largest school at Northeastern³⁹. Soon a small number of other universities began to develop similar co-op programs for engineering as well as for other programs.

The largest boost for cooperative education programs occurred in 1965 with the passage of the federal Higher Education Act which included a section of the law that provided funding specifically for schools that offered co-op⁴⁰. With the new grants, Northeastern created a Division of Cooperative Education, which consisted of five departments including a Department of Cooperative Education, a Center for Cooperative Education, a Cooperative Education

³⁹ *IBID*,

⁴⁰ *IBID*,

Research Center, a Center for Secondary School Work Experience Education, and a Department of Graduate Placement Services. The Division of Cooperative Education, in addition to managing the co-op program at Northeastern University, served as the focal point for a big expansion of co-op across the country. Northeastern continued to provide a focal point for the development of cooperative education program and by the 1980s had become the acknowledged leader in co-op education across the world.

From this period on, there was a rapid growth of co-op programs across the U.S. Within two years after the passage of the federal Higher Education Act, over 100 universities around the country were taking advantage of federal grant funds to launch their own cooperative education programs.⁴¹ By 1980 the number of private and public colleges and universities that were offering cooperative education programs had grown to over 1000 with total student enrollments in such programs exceeding 200,000.

From these early beginnings, cooperative education programs have spread around the world⁴². They have been adopted not only by engineering and technology related programs but by business schools and a wider variety of other colleges and disciplines. At the present time, we can find various types of cooperative education programs throughout North America and Europe, as well as in a diverse array of countries such as Japan, Australia, Canada, China (Hong Kong), the Philippines, and South Africa. According to one researcher, by 2004 cooperative education programs were being carried out in more than 60 countries around the world.

⁴¹Wright, Claire B., "Developing a Comprehensive Cooperative Education Program: Strategic Planning Stages", National Commission for Cooperative Education, Boston, Massachusetts, 1980.

⁴²Reeve, R.S., *op.cit.*

2.2 Objectives and Definitions

The original objective of cooperative education programs was to provide opportunities for students to combine their studies with on-the-job experience. In addition to this continuing emphasis on gaining practical work experience, thinking about the value of cooperative education has begun to place increased importance on the role of “experiential learning” as a vital part of the educational process.

A shared definition of cooperative education that includes a statement of the essential characteristics of a cooperative education model has been proposed by a national committee of experienced practitioners made up of representatives of the National Commission for Cooperative Education, Cooperative Education Association and the Cooperative Education Division of the American Society for Engineering Education⁴³. As defined by the members of this committee,

“Cooperative education is a structured educational strategy integrating classroom studies with learning through productive work experiences in a field related to a student's academic or career goals. It provides progressive experiences in integrating theory and practice. Co-op is a partnership among students, educational institutions and employers, with specified responsibilities for each party.”

According to Groenewald, “cooperative education can solve four core main problems: (a) an integrated curriculum, (b) learning derived from work experience, (c) cultivation of a support base, and (d) the logistical organization and coordination of the learning experience”.⁴⁴ The four components refer to developing a curriculum which integrates the needs of industry with academic requirements.

Although cooperative education programs may share these basic components, universities that have developed programs exhibit many variations in their structure and operations. As part

⁴³ *The Cooperative Education Model*, National Commission for Cooperative Education. Retrieved on June 12, 2010 from <http://www.co-op.edu/aboutcoop2.html#definition>

⁴⁴ Groenewald, *Towards a Definition for Cooperative Education*, 2004, p. 24.

of a cooperative program between universities and companies, students may be offered opportunities for summer internships, which provide structured work experiences that enable students to apply the knowledge they have gained in their university studies to actual work requirements. In other cases, students may have opportunities to participate in work-study programs, in which case they may work part time in a job that is relevant to their field of study and receive university credit for the time worked. Still another common type of cooperative education program involves joint R&D efforts between a company and a university department. These types of cooperative programs provide students opportunities to participate in research and development activities as part of their program of study, under the supervision of a faculty member or a technical person from the company sponsoring the joint R&D program.

Whatever the specific form a cooperative education program takes, the end objective is the same – to enable students to combine their studies with practical work experience so they understand how the theoretical concepts they are learning in the classroom relate to real-world problems and thus help them be better prepared for the requirements of the job market. As cooperative education programs have developed, educators have begun to recognize that they provide an important channel for “experiential learning”. In other words, co-op programs are not simply a way to provide students with an introduction to the real world of work; they are a means of integrating their coursework with real-world applications and blending theory with practical application of engineering concepts.

2.3 The Benefits for Universities

The benefits of cooperative education programs for universities are many, including improved ability to attract and recruit students, financial support from industry, and staff development and research opportunities. Weisz discussed the economic benefits of cooperative

education for recruiting students and attracting funding⁴⁵. This study, involving 71 graduates, showed that 72% of students of non-cooperative graduates would have chosen to undertake a cooperative degree. Coll (2001) showed an increase of student recruitment by including industry visits in student recruitment programs⁴⁶.

Another benefit of cooperative education is increased opportunities for staff development. Through cooperative programs staff can stay in touch with the rapid changes occurring in industry. These programs create opportunities for faculty members to carry on collaborative research with companies. And not a least important benefit is that these relations help to align the curricula with the needs of both students and employers⁴⁷.

Curriculum development is the other benefit of cooperative education. It is very important for academic institutions to keep up with changing technology developments and market demand in the engineering industry and close cooperation with companies is the best way for universities to stay current and relevant. This cooperation can be achieved through different strategies such as organization of a joint venture between a university and a company to upgrade training facilities development of joint departmental training courses⁴⁸, and finally interaction between academic supervisors and technical staff of companies⁴⁹.

⁴⁵ Weisz, M., Chapman, R. (2004) Benefits of cooperative education for educational institutions. *In International handbook for cooperative education* (pp. 247 – 260). Hamilton, New Zealand: University of Waikato.

⁴⁶ Coll, R. K., & Lay, M. (2001). Using trial interviews to enhance student self-efficacy towards pre-placement interviews. *Journal of Cooperative Education*, 36(3), 25-36.

⁴⁷ Cates, C.L., & Jones, P. (1999). *Learning outcomes: The educational value of cooperative education*. Columbia, MD.: Cooperative Education Association.

⁴⁸ McRae, N. (1996). Curriculum on the Internet. *In Proceedings of the Second Pacific Conference on Cooperative Education* (pp. 436-442). Melbourne: Austrian Cooperative Education Society.

⁴⁹ Faraday, D. (1999, July). *Integration of personal and professional development into cooperative education*. Paper presented at the 11th World Conference on Cooperative Education. Washington, DC. World Association for Cooperative Education

2.4 The Benefits for Students

Cooperative education programs not only benefit the university, they also provide many benefits for students. Mostly, the benefits are in two areas: increased opportunities to gain practical on-the-job work experience that enable students to apply their studies to real-world problems and investigate different career options; and improved career prospects after graduation more job opportunities and higher pay.

Wilson offered a review of the research of the previous 25 years based on which he revealed that cooperative education helps participants to 1) set and clarify realistic career goals, 2) continue progress toward graduation, 3) achieve better academic results, partially due to the increased motivation from seeing the connection with studies and requirements of the workplace, 4) increase self-confidence, gain knowledge about work, develop realistic expectations, and acquire information about career and job seeking skills, and 5) command higher salaries⁵⁰.

2.5 Standards for Effective Cooperative Education Programs

For cooperative education programs to be highly successful in meeting the objectives of students, universities, and companies, they need to be carefully structured as well as competently managed. Although cooperative education programs that are being implemented in the United States and some other countries share many common features, upon closer examination it is evident that they also exhibit significant differences. Notwithstanding, for cooperative education programs to be considered *highly successful*, they should comply with the core set of

⁵⁰ Wilson, J. W. (1989). *Assessing outcomes of cooperative education*. *Journal of Cooperative Education*, 25(2), 38-45.

performance standards outlined by the Accreditation Council for Cooperative Education (ACCE)⁵¹.

ACCE is an independent organization founded by representatives of some of the leading U.S. cooperative education programs. They have developed a set of five standards that should be used to guide the design and implementation of cooperative education programs. These five standards define the necessary requirements that cooperative education programs must meet to be accredited by ACCE. The ACCE accreditation standards focus on program design and performance in the following five areas:

1. Mission and Goals
2. Institutional Relationships
3. Employers and External Partners
4. Learning Environment
5. Learning Outcomes and Program Effectiveness

2.5.1 Standard One: Mission and Goals

Effective cooperative education programs should have clearly defined goals and program objectives. Mission statements and goals should describe the program's practices and policies, and provide a basis for evaluating program performance. The statement of program goals should describe the expected outcomes and what participants should expect as a result of their participation. The statement of mission and goals should be developed through a collaborative process that ensures the commitment of administrators, faculty, business partners, and students. The program should be periodically evaluated and approved by the host institution, publicized to

⁵¹ See ACCE website at <http://www.co-opaccreditation.org/criteria.htm>

constituents and made readily available to potential participants, and aligned with the host institutions missions and goals⁵².

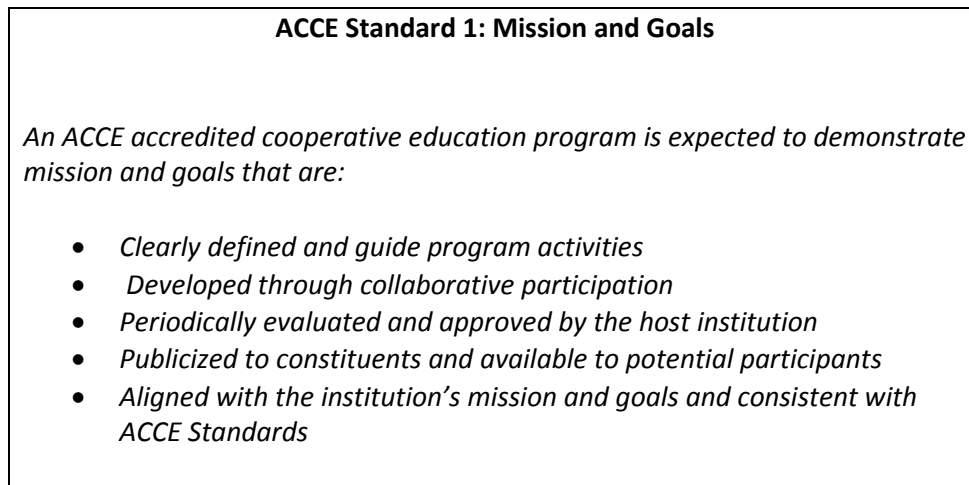


Figure 2-1: ACCE Standard 1: Mission and Goals

2.5.2 Standard Two: Institutional Relationships

The standard that defines institutional relationships requires that the university has clearly determined that cooperative education will be an integral part of the academic program and has implemented policies and practices appropriate to the achievement of program mission and goals. This includes defining how the program will be managed, how it relates to other normal course requirements and research activities, the key roles that faculty members will play, and how cooperative relationships with companies and other partners will be developed and managed.

These specific elements for this standard that are listed on the ACCE website are as follows:

⁵² ACCE, *op.cit.*

ACCE Standard 2: Institutional Relationships⁵³

- *How effectively the program is integrated into the academic and administrative culture, policy, and practices of the institution*
- *How the academic nature of the program is ensured including the awarding of academic credit*
- *Effective role of faculty in program support, endorsement, development, and evaluation*
- *Finances, staffing, and administrative processes that are sufficient to achieve program mission and goals*
- *Qualified professionals to lead the program and to carry out program goals*
- *Ethical standards that govern behavior of all program participants are established, communicated, and periodically reviewed*
- *Processes used to periodically evaluate program effectiveness*

Figure 2-2: ACCE Standard 1: Mission and Goals

2.5.3 Standard Three: Employers

The ACCE standard relating to employers that are selected as partners in a coop program requires that

“The program effectively selects, prepares, engages and monitors employers so that students achieve learning outcomes consistent with program goals. In addition, employers are included in periodic reviews of program effectiveness.”⁵⁴

Employers are expected to provide high quality cooperative education work assignments to students. There should be effective communication between employers and the students' faculty advisors. Employers should offer job assignments that provide productive learning experiences through different work assignments. They should provide scope for creative efforts and contributions by students and not just include mundane tasks that no one else wants to do. Also, employers, in partnership with faculty members, should be actively involved in supervising and evaluating student performance and providing feedback regarding program effectiveness.

⁵³ ACCE website, op.cit.

⁵⁴ *IBID.*

2.5.4 Standard Four: Student Learning Environment

The ACCE standard requires that the cooperative education program provide students with a productive learning environment. Educational institutions and industry partners should be able to demonstrate that the program provides “an environment at employer locations that supports the achievement of student learning outcomes”, as well as offering “a student learning and development focused approach guides preparation, reflection, and monitoring activities”⁵⁵. In other words, programs that meet this standard should provide excellent opportunities for “experiential learning” which will not only benefit a student during his university years but help him acquire the capacity to continue to learn from solving problems throughout his career and lifetime.

2.5.5 Standard Five: Student Learning Outcomes and Program Effectiveness

Since the principal objective of cooperative education is to provide participants with a superior learning experience and excellent career preparation, good programs are expected by the ACCE to be able to demonstrate

*“the effective use of a student learning assessment process for each work term and a cumulative one at the end of the student’s participation”, in addition to “an assessment process that evaluates its overall effectiveness and its impact on its constituencies”.*⁵⁶

2.6 Cooperative Education in Developing Economies

Although, cooperative education is growing rapidly in higher education institutions in the US, Canada and Europe, in developing countries efforts in this area are still in the beginning stages. The implementation of cooperative education in developing countries has its own specific

⁵⁵ *IBID.*

⁵⁶ *IBID.*

challenges caused by large populations, less industrialized areas, and poorly schooled students⁵⁷. Tailor describes the specific challenges that have been faced during the implementation of a cooperative education model in two developing countries, Thailand and South Africa⁵⁸. According to this study, Suranaree University of Technology in Thailand has been able to establish close collaboration with the local industry. In contrast to Thailand, in South Africa new legislation is needed that will require technikons (local technical universities) to resolve employment issues with their employers. At the end the author recommends that higher education institutions in developing countries need support from companies in developed countries to better explore international work and study opportunities.

2.7 Cooperative Education in Armenia

Armenia is in the very early stages of developing cooperative education programs. However, there are two programs that have provided encouraging examples of how such programs could contribute to reforming and upgrading the system of technical education in Armenia.

On December 1, 2004, Synopsys Corporation, one of the world's leading producers of micro-chip design software developed a cooperation agreement with the Chair (college) of the State Engineering University of Armenia (SEUA). Through this agreement, SEUA became a member of the Synopsys Worldwide University Program. The aim of this cooperative education program is to train highly qualified specialists in the field of chip design who will meet the specific requirements of semiconductor and IT companies. To support this effort Synopsys

⁵⁷ Srisa-an, W. (2002). An investigation into the possibility of a growing trend in cooperative education: 'Reverse Cooperative Education'. *Asia-Pacific Journal of Cooperative Education*, 3(2), 45-52.

⁵⁸ Tailor, S. (2004). *Cooperative education in emerging economies, in International handbook for cooperative education* (pp. 207 – 216). Hamilton, New Zealand: University of Waikato.

established a computer laboratory at SEUA and donated several hundred engineering software tool packages to the university. Under this program, top-performing students from the Computer Science and Informatics, Cybernetics, and Radio Electronics Departments who have completed 4-5 semesters of general studies are selected to continue their education in the Synopsys Armenia Educational Department (SAED) program. Studies are carried out in specially-equipped classrooms donated by Synopsys (located in both the Synopsys Armenia campus and the university) where each student has access to the latest engineering software tools via the network. Course curricula, instruction, course projects, and Master theses and PhD dissertations are targeted toward real industry projects at Synopsys Armenia, which are completed jointly with leading professionals from Synopsys and experienced professors from the university.

According to the Executive Director of Synopsys-Armenia, Hovik Musaelyan, 55 percent of the cooperative program's graduates are currently employed in Synopsys's Armenian operations, where they comprise 30 percent of the company's local workforce⁵⁹. This cooperative education program has been a big boost to Armenia's education system. It has helped SEUA update its curriculum and teaching methods, and provided the university with new laboratory facilities and software. The total investment that Synopsys has made in money, tools, facilities, and staff time is now approximately \$100 million, a level of funding that SEUA and the Armenian Government would not have been able to provide out of their own resources. Besides these benefits, this program has enabled the university to prepare highly qualified graduates who meet the requirements of semiconductor industry, and thus has contributed significantly to the growth of the IT industry in Armenia.

⁵⁹ Synopsys Corporation. Synopsys University Program. Retrieved from <http://synopsys.com/Community/UniversityProgram/Pages/default.aspx>

From 2008, another company, Cambric Corporation has been working with the State Engineering University to provide training in 3-D CAD software applications⁶⁰. This program has helped create 30 new jobs in a branch office that Cambric subsequently established in Armenia. This program, like the Synopsys program, is exposing students to new engineering technologies, as well as providing them with the practical skills they need to work for international companies.

⁶⁰ CAPS (2009) Workforce Development Incentives For International Engineering Companies. Retrieved from http://caps.am/index.php?cat_id=212

3 ASSESSING COOPERATIVE EDUCATION BEST PRACTICES

The assessment of cooperative education best practices in this section analyzes how some of the more successful programs performed with respect to the core set of quality standards that have been developed by organizations such as the Accreditation Council for Cooperative Education (ACCE). This approach makes it possible to identify best practice examples of how some of the leading cooperative education programs have performed with respect to certain agreed upon performance standards and how they have addressed the particular problems related to these various standards. By investigating and analyzing best practice examples in this way, the study aims to develop an information base of best practice examples and principles that could serve as guidelines to Armenian educational leaders seeking to develop new cooperative education programs.

To identify best practices related to the management and implementation of cooperative education programs, this study focused first on identifying programs that have been consistently acknowledged as being among the most effective and highest ranked programs in the United States. To select a manageable number of top-ranked programs, the study drew upon the university rankings compiled annually by the US News and World Report from 2002 to 2011. The US News and World Report “Best Colleges Guide – Internships and Co-op programs” typically includes from 12-18 colleges with programs that are judged to be the best in the nation. By examining the frequency that different programs are included in these annual lists, it was

possible to identify the programs that were consistently included in the top ranked “Internships and Co-op programs” list over the past 10 years.

The following table lists the cooperative education programs that were included in the US News and World Report rankings for the past four years.

Table 1: Top-ranked University Co-op Programs 2008-2011

<i>College/University</i>	<i>2008</i>	<i>2009</i>	<i>2010</i>	<i>2011</i>	<i>Total Number of Years</i>
Alverno College	•	•	•	•	4
Berea College	•	•	•	•	4
Bradley University			•	•	2
Calvin College				•	1
Drexel University	•	•	•	•	4
Elon University	•	•	•	•	4
Georgia Institute of Technology	•	•	•	•	4
Johnson and Wales			•		1
Harvey Mudd College	•				1
Kalamazoo College					
Kettering University	•	•	•		3
Keuka College			•		1
Massachusetts Institute of Technology	•	•			2
New York University		•	•		2
Northeastern University	•	•	•	•	4
Portland State University		•	•	•	3
Purdue University	•	•	•	•	4
Rochester Institute of Technology	•	•	•	•	4

Table 1, Continued

<i>College/University</i>	<i>2008</i>	<i>2009</i>	<i>2010</i>	<i>2011</i>	<i>Total Number of Years</i>
University of Cincinnati	•	•	•	•	4
University of Maryland			•		1
University of Southern California			•	•	2
Wagner College				•	1
Worcester Polytechnic Institute		•		•	2

After reviewing the U.S. News cooperative education program rankings, the nine programs that were included in each year's rankings for the past four years were selected for further study. A review of the university websites and other online program descriptions of the cooperative education programs of these nine universities was carried out; from this review six programs that provided the most complete online descriptions and documentation of the organizational and operational features of their programs were selected for further analysis. The following table provides a brief summary of the six universities that were selected for more detailed analysis of their cooperative education and experiential learning programs.

The features of these six programs were analyzed in more detail to identify specific organizational and operational features that help account for their success. This analysis made it possible to identify specific "best practices" that have enabled these programs to consistently excel in meeting ACCE performance standards and achieve widespread recognition as the leading top cooperative education programs in the country.

Table 2: Top-Ranked Co-op Programs

- Northeastern University⁶¹ is private university that is the home of the largest and second-oldest cooperative education program in the United States. More than 6,000 Northeastern students are on co-op during some part of each academic year. Students have the option of pursuing up to three co-op experiences. A student graduating from Northeastern with a 5-year bachelor's degree has a total of 18 months of internship experience with up to three different companies. Over 2100 employers participate in the Northeastern University co-op program.
- The University of Cincinnati -- The co-op program at the University of Cincinnati is the oldest such program in the United States. UC has the largest public co-op program in the U.S and the second longest employer list of any program in the nation. On average, UC has 5000 placements with 1800 companies worldwide each year.
- Rochester Institute of Technology was among the first universities to begin cooperative education back in 1912. Today RIT's program is the fourth-oldest program in the United States. It is also the fifth-largest in the nation, with approximately 3,500 students completing a co-op each year at over 2,000 businesses.
- Georgia Institute of Technology, like RIT, launched its cooperative education program in 1912. It is the fourth-oldest and the largest optional co-op program in the United States and has perennially been ranked among the "Top Ten" co-op programs in America.
- Drexel University has been a pioneer in cooperative education since 1919 and continues to operate one of the largest cooperative education programs in the nation. Over 1,500 businesses, as well as industrial, governmental, and other institutions “cooperate” with Drexel in offering students the opportunity to acquire practical experience in employment related to college studies.
- Purdue University—Purdue’s Professional Practice Programs are designed to combine practical on-the-job experiences with the classroom training of a four-year college curriculum. Purdue’s program serves about 800 students and 650 employers from private industry and government agencies.

3.1 Learning from Best Practices Examples

The ACCE quality standards discussed in the literature review define the core features of effective cooperative education programs that qualify for ACCE accreditation. They offer a useful framework for universities that are designing or implementing new cooperative education programs. This section focuses on identifying “best practices” that enable universities to excel in meeting the core standards outlined above. This analysis aims to provide a better understanding of program features that would be applicable to the Armenian situation.

⁶¹ Northeastern was ranked #1 by the Princeton Review for "Best Internships/Career Services" for 2008, 2009, 2010, and 2011.

3.1.1 Standard 1: Mission and Goals

Meeting this ACCE standard requires an educational institution to formulate a clear statement of the vision, mission, goals, and objectives of their program. In addition, the university must demonstrate that it places a high value on providing students with superior experiential learning opportunities and linking these job opportunities with their coursework.

Best Practice Example: University of Cincinnati (UC)--The University of Cincinnati (UC) cooperative education program provides a best practice example of a program that operates with a clearly defined mission statement and excels as an example of what is needed to comply with Standard 1 for ACCE accreditation. The following table contains the mission and vision statement for the Division of Professional Practice that is published on the University of Cincinnati's Cooperative Education website⁶²:

The University of Cincinnati's cooperative education program stands out in terms of the emphasis the university has placed on the program, the effort that has gone into defining its mission and objectives, and the clear and comprehensive way the program is organized and managed.

One of the special features of the UC cooperative education program that stands out is the clear and prominent manner in which they describe and promote their program. Descriptions of some university cooperative education programs are hidden in different sections of their websites and contain only vague information about the types of cooperative education programs they offer, their goals and objectives, their structure, how they operate, the types of services they provide, and the concrete advantages they offer to students and employers. Moreover, most of these program descriptions reveal very little about how students participating in a cooperative

⁶² University of Cincinnati Division of Professional Practices website, retrieved on 5-20-2011 from <http://www.uc.edu/propractice/uccoop/employers/mission.html>

education program will relate to their academic supervisors and professors, and how the cooperative education program relates to the teaching and learning strategies the university is offering.

Mission:

“The mission of the Division of Professional Practice at UC is to provide a premier global academic program of cooperative education. Through cooperative education the professional world partners with the university to integrate theory and practice. Supporting the university’s mission, cooperative education extends student learning beyond the classroom providing an enhanced educational experience which includes paid, discipline-related work experience to further students’ career preparation. While students are gaining practical experience in their chosen field, they acquire an understanding of the world of work, integrate theory and practice, and have the opportunity to further develop professional and interpersonal skills.”

Vision:

The Division of Professional Practice is comprised of a dedicated group of individuals, including a multidisciplinary faculty, staff and administrators who are committed to:

- *Leading and innovating in the discipline of cooperative education.*
- *Developing the curriculum and teaching methodologies to enhance the integration of classroom learning with practical work-related experiences.*
- *Creating mutually beneficial partnerships with employers, the community, alumni, academic departments, other universities and professional organizations.*

Figure 3-1: University of Cincinnati (UC) Division of Professional Practice Mission Statement

The UC description for their cooperative education program is laid out prominently and clearly on their website. It clearly describes the mission and objectives of the program, as well as the programs scope, relationships to the overall degree program a student is pursuing, scheduling of cooperative education activities, what students and employers can expect by participating in the program, how faculty members are involved, and the advantages the program offers for improved learning outcomes, career preparation, and job prospects.

There are many other universities in the U.S. and Canada that have excellent cooperative education programs, including some that feature cooperative education programs as part of the distinguishing features of their institution. Features of these programs and overall program descriptions are typically described in detail on their university websites. However, in spite of having extensive descriptions of their programs, including special sections for students, employers, and faculty, many otherwise excellent program descriptions lack clear statements of the vision, values, mission, and objectives of their programs.

As programs grow and become more complex, universities sometimes are forced to pause and reflect on the core mission and objectives of their cooperative education programs and engage in periodic strategic planning efforts to evaluate and reformulate their mission statements. The University of Waterloo in Waterloo, Canada provides an excellent illustration of this need. Even though this university is widely recognized as having one of the premier co-op education systems in Canada, which serves as a model for more than 100 universities throughout Canada⁶³, they came to a conclusion as part of their 2005 review that the “CECS (Cooperative Education and Career Services) should develop a clear mission statement to define its roles and functions, define clearly its relationships with partners, and determine criteria and indicators to monitor its success in achieving them.”⁶⁴

3.1.2 Standard 2: Institutional Relationships

The various elements that need to be considered as part of the “Institutional Relationships” standard include the core variables that determine whether or not a cooperative education

⁶³ University of Waterloo Cooperative Education and Career Services website, retrieved from <http://coopuwaterloo.ca/about>

⁶⁴ Learning for Experience: Enhancing Co-operative Education and Career Services at the University of Waterloo”, UW Review Committee for Co-operative Education and Career Services, University of Waterloo, Waterloo Canada, 2005. Retrieved on 3-22-2011 from <http://secretariat.uwaterloo.ca/OfficialDocuments/CECSReport.pdf>

program will perform effectively. Complying with this standard requires a university to clearly demonstrate that it has made a firm decision that cooperative education will be an integral part of its academic program and has been successful in implementing policies, management practices, and institutional arrangements that are required to achieve the mission and goals that have been defined for the program. The task of establishing an effective structure for managing the cooperative education program requires universities to make critical choices that directly affect the focus and effectiveness of the program.

The high degree of recognition that all of the six programs listed above have achieved is directly related to their success in establishing highly effective institutional relationships and management systems to maintain their focus on the goals and objectives the programs were designed to achieve and deal with the ongoing and evolving operational challenges that need to be met to ensure continuing success. In effect, all of these six programs could be considered to be “best practice” examples of success in developing and maintaining highly effective “institutional relationships”. Nevertheless, it is useful to highlight particular practices and achievements that could be considered to be among the “best of the best” practices with respect to the Institutional Relationships standard.

The first requirement for excelling in the “Institutional Relationships” standard requires that a university clearly demonstrates that it has made a firm decision that cooperative education will be an integral part of its academic program, and that their cooperative education programs are effectively integrated into the academic and administrative culture, policy, and practices of the institution. Evidence of the degree to which coop programs are emphasized and integrated into the overall academic programs of particular universities can be assessed by examining the manner in which universities communicate their commitment to such programs in their various

promotional materials and program descriptions. Examining the university's website provides a convenient way of assessing this level of commitment, since websites are increasingly becoming a principal channel for disseminating information about the university's mission, programs, and academic requirements. Universities that consider cooperative education and experiential learning programs to be a central part of what they are about would promote the visibility of their programs by 1) including a prominent link on the home page of the university website to their coop program, and 2) maintaining a comprehensive website that fully describes the nature, operations, and requirements of their cooperative education activities.

Table 3 illustrates how the six universities cited above highlight the importance of their cooperative education programs in their university websites. All six of these universities maintain websites that offer full descriptions of their cooperative education and experiential learning programs and show how these programs are "*effectively integrated into the academic and administrative culture, policy, and practices of the institution*". Although it is difficult to pick out one particular website as a best practice example, the Purdue University Professional Practice (cooperative education) Program website provides a particularly good example of a program website that fully demonstrates the commitment of the university to cooperative education and the institutional relationships that have been established to implement their cooperative education program. The Northeastern University website also clearly demonstrates the features and requirements of their program, their focus on experiential learning, and the benefits it has provided to program participants over the years that it has been operating.

Table 3: Descriptions of Cooperative Education Programs in University Websites

<i>College/University</i>	<i>College/University Cooperative Education Website Content</i>
Drexel University	Detailed description of cooperative education program and career services. Separate sections that provide information for students, faculty, and employers.
Georgia Technology University	Description of co-op programs managed by the Division of Professional Practices, Undergraduate Cooperative Education, Graduate Cooperative Education, Georgia Technology Internship Program (GTIP) , and Work Abroad Programs. Undergraduate Cooperative Education section contains program descriptions, application requirements, schedules, staff profiles, and detailed information for students and employers.
Northeastern University	Complete description of its program structure and requirements for participation. Sections for students, employers, parents, and alumni that describe how the coop program works, areas of study, core requirements, outcomes, and quick facts. Link to a downloadable student handbook. Section on the website that contains accounts of some of the personal reflections on NE University graduates about their co-op experiences.
Purdue University	Excellent description of the various coop programs that are offered, along with requirements, application procedures, and schedules. Special sections for students, employers, parents, and coordinators. Section on co-op opportunities and global and domestic internships. Links to newsletters and other relevant program information.
Rochester Institute of Technology	Detailed description of RIT's cooperative education programs. Information for students, alumni, employers, and visitors. Login for faculty and staff.
University of Cincinnati	Extensive information about UC's programs that emphasize experiential learning, including the Cooperative Education Program, Academic Internship Program, Center for Cooperative Education Research and Innovation, and Center for Service Learning and Civic Engagement. The Cooperative Education section provides detailed information about co-op programs for students, faculty, and employers.

Although a website may help a university highlight its commitment to cooperative education and experiential learning, excelling with respect to the “Institutional Relationships” standard requires a university to have effective management systems and operating policies. The universities included above on our “top-ranked programs” listing have committed financial and staff resources to establish special departments, divisions, or offices that are devoted to

supporting and managing cooperative education programs. The specific types of administrative structures that these universities have established to support their top-ranked cooperative education programs are summarized in the following table:

Table 4: Management of Cooperative Education at the Universities Sponsoring Top-Ranked Programs

<i>College/University</i>	<i>Office/Division Responsible for Co-Op/Experiential Education Program Management</i>	<i>Functions</i>
Drexel University	Steinbright Career Development Center (SCDC)	Works to ensure that students and alumni get the most from their experiential and career placement activities; conducts course to prepare students for co-op; helps students search for and secure co-op assignments; conducts.
Georgia Technology University	Division of Professional Practice -- includes four programs: Undergraduate Cooperative Education (Co-op); Georgia Technology Internship Program (GTIP); Graduate Cooperative Education (Grad Co-op); and Work Abroad	Provides overall management support for an integrated program of career development and experiential learning activities, including co-op, internships, study abroad programs, etc. Manages central support for employer relationships, business partnerships, marketing, communications, and program evaluation.
Northeastern University	The Central Co-op Office serves as the focal point for university-wide activities related to cooperative education Departmental Co-op Programs -- each of the University's seven colleges has its own co-op program, enabling each to tailor /the program to the needs of the students in that particular college Office of International Co-op (operates under the direction of Central Co-op)	Establishes policies and procedures for co-op programs. Manages employer relations, marketing and communications of co-op, and data analysis. A network of co-op coordinators within each college support students in preparing for and succeeding on their co-ops Individual department co-op managers assign faculty advisors and co-op coordinators to help students secure co-op assignments, monitor and evaluate co-op assignments and overall learning performance. Expands co-op opportunities for student in areas of the world outside of the United States. Responsibility include developing such opportunities and preparing students for international co-op.
Purdue University	Office of Professional Practice	Facilitates the experiential practical education of Purdue University students by overseeing development of co-op program and policies; assists the traditional academic units develop and manage co-op assignments with employer host organizations.; coordinates employer relations activities with faculty coordinators who screen potential employers to assure quality job assignments and refer interested students for job interviews.
Rochester Institute of Technology	Office of Cooperative Education and Career Services	Develops and manages partnerships with employers; hosts employer visits; manages co-op placement events and career fairs; oversees activities of program coordinators, assistants, and associate directors who are aligned with particular academic programs; promotes co-op program.
University of Cincinnati	Division/Professional Practice (Includes the Cooperative Education Program, the Academic Internship Program, the Center for Cooperative Education Research and Innovation, and the Center for Service Learning and Civic Engagement)	Division/Professional Practice establishes policies and procedures and provides management support for an integrated set of experiential learning programs, including co-op, internships, research, and civic engagement. Manages employer partnerships, marketing and communications, and program evaluation.

Another basic requirement for meeting the “Institutional Relationships” standard involves evaluating the nature and extent of academic faculty involvement in the program. This decision is directly related to the purposes of the cooperative education program and the learning philosophy upon which the cooperative education program is based. For example, if the learning philosophy is based on a clear recognition of the value of experiential learning, the program will

take steps to ensure that academic faculty members are actively involved in the cooperative education program. This involvement will include such activities as helping students identify cooperative education assignments, supervising students during the course of their assignments, interacting with company sponsors to help structure productive cooperative education assignments and get feedback on student performance, and assessing company needs and changing industry trends in order to ensure that the teaching curriculum and research activities are closely aligned with these evolving needs and are keeping pace with technology developments.

Northeastern and the University of Cincinnati are universities that offer best practice examples of meeting this aspect of the “Institutional Relationships” standard—faculty involvement. Students involved in cooperative education programs at both universities have faculty advisors that work with them to provide overall guidance for their academic program, including integrating course work with co-op assignments. In addition, they appoint cooperative education coordinators that help students identify cooperative education opportunities, submit applications, and prepare for job assignments. Both coordinators and advisors work together to integrate the classroom and cooperative education experience. Faculty advisors and coordinators that participate in the various cooperative education programs supported by these universities recognize that they are making a commitment to providing students with experiential learning opportunities and operating in an environment where practical applications of knowledge are highly valued and where the core values of the university fully support the commitment to

working with students to maximize the benefits from experiential learning derived from on-the-job experience⁶⁵.

Northeastern University provides a particularly useful model for structuring its institutional relationships for its cooperative education program. Northeastern University's century-old cooperative education program is decentralized; each of the University's seven colleges has its own cooperative education program, enabling each to tailor the program to the needs of the students in that particular college. Cooperative education programs are closely integrated with course curriculum, scheduling, and the university's advising system. A network of cooperative education coordinators within each college helps students prepare for and succeed on their cooperative education programs. The institutional structure for Northeastern's cooperative education program also includes a Central Cooperative education office that coordinates and supports departmental cooperative education programs and serves as the focal point for university-wide activities related to cooperative education, including employer relations, marketing and communications of cooperative education, and data analysis.

3.1.3 Standard 3: Employers

The ACCE standard relating to selecting employers to participate in the cooperative education programs requires that *“the program effectively selects, prepares, engages and monitors employers so that students achieve learning outcomes consistent with program goals.”*

Establishing mutually advantageous university-industry partnerships is a critical requirement for a successful cooperative education program. Simply having a list of companies that agree to

⁶⁵ Note: Some studies of cooperative education programs have noted that experiential activities are not necessarily rewarded in many post-secondary promotion and tenure systems (except in certain extenuating situations), and co-op faculty may be isolated from other faculty (Crow 1997; Schaafsma 1996).

provide internship opportunities or part-time work-study assignments to students does not provide a sufficient basis for developing an effective cooperative education education program.

The success that all of the top-ranked cooperative education programs that selected for this study have achieved over the years is due in great part to the efforts that program administrators have invested in developing mutually beneficial partnerships with large numbers of companies that have been willing to provide meaningful cooperative education assignments for students, in addition to engaging university faculty and departments in other related activities, such as joint R&D activities, development of new course curricula, and sharing of software, equipment, and facilities.

Best Practice Example: Purdue University: Purdue University has developed an effective system for systematically recruiting, selecting, preparing, engaging, and monitoring employers to serve as partners in the university's professional practice (cooperative education) program. Although Purdue's professional practice program has been established more recently than the other programs included on the "Top-Ranked Co-op Programs" list included in Table 1 above and includes partnerships with fewer employers than the longer-established programs on this list, the program has developed effective procedures for developing and maintaining strong relationships with employers and soliciting their active participation in Purdue's cooperative education program.

Recruiting and selecting employers -- Activities related to recruiting and selecting employers to participate in Purdue's cooperative education program are managed by the Office of Professional Practice (OPP). The employer relations staff of the OPP actively participates in various professional networking events and conducts regular marketing and outreach campaign

to advertise the university's professional practice program and promote the advantages to employers becoming an active partner in Purdue's cooperative education program.

To participate as partners in Purdue's cooperative education program, companies must first complete the Purdue Co-op employer accreditation process. The accreditation process requires employers to take a long-term view regarding their participation in the cooperative education program and make a commitment to abiding by the terms and conditions that the university has set for employers that are interested in hosting students for cooperative education assignments⁶⁶. These requirements include following university program guidelines for structuring co-op assignments, supervising students, and evaluating performance. Failure to follow the program guidelines will disqualify the employer for future participation in the cooperative education program, although they will still be encouraged to offer internships and participate actively in other recruitment activities. Once companies complete the employer accreditation process, they are authorized to begin offering cooperative education assignments and participating in various student recruitment events such as the annual Cooperative Education Days event⁶⁷.

Preparing employers – The Cooperative Education Program Employer's Handbook provides detailed information about the roles and responsibilities of employers that are participating as partners in the Purdue Co-Op program. The Handbook contains a full set of instructions for

⁶⁶ Note: Specific requirements for accreditation include: "submitting an outline of a typical work program for the initial discipline in which the employer wishes to recruit. This typical work program description will be approved by the appropriate Faculty Coordinator(s) and School Coordinator(s) when the program is initiated and will be the basis for qualification of the employer to recruit students in that discipline. After a student has successfully completed three work sessions, the employer will be approved to recruit for all disciplines within an academic college at Purdue." (Retrieved on 5-22-2011 from <https://engineering.purdue.edu/ProPractice/Programs/EmployerHandbook/EmployerRes.pdf>)

⁶⁷ Note: Co-Op Days is a major recruiting event that is held every February on campus. This event is the best time for employers to interview and hire Co-Op students because the largest pool of prospective recruits is available at that time. (Retrieved on 5-22-2011 from <https://engineering.purdue.edu/ProPractice/Programs/EmployerHandbook/EmployerRes.pdf>)

employers regarding the following types of requirements: developing job descriptions for initial co-op assignments; providing diversified job assignments with increasing level of technical responsibilities as part of cooperative education assignments; arranging for a competent manager to supervise the cooperative education participant; providing guidance and mentoring support; evaluating the performance of the cooperative education participant; counsel students regarding job performance and prepare required evaluations; and support and assist in the enforcement of the academic standards required for entrance to and continuation in the program.

Engaging employers – Purdue seeks to engage employers as long-term partners in their professional practice --co-op program through a number of means. The university’s professional practice sponsorship programs provide special recognition and advantages to employers that make annual financial contributions, ranging from \$2500 for the basic (black) level to \$5000 per year for gold level sponsorships and \$10,000 per year for platinum level sponsorships. Such sponsors receive special advantages in reviewing co-op applicants, participating in recruitment events, and engaging in other activities that raise the profiles of their companies in ways that support their recruitment and training interests. Partner companies are frequently invited to conduct seminars on targeted topics to co-op students, and are invited to serve as advisors on structuring curricula, developing new courses, and engaging in other activities to ensure that academic programs are keeping pace with industry demands. Additional activities that are carried out to engage employers include recognizing co-op employers at campus-wide events, in publications and press releases, and through other media channels.

In exchange for active participation and support by industry partners, the Purdue Professional Practices Program commits to providing active support to the co-op program by activities such as helping companies identify qualified students to participate in particular co-op

assignments, conducting workshops and seminars to help students develop professional skills, and providing administrative support and academic guidance to ensure that co-op assignments meet the needs of employers and students alike.

Monitoring – The Purdue Professional Practices Program expects employers that sponsor co-op assignments to provide active supervision and guidance to co-op participants. They are expected to select a qualified manager who can provide the student with effective guidance and counsel during the work session, supervise the student’s work assignments, and assist the student in adapting to the work environment and the organization. Employers are also expected to counsel with the student regarding job performance, complete a performance evaluation form at the end of each work session, and approve the written work report required of the student prior to the departure of the student for the subsequent academic session. Employers are also expected to permit Co-Op Coordinators and/or the Director to visit the work site and the students periodically to review the program and allow the collection of reasonable data for statistical evaluation purposes.

3.1.4 Standard 4 – Student Learning Environment

ACCE standard 4 requires that the coop program provide students with a productive learning environment. This standard deals with the central reason for developing cooperative education programs -- providing an environment that enables students to acquire not only a theoretical or academic understanding or the major aspects of a particular discipline but also opportunities to apply this knowledge to real-world problems and meaningful activities.

Some of the key questions that should be considered in determining how well a particular cooperative education program is performing with respect to this standard include the following:

- Commitment to experiential learning -- Are all relevant parties – students, co-op coordinators, academic faculty, university administrators, and students -- fully committed to seeking ways of maximizing opportunities for experiential learning? Do all parties fully support the value of this approach to learning, or does it occupy a secondary position in the system of educational values, behind theoretical research, production of academic papers, or other traditional academic pursuits?
- Relationship of co-op activities to the overall academic program -- Are co-op assignments an integral part of the academic program, with active supervision and interaction with faculty supervisors during the course of the assignments, or are students on their own and only obligated to report back at the end of their assignment – along the lines of “what did you do on your summer vacation”? Does the program focus on "earning while learning" is its principal focus on the inverse: learning while earning⁶⁸.
- Securing co-op opportunities -- What help is provided to students to secure productive coop assignments -- do program coordinators, including academic faculty members, help students identify coop assignments that will provide productive work experiences or are job placements handled by an office of career services with little guidance from academic faculty?
- Commitment of employers to student learning objectives -- Do the university and the coop program have firm partnerships in place with companies that fully support the goals of providing students with excellent experiential learning opportunities and productive work opportunities?

⁶⁸ Smollins, John-Pierre, “The Making of the History: Ninety Years of Northeastern Co-op”, from Northeastern University Magazine, May 1999, retrieved on 9-3-2010 from <http://www.northeastern.edu/magazine/9905/history.html>

Best Practice Example Northeastern University: As the sponsor of one of the preeminent cooperative education programs in the world, Northeastern University is a clear choice as a best practice example of a co-op program that has as its central objective the creation of productive experiential learning opportunities. Northeastern has more than one hundred years of experience determining the best ways of providing students with practical ways of combining classroom study with opportunities to learn on the job. Their co-op program clearly excels in the following key areas required to create an effective student learning environment.

Commitment to experiential learning -- Northeastern's commitment to the value of experiential learning is highlighted throughout their program descriptions that outline their cooperative education programs; for example:

“Northeastern students don’t just take class: They take class further, integrating their coursework with real-world experiences—professional co-op placements, research, study abroad, and community service.”⁶⁹

Our co-op program, founded over a century ago, is one of the largest and most innovative in the world. Students alternate semesters of academic study with semesters of full-time employment in positions related to their academic or career interests: in business, health care, education, engineering and technology, the visual and performing arts, and public policy, to name a few. Co-op coordinators in each college provide support for students in preparing them and succeeding on their co-ops. Students are assigned to a coordinator based on their major. More than 6,000 Northeastern students are on co-op during some part of each academic year. Students have the option of pursuing up to three co-op experiences. Co-op is closely integrated with our course curriculum, our scheduling, and our advising system. A network of co-op coordinators within each college support students in preparing for and succeeding on their co-ops⁷⁰.”

Northeastern has demonstrated its commitment to experiential learning by serving as a leader in co-op education for more than 100 years. From its early beginnings at the start of the 20th Century, Northeastern has been a pioneer in developing innovative programs to provide students

⁶⁹ Retrieved on 12-25-2011 from <http://www.northeastern.edu/experiential-learning/cooperative-education/index.html>

⁷⁰ Retrieved on 5-25-2011 from <http://www.northeastern.edu/experiential-learning/coop/>

with practical experiential learning opportunities that are closely integrated with classroom work and career preparation activities. Students are attracted to Northeastern because of this special focus. They are drawn to this particular university because they expect that it will provide them with a learning environment that will enable them to master the key knowledge requirements of their chosen disciplines along with the added practical advantage of being able to apply this knowledge to real world problems, learn on the job, earn money during their course of study, and develop the qualifications that employers look for in hiring new graduates. Faculty members, program coordinators, and employers also share in this commitment.

Relationship of co-op activities to the overall academic program -- Northeastern provides a broad-based network of support that helps students prepare for co-op and get the most from it. Co-op programs are a central part of the overall academic program. Course work and co-op assignments are closely coordinated throughout the full term of a student's program in the various disciplines that offer co-op programs.

Faculty support is provided by an academic advisor and a co-op coordinator. Co-op coordinators help students prepare for co-op, identify and pursue the right co-op jobs, and afterwards help them reflect on their experiences and the ways these experiential learning opportunities relate to the student's classroom studies. To aid in this reflection process, students participate in seminars and faculty conferences, complete writing assignments, and give presentations to report on their co-op experiences. Academic advisors work with students to help them develop their academic programs and ensure that graduation requirements are met. Co-op coordinators help students identify co-op jobs that meet their academic, professional and personal goals and prepare for the interviewing process. Both coordinators/advisors work together to integrate the classroom and co-op experience.

Northeastern's cooperative education program supports students from the time they arrive on campus through the final stage of their program during their senior year. Students begin their co-op program by participating in a co-op preparation course, which helps them develop their skills and abilities related to job search, résumé writing, and interviewing. In addition, the co-preparation course provides students with tools and tips on professional conduct, proper attire, and how to ask relevant questions during job interviews. After completing the co-op orientation course, students work with their co-op coordinator to review available co-op assignments that correspond to their areas of interest and qualifications and prepare and submit applications. Employers that have posted the co-op positions review resumes that are submitted and select students for interviews. Final hiring decisions are made by employers.

While students are engaged in co-op assignments, coordinators continue to provide support and advice, as needed, including working with students to help them integrate their on-the-job experience into the student's course work. When students return to classes from co-op, they participate in activities such as: seminars, faculty conferences, writing assignments, and formal presentations to help evaluate and process lessons learned from the co-op assignment and share the knowledge gained in classroom discussions with other classmates.

Students participating in the co-op program alternate periods of academic study with periods of paid professional employment related to their major. In most majors that participate in the co-op program, students can choose between a four-year program with fewer co-op placements and a more popular five year program that includes 18 months of co-op assignments. This process culminates in the senior year, during which students enroll in the capstone course, which provides students with opportunities reflect on how all of their experiential learning activities,

including co-op, research, service, and international experience, relates to what they have learned in their classroom studies.

The co-op program is the cornerstone of a Northeastern University education and ninety percent of Northeastern students participate in co-op programs offered by various departments. However, the co-op program is not required for all students; undergraduates who choose not to pursue co-op can fulfill Northeastern's experiential learning requirement by participating in other activities, such as research, service learning, or study abroad programs.

Commitment of Employers to Student Learning Objectives -- Employers that participate as partners in the Northeastern University Co-op program are required to do more than simply offer students short-term employment opportunities. They are expected to actively support the student's learning objectives by providing work assignments that provide appropriate opportunities and challenges for students to gain particular skills and experiences.

Employers are aided in these tasks by the co-op coordinators that are assigned to oversee specific majors and groups of students. Employers are assigned a designated co-op faculty member. The coordinators support employers and ensure that the co-op experience benefits both the sponsoring organization and the student. The coordinator provides a wide range of expertise, helping define the responsibilities of a co-op job, referring appropriate students for job interviews, answering questions, and solving any challenges that may occur.

3.1.5 Standard 5-- Learning Outcomes and Program Effectiveness

To meet or excel with respect to the requirements for ACCE Standard 5, co-op programs must include effective tools for monitoring and assessing specific program components as well as the overall impact or effectiveness of the programs⁷¹. Specifically, the program must establish:

- *“The effective use of a student learning assessment process for each work term and a cumulative one at the end of the student’s participation”, and*
- *“An assessment process that evaluates its overall effectiveness and its impact on its constituencies”.*

Performing effectively with respect to this standard is essential if co-op programs are going to help academic programs keep pace with the changing demands of the marketplace and provide the types of learning opportunities that students will need to meet employer hiring requirements and compete for jobs. Effective evaluation procedures are needed to enable program managers to continually monitor and evaluate program performance and make adjustments as needed. The evaluation procedures should also provide data and analyses that help advance an understanding of how technology education can be improved by incorporating productive experiential learning experiences.

Best Practice Example: University of Cincinnati Center for Cooperative Education Research and Innovation (CERI): The University of Cincinnati excels in its commitment to employing assessment systems and research to improve the performance of its co-op and experiential learning programs. Co-op faculty members and co-op coordinators have developed an online performance assessment system that enables them to continually monitor and evaluate program activities and results and make adjustments as needed. For normal co-op assignments,

⁷¹ *IBID.*

evaluations are submitted by students, employers, and faculty supervisors. The survey data collected by this evaluation instrument is quantitative in nature and entered electronically over the internet. Data from this evaluation instrument is analyzed to assess the strengths and weaknesses or particular programs as well as student and employer performance.⁷²

In addition to conducting regular assessments of student co-op assignments, the UC assessment process evaluates the cumulative results of the student's participation in co-op activities at the end of his or her period of academic study. This ongoing process of surveying performance and analyzing results enables co-op program managers and faculty to make adjustments in course curricula and co-op program operations to take into account the feedback they receive from students, employers, and co-op coordinators.

What sets the UC program apart from some of the other top ranked co-op programs with respect to evaluation and assessment practices is the emphasis they have place on advancing the "state of the art" with respect to experiential learning and the development of effective co-op/professional practice programs. In order to contribute to advances in the field of experiential learning and co-op/professional practices programs, the University of Cincinnati has established a Center for Cooperative Education Research and Innovation (CERI) that is specifically devoted to advancing the state of the art in the practice area in which they founded and have helped lead over the past century.

As noted on the UC Center for Cooperative Education Research and Innovation website⁷³, the goals and objectives of this center are to:

⁷² Cates, Cheryl and Todd, Anita. "Online Assessment and Learning Instruments for Cooperative Education Students; the Importance of Co-op Data to ABET"., retrieved on 5-20-2011 from http://www.icee.usm.edu/ICEE/conferences/asee2007/papers/520_ONLINE_ASSESSMENT_AND_LEARNING_INSTRUMENTS.pdf

⁷³ See www.uc.edu/propractice/ceri.html

- *Drive the development and implementation of cooperative education as a pedagogic model at the University of Cincinnati.*
- *Develop assessment systems that measure student learning outcomes.*
- *Serve as a data repository that can provide cooperative education data to assist in externally funded research at the University of Cincinnati.*
- *Advocate the use of cooperative education assessment data in policy development within the University of Cincinnati.*
- *Provide a forum to discuss the impact of cooperative education.*
- *Share our knowledge to the benefit of higher education through scholarly work and training.*
- *Seek externally funded research opportunities related to the mission of the center.*
- *Facilitate connections between cooperative education employers who have research needs and faculty members in the UC co-op colleges to enhance UC's industry funded research portfolio.*
- *Serve as an incubator for innovative programs of cooperative education.*

CERI is currently contributing to advances in the field of experiential learning by supporting research on key aspects of cooperative education programs. Examples of CERI research programs and publications⁷⁴ include:

- *Leveraging Cooperative Education to Guide Curricular Innovation, The Development of a Corporate Feedback System for Continuous Improvement*, Cates, Cheryl and Cedercreutz, Kettil [Ed.] (2008). This handbook shows how to create evidence-based curricular reform using corporate feedback from co-op employer evaluations. The research that was conducted to produce this handbook was funded through a grant from the U.S. Department of Education Fund for the Improvement of Postsecondary Education (FIPSE). US faculty members from several departments were involved in various components of this research program.
- *Learning Outcomes: The Educational Value of Cooperative Education*. Commissioned by the Cooperative Education and Internship Association, this publication demonstrates the educational value of cooperative education.
- *Co-op Supervisor's Handbook*, (Currently under development with an anticipated electronic release of early 2011).

⁷⁴ See <http://www.uc.edu/propractice/ceri/publications.html>

4 RECOMMENDATIONS

Over the past 50 years, a great variety of cooperative education programs have been developed by U.S. universities, building on the foundations of the early programs developed by co-op pioneers such as the University of Cincinnati and Northeastern University. These programs exhibit a wide variety of organizational and program features. Various models have been developed by universities and colleges to respond to particular organizational priorities and conditions, including such factors as: financial resources, ability to recruit industry partners, staff resources, or the prevailing views on their primary missions and objectives. The diversity of program models and objectives makes it difficult to compare different programs or draw conclusions regarding their overall performance and effectiveness.

In spite of the diversity of program types and models, the ACCE accreditation standards still provide a useful means of evaluating the degree to which different programs deal with basic problems that are common to almost all cooperative education programs. The five standards discussed above make it possible to assess the degree to which co-op programs are emphasized within the institution, whether or not the cooperative programs have established the types of institutional relationships needed to manage the program and engage faculty, students, and employers in productive activities, the manner in which they engage employers, how they support productive learning environments for students and promote experiential learning, and the degree to which they are able to evaluate program performance.

By assessing the performance of different co-op programs with respect to these standards, various programs have been identified that not only meet these standards but contain features that enable the programs to excel with respect to core program requirements. These “best practice” examples provide models that other educational institutions can study as they seek to develop new co-op programs or improve the performance of their existing programs. With these examples and standards in mind, this study presents lessons learned from these program models, and suggests standards and best practices that can be used to address the challenge of improving engineering education in Armenia.

The principal objective of this research, as stated previously, is to provide practical recommendations for improving the system of engineering education in Armenia by applying lessons learned from leading cooperative education programs in the U.S. This final section will provide a summary of the rationale for expanding cooperative education programs in Armenia, recommendations for next steps that are needed to develop effective co-op programs, and a discussion of how some of the “best practice” features of leading U.S. programs discussed in the findings section can be applied to cooperative education program designs for Armenian universities.

4.1 Rationale for Implementing Cooperative Education Programs to Improve Engineering Education in Armenia

The analysis of engineering education challenges in Armenia presented in this study suggests that Armenia is facing many of the same types of issues that universities in the U.S. and other parts of the world are concerned with - particularly how to develop educational programs that help engineering students acquire the knowledge, skills, and experience that they need to secure jobs and embark on successful engineering careers. The following table provides a summary of

the problems that the Armenian engineering system is facing and ways that cooperative education programs could help to solve priority problems.

Table 5: How Co-Op Programs Can Address Current Challenges in Armenian Engineering Education

<i>Armenian Engineering Education Challenges</i>	<i>How Cooperative Education Programs Could Help</i>
Academic programs are not aligned with the needs of the marketplace	Partnerships between universities and companies could provide a means of restructuring programs to make it more relevant to market needs. Feedback from co-op students, employers, and co-op coordinators could enable universities to revise course curricula to provide more relevant instruction and experiential learning opportunities.
Engineering graduates lack the kinds of practical experience that employers are looking for	Combining co-op assignments with course work could enable students to gain practical work experience and the types of skills demanded by employers.
Engineering curricula is outdated and there are shortages of qualified staff	Closer relationships between universities and employers could open up opportunities for faculty members to keep up with industry developments, participate in employer-funded research, and obtain consulting contracts.
University facilities and lab equipment are outdated	By developing partnerships with the right types of companies, universities might be able to obtain financial support to upgrade facilities or contributions of specialized equipment, software, tools, and training materials.
Linkages between universities and employers are weak	Developing structured partnerships between universities and employers would not only help develop co-op opportunities with students but could lead to joint R&D activities, sharing of facilities, and corporate support to help universities upgrade their equipment and software.

Currently the system of engineering universities in Armenia provides students with a strong theoretical foundation in math and science but very little practical training that would prepare them for the requirements of the job market. Opportunities to participate in cooperative education programs would enable students to gain more practical experience in different engineering disciplines directly from the industry rather than just from their studies and

laboratory exercises. Such opportunities would also help students earn money to pay for their education and make it easier for them to get jobs after graduation.

4.2 Recommended Steps for Developing Effective Cooperative Education Programs in Armenia

Both faculty members and administrators in Armenian universities such as the State Engineering University of Armenia (SEUA) are keenly aware of the problems that they are facing as a result of the severe cutbacks in educational funding that have occurred in the post-Soviet era⁷⁵. Interviews and conversations conducted with Armenian educational leaders indicate that they are actively seeking to identify feasible solutions to their current problems. However, because of current funding constraints and government inertia, there are few easy solutions to current problems. This study does not attempt to develop a complete roadmap of steps for reforming the engineering education system. Instead, it focuses on identifying some of the basic steps that educational and industry leaders could take to initiate a process that over time could produce significant improvements in Armenia's current engineering education system. The recommended steps and expected outcomes associated with this reform process are summarized below as part of a three-stage process to develop effective cooperative education programs in Armenia. These stages include: 1) strategic planning; 2) change management; and 3) detailed program design and business planning.

4.2.1 Stage One: Strategic Planning

Strategic planning is generally accepted in the business world as a useful tool in designing and implementing new business strategies or programs. The process of developing a

⁷⁵ Note: Interviews with companies and university faculty were conducted during 2008-9 by the author while serving as a technical advisor on the USAID-funded Competitive Armenian Private Sector Project.

strategic plan for a new cooperative education program in Armenia could benefit from carrying out a standard strategic planning process, including the following steps:

- Defining the overall mission the program is expected to achieve, along with the vision and values that will help shape the program;
- Determining the specific goals and objectives that the program will focus on to achieve the mission;
- Providing details of the specific strategic actions that will be required to meet specific objectives; and
- Deciding on performance indicators that will be used to assess progress in achieving strategic objectives.

4.2.2 Stage Two: Change Management

Extensive studies have been carried out in recent years on the processes involved in initiating and managing change, including studies of change management processes in higher education⁷⁶. These studies highlight the importance of several key activities that are essential parts of the change management process, including:

- Raising awareness
- Mobilizing support
- Finding champions, advocates, change partners, and sponsors

Armenian university administrators and department heads should recognize from the start that implementing a new or expanded cooperative education program will not be an easy task. They should understand that pursuing such a plan will require significant changes in a number of

⁷⁶ Scott, G. "Effective Change Management in Higher Education", Retrieved on 6-1-2011 from <http://net.educause.edu/ir/library/pdf/ERM0363.pdf>

key areas, including the overall structure of the academic program, faculty roles and responsibilities, course offerings and schedules, and even the system of rewards and recognition for academic and administrative faculty members. In addition, it will require significant efforts to forge new university-industry partnerships arrange and manage co-op placements and assignments, and evaluate program performance to determine whether or not experiential learning objectives are being met. Following a standard change management methodology would provide an effective means of raising awareness about the new program, mobilizing support, and finding sponsors, champions, and advocates to help implement the changes that are needed to create a successful cooperative education program.

4.2.3 Stage Three: Applying “Best Practice” Features of U.S. programs to Cooperative Education Program Designs in Armenia

The approach previously discussed in this study for identifying key elements of successful cooperative education programs and “best practice” examples of ways in which leading co-op programs accomplished core objectives involved two basic steps:

- Step One: Reviewing core standards that have been proposed by the Accreditation Council for Cooperative Education (ACCE) as a means of encouraging and recognizing excellence in programs of cooperative education⁷⁷.
- Step Two: Studying leading programs to identify particular features and practices that enable them to excel with respect to the core ACCE standards.

The following section includes specific recommendations regarding ways in which Armenian universities and engineering education programs could use this approach to design programs that

⁷⁷ Note: The standards and procedures developed by ACCE recognize that there is a diverse array of cooperative education programs and approaches; however, by developing a core set of standards and procedures that characterize highly successful programs, the ACCE accreditation standards offer useful guidelines that universities can follow as they seek to design and implement highly effective co-op programs.

incorporate “best practice” features in their structure and operations. The proposed recommendations are applied to a particular case – the State Engineering University of Armenia (SEUA). This case is selected because it is one of the top technical universities in Armenia and because it has previous experience in co-op type programs as a result of its partnership with the Synopsis Corporation that was discussed previously.

4.2.4 Standard 1: Mission and Goals

SEUA or other universities that might be interested in restructuring their engineering education programs to focus more on experiential learning approaches and on-the-job assignments as core components of their program should study the mission statements of universities that have succeeded in developing cooperative education programs that are consistently ranked among the top performers. The first step in designing a cooperative education program would involve reaching agreement on the mission, goals, and objectives of the proposed program. This study has previously cited the example of the University of Cincinnati as a program that has a clear mission statement and strategic objectives for its cooperation education program. The examples provided by the University of Cincinnati and the other top-ranked co-op programs examined in this study can provide guidelines for formulating a clear statement of the mission, vision, and values that would be included in the strategic plan that SEUA or other Armenian universities might develop as the first step in designing co-op education programs adapted to their own objectives and conditions.

4.2.5 Standard 2: Institutional Relationships

The Institutional Relationships standard for cooperative education programs emphasizes that programs should be: integrated into the academic and administrative culture, policy, and

practices of the institution; provide effective roles of faculty in program support, endorsement, development, and evaluation; and have sufficient financial resources, staffing, and administrative processes to achieve program mission and goals.

One of the first institutional issues that Armenian universities would need to address would be to establish a cooperative education office that has adequate staff and financial resources to provide overall management support to the cooperative education programs the university was interested in developing. As a practical matter, the most convenient approach might be to set this up as part of their current Career Services offices. The best practice examples cited earlier of the Divisions or Offices of Professional Practice that have been set up to manage co-op programs could provide useful guidelines for Armenian universities. Such divisions or offices are responsible for the full set of professional practice activities, including co-op programs, internships, career placement, and study abroad programs; consequently, the related functions performed for each of these program areas can be closely coordinated to avoid overlap and redundant efforts.

A second Institutional Relationships-related requirement for implementing co-op programs would be to develop effective systems and procedures for engaging faculty members in the management and oversight of engineering cooperative education programs. This would involve selecting faculty members in each engineering department to serve as faculty advisors and co-op program coordinators to supervise the participation of students in their co-op assignments with local and international companies. Faculty members would need to be actively engaged in the co-op program so that class room studies and curricula are closely coordinate with student's co-op assignments and a consistent emphasis on experiential learning is maintained. Best practice examples such as those developed by all of the top performing

programs described earlier could be used as models for developing similar systems for Armenian co-op programs.

An additional key requirement for addressing the Institutional Relationships standard would involve implementing effective systems and procedures for developing industry partnerships – particularly with companies that are willing to provide useful co-op opportunities to Armenian engineering students. Approaches for dealing with this requirement are discussed in the next section.

4.2.6 Standard 3: Employers

As noted earlier, the ACCE standard relating to selecting employers to participate in the co-op programs requires that “the program effectively selects, prepares, engages and monitors employers so that students achieve learning outcomes consistent with program goals.⁷⁸” Establishing a network of industry partners that are willing to provide meaningful co-op assignments to students is one of the core requirements for developing a successful program.

Armenian universities such as the SEUA typically have career support centers that focus mainly on helping students get jobs after they graduate. Their activities include conducting job fairs, maintaining databases of employment opportunities offered by local companies, and helping students prepare resumes and arranging interviews with companies. In former years the state universities also maintained relationships with government run companies that provided on-the-job training opportunities for students. However, with the decline of the engineering sector after independence, these opportunities largely evaporated. At the present time, technical universities such as SEUA are attempting to rebuild relationships with companies. In the particular case of SEUA, they have renamed their career services centers to reflect this renewed

⁷⁸ ACCE website, op.cit

emphasis on developing relationships with industry. The new name for the career services group is the Students Career Support Centre.

Given this previous tradition of university-industry relationships, current concepts of cooperative education should be quite familiar to Armenian educators. Problems related to establishing new cooperative education programs are likely to be more closely related to difficulties in finding appropriate industry partners than to resistance from university administrators and faculty members. Therefore, to design the management structure and systems that would be needed to implement a new cooperative education program; a critical first task would involve developing and strengthen the efforts of the Student Career Support Centers. Additional efforts and budget would be required to build staff capabilities to manage cooperative education programs, internships, and educational exchange or study abroad programs, in addition to the current post-graduate career placement services.

Studying the experiences of leading U.S. co-op programs such as those described previously that have developed Professional Practice Divisions or Offices could provide best practice examples of how the leading U.S. universities manage key functions such as employer relations. For example, all of the universities listed as the top-ranked programs maintain regular communications with companies and prospective employers through multiple channels, including conferences, seminars, webcasts and co-op employer award recognition events to highlight the success of co-op and to brand co-op as a valuable program for both the student and employer. They also conduct advertising campaigns to highlight the contributions of their corporate partners and promote their co-op programs through both print media and social networking channels (such as Facebook and Twitter).

It is important to note, however, the U.S. best practice models are not entirely applicable to the Armenian situation, since these leading U.S. co-op programs have built up their network of business partners through decades of effort in environments where great numbers of potential business partners were either close by or easily accessible. Armenian universities are faced with an environment where there are very few internationally competitive engineering companies in the local marketplace and where local job opportunities are scarce.

To solve this problem, Armenian universities need to look for several ways to expand their networks of industry partners. Initial efforts to develop industry partnerships should be directed first at the small number of international companies that have established operations in Armenia and the leading group of Armenian engineering companies that might be in a position to offer co-op assignments to some of the better qualified university students. Next, the Armenian Diaspora network should be used to the maximum extent possible to identify possibilities of developing partnerships with international companies owned or managed by Armenian Diaspora members.

Armenian universities planning new cooperative education programs should also seek to develop partnerships with U.S. and European universities that support international cooperative education programs. For example, the Northeastern co-op program recognizes the importance of providing students with opportunities to gain work experience not only in the U.S. but in international environments as well. Their international cooperative education program offers co-op positions in 50 countries, with employers ranging from multinational corporations to international agencies and NGOs⁷⁹. All of the other co-op programs from our leading universities list, including the University of Cincinnati, Georgia Tech, Drexel, and RIT also offer international co-op opportunities. Developing university partnerships with these and other U.S.

⁷⁹ See <http://www.northeastern.edu/experiential-learning/global-experience/index.html>

or European universities could provide Armenian universities with a means of learning the best ways to develop and manage an international co-op program, as well as possible opportunities to develop exchange programs and tap into the network of industry partners that these universities have developed.

4.2.7 Standard 4: Student Learning Environment

The ACCE standard 4 specifies that the coop program should provide students with a productive learning environment. This requires a commitment of the university to experiential learning as a key aspect of their academic programs as well as active efforts by the faculty members and co-op program staff to help student secure co-op assignments that will provide productive work experiences. The best practice examples from leading U.S. co-op programs provide practical examples of how this can be accomplished. However, the basic requirement that must be met is to develop partnerships with the types of companies that are willing and able to offer co-op assignments that provide students with productive work assignments and excellent experiential learning opportunities.

As discussed in the previous section, developing relationships with industry partners that are willing and able to offer co-op opportunities to students that will contribute to the experiential learning objectives of the program is a task that Armenian universities can accomplish easily in the current environment. Nevertheless, if one or more Armenian universities were to make a firm commitment to developing cooperative education programs and restructuring their curricula and program requirements to place a heavier emphasis on experiential learning, they would be better prepared to take advantage of existing industry partnership opportunities and create new ones as opportunities arise. In these instances, studying the best practice approaches that are part of the leading U.S. cooperative education programs

offered by Northeastern University and others would provide excellent guidelines of how relationships with employers should be structured and managed to ensure that the provided students with high-quality work experiences and excellent experiential learning opportunities.

4.2.8 Standard 5-- Learning Outcomes and Program Effectiveness

Meeting ACCE Standard 5 requires that co-op programs include effective tools for monitoring and assessing specific program components as well as the overall impact or effectiveness of the programs. Studying the methods used by the University of Cincinnati or Northeastern University for assessing the performance of their co-op and experiential learning programs would provide useful guidelines and methodologies for implementing effective evaluation procedures. In particular, they could profit by studying the initial co-op orientation courses that several of these leading universities have developed, as well as the fourth year courses that provide opportunities for students, faculty members, and employers to review specific co-op assignments and assess ways of improving their effectiveness and providing more effective experiential learning opportunities.

5 CONCLUSION

This research has provided recommendations for addressing some of the problems of the system of engineering education in Armenia by promoting the further development of cooperative education programs and university-industry partnerships. In establishing the case for an expansion of cooperative education programs, the study has analyzed some of the key problems that Armenia faces in reforming its system of engineering education and ways in which cooperative education programs could help overcome current constraints. These problems include lack of connections between universities and industry, outdated curricula, shortages of funding for university staff and facilities, and limited success in helping students qualify for job-related demands of the global economy.

The research shows that cooperative education programs have many benefits for students, universities, and companies. In particular, expanded efforts by the leading engineering schools in Armenia to implement cooperative education programs could be an effective means of providing students with the practical work-related skills required by employers, particularly those firms that are capable of competing for international customers. In addition, an expansion of university-industry partnerships to implement such programs could provide universities with a means of upgrading their facilities, keeping abreast of new technologies, and reforming curricula and teaching methods to align them more closely with current market requirements and global standards.

In discussing the features that contribute to the success of cooperative education programs in the United States, the study focused on five core standards that are recognized as essential features of leading programs. As noted earlier, these core standards include: clear ideas about the program's mission goals, and values; effective institutional relationships and management structures; strong relationships with employers; supportive student learning environments; and attention to learning outcomes.

In order to identify requirements for developing effective cooperative education programs in Armenia, the study has analyzed the characteristics and features of highly successful cooperative education programs in the United States that contribute to their success and that might be applicable to the requirements of Armenian engineering education programs. The six universities that were selected for an analysis were: Northeastern University, The University of Cincinnati, Rochester Institute of Technology, Georgia Institute of Technology, Drexel University, Purdue University. The study also examined experiences with industry-university partnerships in Armenia such as the Synopsis-SEAU program and noted the accomplishments of this program in promoting increased competitiveness of Armenia's IT capabilities in electronic design automation and chip design. The lessons learned from international best practices, combined with lessons learned from the Synopsis-SEAU partnership provide guidelines that can be used to support engineering educational reforms and workforce development programs in Armenia.

In Armenia's case, the relationship with employers, particularly the development of productive relationships between universities and globally competitive international companies – whether foreign owned or domestic, appears to be one of the particularly important requirements for success. Universities need to develop partnerships with companies with a demonstrated capacity to compete in global markets. These partners should be firms that employ up-to-date

technologies in their management and service/production operations. In addition, they should be willing to commit resources to the partnerships with universities, including such things as software licenses, modern tools and equipment, and training materials. And particularly, they should be willing to provide employment opportunities to engineering graduates that they help prepare for the demands of 21st Century marketplace. The successful example of the partnership between the Synopsis Corporation and SEAU provides evidence of the importance of engaging the right types of industry partners in these programs.

It is important to emphasize that new cooperative education programs in Armenia need to be structured so faculty members are involved in working with employers to design and supervise the co-op programs so they will be able to understand company needs and requirements and implement changes in their course curricula to address these requirements. The university curriculum and the co-op program should both emphasize the value on experiential learning. Co-op programs should offer real learning experiences, not simply low-cost, low value jobs. Ideally, Armenian universities should seek to develop relationships with industry partners that are willing to support programs that include other features, such as joint R&D activities, contributions of laboratory equipment, software and tools to the university by company partners (to make up for the university's lack of these critical resources)

The Government of Armenia could facilitate the development of such partnerships by offering investment incentives and tax breaks for companies that commit to investing resources in such partnerships. In addition, international donor organizations could play an important role in promoting and financing some of the initial costs of developing successful university-industry partnerships.⁸⁰ Ultimately, however, the successful development and expansion of cooperative

⁸⁰ Note: See www.caps.am for examples of university-industry partnerships that were promoted as part of the USAID-funded Competitive Armenia Private Sector project.

education programs in Armenia will require committed efforts by individuals from universities and industry who share a common vision of the need to develop a globally competitive engineering sector and are willing to serve as champions, advocates, and sponsors to translate this vision into reality.