



# THE LEVERAGING GLOBAL ENGINEERING SKILLS PROJECT

## SUMMARY REPORT

*By Gurmeet Bambrah PhD*

Deriving from extensive community action research over five years, CAPE initiated the Ontario-wide Leveraging Global Engineering Skills (LGES) project in October 2008.

The project is funded by the Ministry of Training Colleges and Universities and in-kind contributions from CAPE using its specialized competency matching tools. It ends on September 30, 2010

The primary objective of this project is to improve the quality of employment preparation and skills development programs for immigrants with engineering backgrounds seeking to join the engineering profession in Ontario by linking these directly to employer needs.



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*Employment Ontario* project is partly funded by the Ontario Government through the Employment and training Division of the Ministry of Training Colleges and Universities

*The opinions and interpretations in this publication are those of CAPE Council for Access to the Profession of Engineering and do not necessarily reflect those of the Government of Canada.*

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## EXECUTIVE SUMMARY

Deriving from extensive community action research over five years, CAPE initiated the Ontario-wide Leveraging Global Engineering Skills (LGES) project in October 2008. The project was funded by the Ministry of Training Colleges and Universities and in-kind contributions from CAPE. The primary objective of this project was to validate an employer-driven, job-function based curriculum development process for internationally trained/experienced engineers, technicians and technologists seeking to join the engineering profession in Ontario by linking these directly to employer needs.

The competency matching tools were adapted for the LGES Project to include a skills-capturing interface (Portfolio Builder) for IEBs and a job requirements capturing employer interface (Job Articulator). These interfaces were linked to the growing IEB database to analyze the two sets of data in real-time (Gaps Abstractor). These gaps provided the content for the pilot employer-driven job-function based curricula development process

An extensive review of the evolution of engineering education and practice in Canada revealed an engineering education system comprising publicly funded universities, community colleges, private career colleges, Employment Ontario (a training and employer network) and service providing organizations. Representative programs provided by each of these players for immigrants with engineering backgrounds (IEBs) were engaged in 4 curricula development pilots cutting across 5 engineering disciplines using the employer-driven job-function based curricula development process.

Using a client driven approach, the project engaged with the following to validate the curricula development process

- 92 engineering employers,
- 3185 internationally trained and experienced engineers, technicians and technologists, of who **1553** joined the growing database of immigrants with engineering backgrounds between October 1, 2008 when the Leveraging Global engineering Skills project was initiated and September 30, 2010 when LGES was completed. In total, **812** immigrants with engineering backgrounds completed their portfolio of skills and competencies. 51 were registered as engineers-in-training
- The number of participants that were engaged in the selected pilots included ; Environmental Engineering (81), Structural Engineering (36), Mechanical/industrial and Plant Design (65); Switchgear and Controls (49) and Electronics & circuits (23)
- 7 Community Colleges, 2 Private career colleges, and 4 service providing organizations

The hypothesis that the real-time employer-driven curricula development tools developed by CAPE portend well for improving employment preparation programming for IEBs by linking these to employer requirements for managing change was tested under the LGES project. An analysis was performed to identify components of the employment preparation programs that need to be strengthened to meet employer requirements for jobs.

These pilots revealed that although learning for engineers is increasingly moving out of the classroom, into the workplace and online, one constant in engineering education is the need for a

sound academic grounding in the basis of science, engineering principles, and analytical capabilities. However immigrants with engineering backgrounds hold higher academic qualifications than are being articulated in the job requirements.

Although learning for engineers is increasingly moving out of the classroom, into the workplace and online, one constant in engineering education is the need for a sound academic grounding in the basis of science, engineering principles, and analytical capabilities. A strong grounding in these fundamentals is still the most important service that universities, colleges and other educational institutions provide through expertly conceived, well delivered lectures as teaching and learning experiences. However immigrants with engineering backgrounds already have this fundamental grounding as they hold higher academic education than is articulated by the employers.

With the need for immediate on-boarding, learning-by-doing, and connectivity to just-in-time information sources, these new entrants to the workforce also need to have high computer proficiency and ability to work in an AutoCAD environment. This is borne out by the real-time skills requirements analysis for all four pilots and indeed across all engineering disciplines which showed that Proficiency in use of the Microsoft Suite of products and knowledge of AutoCAD are essential employer requirements. The need for AutoCAD 3D related proficiencies are on the increase. Again a skills gap analysis did not identify significant deficiency in the skills of IEBs in this connection. It is recommended that mandatory testing for Microsoft suite and AutoCAD should be introduced for all immigrants with engineering backgrounds prior to their entry into software skills trainings.

Significant deficiency gap appeared to exist between employer's requirements for team-leading, working independently, consulting with juniors over an assigned area and management roles. On the other hand a significant surplus appeared to exist between employer's requirements for taking on responsibilities and the abilities of IEBs to take on work responsibility. This indicates a cultural gap whereby the leadership culture is preferred in the Ontarian Engineering workplace while a strong responsibility-based culture is preferred by the IEBs. This clearly indicates a need for cross-cultural learning curricula in engineering in Ontario.

A significant deficiency gap also appeared to exist between employer's requirements for communication, consultation and interpersonal skills and the competencies of IEBs in this area. Strong communications are becoming a central requirement in engineering in general. With the advent of web 2.0 applications virtual learning environments and communities cutting across time and distance are being created that allow engineers to include the following in their professional development:

- Collaborative, socially-relevant learning to develop the professional skills of teamwork, communication, and leadership
- Cross-cultural competence for a global world where products are likely to be co-designed with someone in another country

Typical workplace based technical skills gaps that were identified in the discipline specific pilots revealed the following:

- Environmental engineers would benefit from a curricula that includes Intense grounding in environmental legislation , communications training , teamwork, leadership and inter-personal skills training and computer proficiency tests
- Structural engineers would benefit from a curricula that includes business and financial management, design management and communications training
- Industrial/manufacturing and plant engineering can be strengthened through a curricula that includes business and financial management, report writing and preparation of studies, quality assurance training and communications training
- Electrical/electronic switchgear and circuits engineers would benefit from a curricula that includes design management, documentation, cost estimation and practicum on site investigations

Engineering practice-based learning to support academic learning to fully ground theories taught in a classroom is a new dimension that is emerging in engineering education. This appears to be validated by the composite of discipline specific gaps that have been identified through the four pilots. Consequently engineers are also being alerted to the need to develop attributes which in addition to the traditional essential technical grounding and analytical competencies call for and require engineers to have functional skills such as practical ingenuity, creativity, business and management fundamentals, leadership, agility, resilience, and commitment to lifelong learning. This is required so that engineers can:

- Keep up with the fast changing and multi-disciplinary nature of engineering through life-long learning
- Develop design, creativity, and innovation skills as it is no longer acceptable for engineers to just analyze problems or mathematically derive models of problems; They have to be able to synthesize unique and innovative designs using their knowledge.



# 1. PROJECT BACKGROUND AND RATIONALE

## Background

CAPE Council for Access to the Profession of Engineering (referred to as CAPE hereafter) serves skilled immigrants with engineering backgrounds (referred to as IEBs hereafter) settling in Ontario and Canada. A tenfold increase occurred in the number of highly skilled, internationally trained and experienced immigrant engineers after the 1986 immigration point system Change. These skilled immigrants were experiencing great difficulty in accessing the engineering profession in Ontario<sup>i</sup> and CAPE was set up in 1993 to serve them. In June 2003, CAPE undertook a major community action research project entitled ‘Engineering Access’<sup>ii</sup> in Ontario. This culminated in a multi-stakeholder employment strategy for IEBs<sup>iii</sup>. After incorporation in 2006 as a Canada-wide non-for-profit organization, CAPE shifted focus to employment support for IEBs. It also developed an innovative employment advisory support service for IEBs and started implementing this employment strategy. In November 2006, CAPE undertook an action research project to identify meaningful skills-commensurate engineering opportunities for IEBs in Ontario<sup>iv</sup>. To improve the quality of employment preparation for IEBs CAPE began to offer training workshops on its employment supports for IEBs to service providing organizations (SPOs) across Ontario in May 2007.

## Rationale

CAPE’s extensive action research and multi-stakeholder engagement revealed that poor labor market outcomes for IEBs were due to:

- Weak analysis of training and academic gaps, to compare employer needs with applicant competencies
- Inadequate career and transition planning by IEBs
- Poor information on Canadian labor market and employers
- Weak involvement of employers

Following from this, CAPE developed specialized competency matching tools for IEBs and initiated the Leveraging Global Engineering Skills Project (LGES) to develop an employer-driven, job-function based curricula development process to improve the quality of employment preparation programs for IEBs.

## THE MULTI-STAKEHOLDER EMPLOYMENT STRATEGY FOR IMMIGRANTS WITH ENGINEERING BACKGROUNDS

*In 2000, Gordon H. Maynard<sup>v</sup> while making a presentation on “The New Economy - Strategies for Importing Workers and Executives” first articulated the fact that “Canada is in the midst of a transition of focus from “Canadian First” to “Canada First”.*

*On October 16, 2004, CAPE initiated a constructive engagement initiative by inviting a number of important stakeholders to present their perspectives on serious issues relating to the integration of immigrants with engineering backgrounds into the Ontario engineering workplace and in meaningful occupations.*

*This provided a baseline document for a series of six structured multi-stakeholder roundtable meetings between October 2004 and May 2006. Through these CAPE developed and launched a forward looking multi-stakeholder driven employment strategy for immigrants with engineering backgrounds coming to Ontario. This employment strategy entitled **From “Canadian First” to “Canada First”** offers the potential to enable this transition for the engineering profession in Ontario.*

## 1. THE LEVERAGING GLOBAL ENGINEERING SKILLS PROJECT

### Description

The Leveraging Global Engineering Skills (LGES) project is Ontario-wide and funded by the Ministry of Training Colleges and Universities through its Employment and Training Division as well as in-kind contributions from CAPE. This two-year long project that will end on September 30, 2010 has sought to pilot an employer-driven, job-function based training curriculum for IEBs using specialized skills and competency matching tools. These were developed between March and August 2008. They include a real-time skills gap analyzer to compare the six sets of engineering skills. These tools were adapted for the purposes of piloting the curricula development process for the LGES Project. This project has sought to strengthen post-secondary programs and the voluntary sector's capacity to serve internationally educated engineers through integration of the employer-driven curriculum into their employment and training supports. This initiative will enable both engineers and employers "to understand their capacity for dealing with human resource requirements and to implement labor force adjustments" as outlined in the criteria for Labor Market Partnerships

### Objectives

The primary objective of the LGES project is to improve the quality of employment preparation and skills development programs for IEBs seeking to join the engineering profession in Ontario by linking these directly to employer needs. Employers were engaged under the LGES project, either directly or through a number of partners in the process of developing training and employment preparation programming content by piloting the job-function based curriculum development process.

Using specialized skills and competencies matching tools, this project has sought to pilot an employer-driven, job-function based training curriculum for internationally trained/experienced engineers, technicians and technologists

This project has also demonstrated how the capacity of post-secondary programs and the voluntary sector to serve internationally educated engineers can be strengthened through integration of the employer-driven curriculum into their employment and training supports.

### TRAINING CURRICULA DEVELOPMENT PROCESS USING SPECIALIZED COMPETENCY MATCHING TOOLS

#### Self reflective portfolio builder captures IEB skills:

- Education by length of years and certification
- Language competency and certification
- Technical engineering experience and skills
- Software skills
- Leadership and responsibility levels
- Communications and soft skills

#### Job Developer Captures Employer Requirements :

- Engineering education
- Technical Skills and Experience
- Knowledge of software
- Soft Skills
- Leadership skills and work responsibilities
- Language requirements

#### Gaps Analyzer

#### Curricula development

#### Pilot applications

## 2. ACTIVITIES AND OUTCOMES

### Activity 1: Engage a minimum of **50** Employers across Ontario in job-function based competency and job-matching tools

- a. The following Employers or groups working with engineering employers across Ontario in selected disciplines were engaged:
- Environmental engineers -Toronto Region and Conservation
  - Civil (structural) engineers - Humber College
  - Mechanical Engineers- (Plant Design and piping)- Humber college, Skills for Change and employers directly
  - Electrical (switchgear, protection and controls) –Humber college, SPOs and employers directly
  - Electronic (Design electronic circuit boards ) – Mohawk College, SPOs and employers directly

Employer and IEB outreach was extended to Toronto, Greater Toronto, Ottawa, Kingston, Cornwall, Essex, Hamilton, St Catherine's Niagara, Thunder Bay, Peterborough, Kitchener, Waterloo, London, Durham and Windsor with SPO support.

- b. **92** Employers across Ontario were individually introduced to the CAPE competency matching technology through:
- Job development workshops for SPOs
  - Meetings with individual organizations and employers.
  - Presentations to service providing organizations and Advisory committees for employment support programs.
  - Presentations to the Program advisory committees (PACs) of community colleges and CIITE meetings
  - Presentations at several Internationally Trained Professionals and Metropolis Conferences
- c. Job development/ hiring personnel from selected disciplines were provided introductory materials and presentations to identify and enter jobs into the employer interface.
- d. By entering these jobs using the employer interface, participating employers and job developers contributed to creating a database of job requirements across the six skill-sets integrated into the curricula development process.

## OVER **92** EMPLOYERS OR GROUPS ENGAGED

Engaged Directly	<ul style="list-style-type: none"> <li>• <b>24</b> Employers across all selected disciplines</li> </ul>
TRCA	<ul style="list-style-type: none"> <li>• <b>40</b> Employers hiring Environmental Engineers</li> </ul>
CIITE Colleges and PACs	<ul style="list-style-type: none"> <li>• <b>8</b> Employers (Civil, Mechanical and Electrical)</li> </ul>
TRIEC, SPOs and Others	<ul style="list-style-type: none"> <li>• <b>Over 12</b> Employers through Employer Roundtable across selected disciplines</li> </ul>
Conferences and other Events	<ul style="list-style-type: none"> <li>• <b>5</b> Employers across selected disciplines</li> </ul>
CEO Consulting Engineers Ontario (Total <b>250</b> member Firms )	<ul style="list-style-type: none"> <li>• <b>3</b> Employers across all selected disciplines</li> </ul>

## Deliverable 2: Engage with training partners throughout Ontario to integrate employer-driven job-function based curricula development into employment supports for IEBs

### a. Employment Support Programs

#### i. Program and Principles

The competency matching tools were adapted for the LGES Project to include an employer interface (Job Articulator) and a skills capturing interface (Portfolio Builder) for IEBs. These interfaces were linked to the IEB database to analyze the two sets of data in real-time (Gaps Abstractor) and pilot an employer-driven job-function based curricula development process. SPOs were engaged to pilot curricula development through job developer workshops. These partners include Toronto and Region Conservation; Skills for Change; ACCES Employment Services and Settlement Integration Services (SISO). A total of **17** Job Developers were engaged in LGES.

#### ii. Competency matching

Six skill-sets described below were integrated into three interfaces linked to a growing database of IEB competencies and job requirements for real-time analysis of “best fits”

- Education by length of years and certification
- Language competency and certification
- Technical engineering experience and skills
- Software skills
- Leadership and responsibility levels
- Communications and soft skills

#### iii. Interface 1: Portfolio Builder

This helps IEBs to capture their engineering skills, experience, and education using drop-down menus for the above six areas.

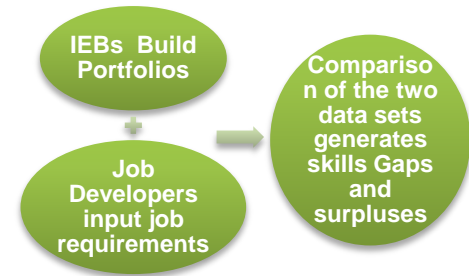
#### iv. Interface 2: Job Articulator

This user-friendly interface helped Job-developers and hiring personnel to quickly and efficiently develop job postings using drop-down menus in the same six areas

#### v. Interface 3: Gaps Abstractor

This matched the IEB skills and competencies to Job requirements and provided “best fits” in real time.

## THE PROCESS



### Interface 1: Portfolio Builder

water and wastewater engineer

Employer:	Type	Expiry Date	Function
EDCL	Non-licensed Job	2010-01-31	Construction Design - Advanced Process Design

Required Education		Required Experience		
Degree	Discipline	Years	Discipline	Focus
Bachelor	Civil engineering	9	Civil	Municipal/Public Health - Sewerage
		3	Civil	Municipal/Public Health - Sewerage
		2	Civil	Municipal/Public Health - Wastewater

### Interface 2: Job Articulator

Experience Details

Years	Job Title	Project Name	Employer	Edit
1979-1984	Graduate Engineer	nine urban sewerage and sewage treatment		

Functional Profile: Entry - Trainee/Intern

Job Complexity: Moderately complex

Technical Skills: Worked in a single engineering discipline, Tracked and reported problems, Specifications and Drawings, Site and Materials Testing, Project management activities, Reporting, Prepared reports, cost estimates and specifications, Prepared feasibility study

### Interface 3: Skills Gaps Abstractor

structural engineer

Employer:	Type	Expiry Date	Function	Complexity	Ref Files
EDCL	Non-licensed Job	2110-04-15	Project - Project Execution	Complex but not difficult	

Required Education		Required Experience			Result of Last Matching: (SISO) on 2010-05-17
Degree	Discipline	Years	Discipline	Focus	
Bachelor	Structural engineering	5	Structural Engineering	Concrete Structure	
Bachelor	Software engineering	5	Structural Engineering	Concrete Structure	

Match by:  Start Matching

List of Candidates (not yet)

PRINT PREP (Page 1 of 4) BEST MATCH

#	Experience (Yrs)	Score (Max 100)	Profile	Remove
1	14	45		
2	13	39		
3	16	35		
4	20	34		
5	7	34		

## b. College –System Initiatives

### i. Engaging Colleges

#### 1. CIITE/CON\*NECT Strategic Alliances

Ontario's 24 community colleges were established between 1965 and 1968. Three define themselves as Institutions of Technology and Advanced Learning and most of the other 21 define themselves as Colleges of Applied Arts and Technology. They serve anywhere between 3000 students (Canadore College of Applied Arts and Technology) to 70,000 students (Humber Institute of Technology and Advanced Learning). Most of the students are part-time and international students. Community colleges are government-regulated post-secondary institutions offering 1- to 2-year academic and pre-professional certificates, diplomas, and 2-year associate's degrees for technicians and 3- and 4-year specialized degrees in technology. The Colleges Integrating Immigrants to Employment (CIITE) project set up under CON\*NECT Strategic Alliances is designed to improve pathways for internationally trained immigrants (ITIs) through the Ontario college system, from pre-entry services to employment transition. LGES has introduced its curricula development process to **17** community colleges and engaged with **7** colleges through CIITE.

#### 2. Private Career Colleges

Canada also allows private career colleges to operate as independent businesses preparing students for a specific job. Private career colleges in Ontario **must** be registered and **must** have their programs approved by the Ministry of Training, Colleges and Universities. There are over 500 career colleges in Ontario offering short (3- to 23-month) certificates and diplomas designed to give students knowledge and skills they need to get jobs. **2** private career colleges were engaged under LGES:

#### ii. Job Requirements

The job articulator was introduced to **8** employers on the college program Advisory committees.

#### iii. IEB competencies

The portfolio builder was introduced to participants in specific college programs to database their competencies **20** participants for the Humber Engineering Connections program and **8** participants for Mohawk College instrumentation program)

*Community and career colleges in Ontario offer academic courses as well as specialized academic upgrading, career and language training for internationally trained engineers. They are particularly relevant to LGES as they combine academics with employer-centered programs, industry connections and internship opportunities.*

## 7 COMMUNITY COLLEGES ENGAGED

- Humber Institute of Technology and Advanced Learning (Civil, Electrical and Mechanical engineering software training)
- Mohawk College of Applied Arts and Technology (Instrumentation) that participated in the curricula development process and
- Centennial College of Applied Arts and Technology
- George Brown College of Applied Arts and Technology
- Confederation College of Applied Arts and Technology
- Fanshawe College of Applied Arts and Technology
- Seneca College of Applied Arts and Technology

## 2 PRIVATE COLLEGES ENGAGED

- North American College
- EPIC College of Engineering Technology



## c. Engineers-in-Training

### i. Customized On-Line Link

Professional Engineers Ontario (PEO) has an Engineering Intern Training (EIT) Program for applicants with a CEAB accredited undergraduate degree, **or** those assigned a Confirmatory Examination Program (CEP) or have completed their Specific Examination Program (SEP) to meet requirements for licensure. EITs can also join the Ontario Society of Professional Engineers (OSPE) that offers extensive preparation courses for CEP and SEP assigned by PEO

### ii. Principles: Emerging Employer And Licensing Requirements

In order to identify the real-time skills and competencies of EITs, and compare these to PEO licensing criteria for EITs these were integrated into the portfolio builder and Job articulator interfaces. OSPE had expressed the possibility of supporting LGES to register EITs during the proposal preparation stage. OSPE continued its engagement with LGES through the Advisory Committee meetings of the 'Engineering your Future Project' of Skills for Change, but did not directly register any EITs under LGES. To meet the deliverables for providing customized curricula for EITs an approach was developed to register EITs through direct outreach. Using a non-OSPE dependent approach and recognizing the key role of PEO for entry into the EIT program, PEO was engaged directly under LGEC through:

- Presentations/ tutorials on the curricula Development Process to the PEO personnel responsible for the EIT program
- Presentations at Program Advisory Groups of Toronto Region and Conservation (TRCA), Skills for Change and SISO
- Through presentations at the TRIEC Employer Roundtable

### iii. Competencies GAPS Abstractor

**51** EITs entered data into the portfolio builder for analysis through the EIT specific 'gaps' analyzer. These comprised:

- 6 Environmental Engineers
- 10 Civil Engineering Graduates (4 Structural)
- 14 Mechanical/Industrial Engineering graduates (4 Plant and piping)
- 6 Electrical Engineering graduates (control/power transmission)
- 9 Electronic Engineering graduates (3 PCBs or circuits)
- 6 from Other disciplines

## ABOUT EITS

**According to information on the EITs in the membership data publicly available through the PEO website**

- Licensing of an engineering intern by PEO is structured along the lines of the following five criteria which must be met over the course of the 48- month internship.
  - Application of Theory
  - Practical Experience
  - Management of Engineering
  - Communication Skills
  - Social Implications of Engineering

Engineering work experience is reviewed for indication that the applicant has had exposure and understanding of each of the criteria.

- Just over 5300 members of PEO are registered as EITs. Just over 4000 are Canadian graduates. Some 1200 are foreign trained. 45% of the foreign trained EITs are from India, Pakistan and Bangladesh alone as compared with 0.8% from Russia, Romania and Ukraine.
- 70% of the EITs belong to civil, electrical, mechanical and chemical engineering disciplines

## d. Direct Employer Engagement

### i. Employer outreach and Mapping

Employer mapping from the employment support tools has been converted into a GIS mapping of over **700** employers in Ontario from all disciplines. This mapping was used to reach out to employers across Ontario. The employer interface has been opened to allow engineering employers to log-in freely from all over Ontario.

### ii. Employer Engagement

Employer outreach and engagement was initiated through:

- Employer research to develop tele-scripts and other materials
- Tele-research to engage employers
- Presentations and brochures

Through this effort Consulting Engineers Ontario, an agglomeration of **250** engineering employers and **24** other employers were engaged in LGES.

### iii. Job-function related Competencies

**1216** Jobs were entered by employers and job developers into the job requirements database under LGES. The following were the numbers in the selected pilots:

- Environmental Engineering (136 Jobs)
- Structural Engineering (120 Jobs)
- Plant Design (14 jobs)
- Switchgear and Controls (36 Jobs)
- Electronics (circuits) (10 jobs)

### iv. Skills and competencies of IEBs

**1583** IEBs joined the CAPE membership since LGES started bringing the total database membership to **3132** immigrants with engineering backgrounds of whom **812** completed their portfolio of skills and competencies. The following were the number of participants engaged for the selected pilots:

- Environmental Engineering (81 IEBs)
- Structural Engineering (36 IEBs)
- Plant Design (65 IEBs)
- Switchgear and Controls (49 IEBs)
- Electronics (circuits) (23 IEBs)

## EMPLOYER MAPPING TOOLS

### MAPPING INTERFACE

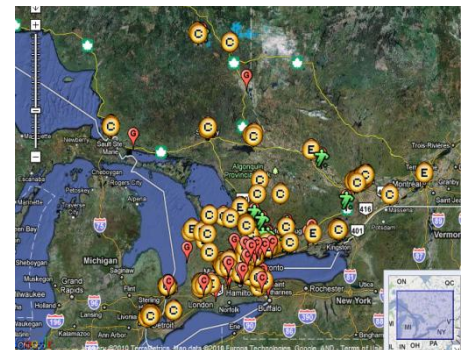
#### Locating an Employer

##### Ontario Business Maps:

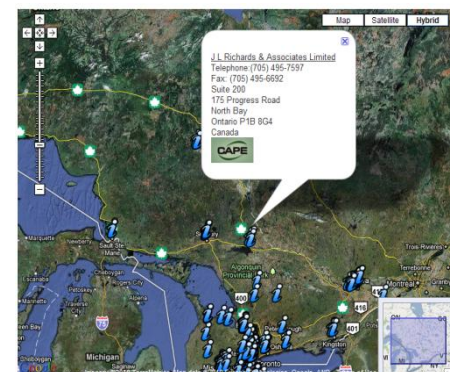
Select Employers by:

Select Category...  
Select Category...  
**By Area Code**  
All Ontario  
Greater Toronto Area (GTA)  
**By Employer Category**  
All Categories  
Chemical Engineering  
Civil Engineering  
Colleges  
Electrical Engineering  
Mechanical Engineering  
Municipality  
Technology

### GIS MAPPING – ALL CATEGORIES



### GIS MAPPING – CIVIL ENGINEERING



### IEB SPREAD BY COMMUNITIES

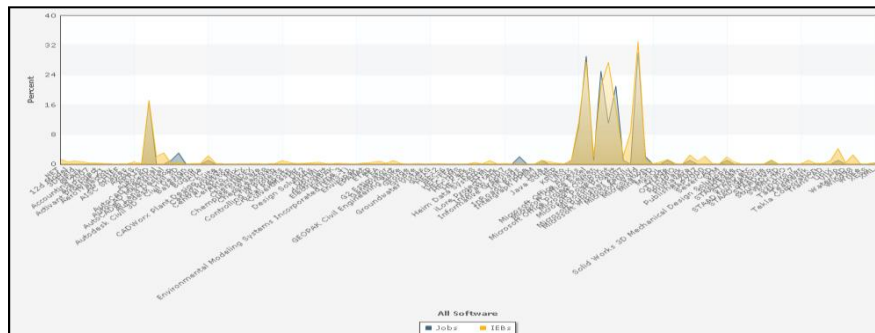
Toronto (416, 647)	-69%
Greater Toronto (905)	-23%
Kitchener/waterloo	
London and Windsor (519)	-3%
Kingston /Ottawa (613)	-3%
Sadbury/Thunder Bay (705)	-2%

## Deliverable 3: Develop Employer-Driven Curricula

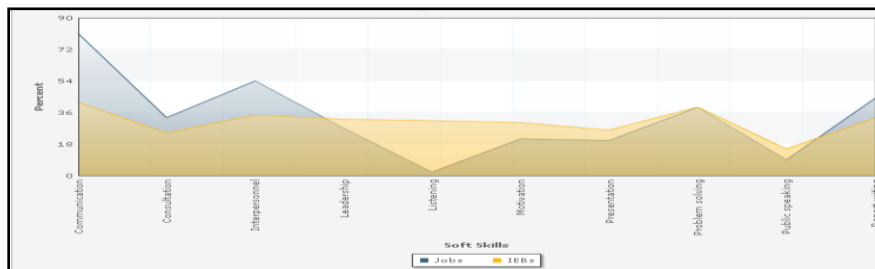
### a. Employer Requirements

Employer requirements entered through the Job articulator were data-based and a labor market reporter adapted to produce real-time reports. Samples of Reports common to all engineering disciplines are produced below.

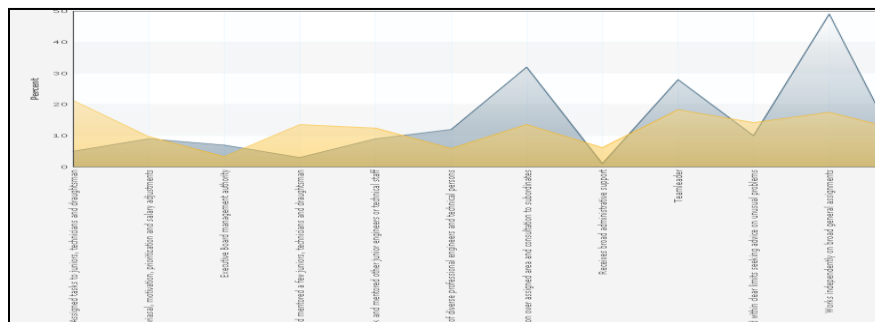
**GAPS: SOFTWARE KNOWLEDGE**



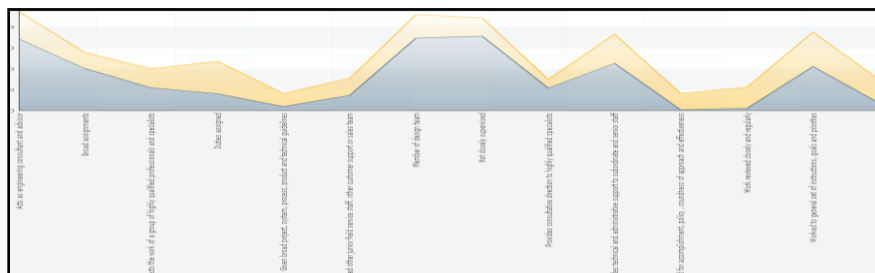
**GAPS: SOFT SKILLS**



**GAPS: LEADERSHIP SKILLS**



**GAPS: WORK RESPONSIBILITIES**



## COMMON REQUIREMENTS

### Software Proficiencies in Demand:

- Microsoft Office Suite especially word, Excel, Outlook and PowerPoint are a must
- Familiarity with AutoCAD and increasingly AutoCAD 3D linked to specific discipline e.g. AutoCAD Civil3D are required
- Knowledge related software is unique to the job and employer

### Soft Skills: Significant Gaps in:

- Engineering communications,
- inter-personal and
- report writing

### Employers: Favor a Leadership Culture

- Supervising staff and subordinates
- Leading Design Teams
- Working independently

### IEBs – Favor Teamwork and responsibilities-driven Culture

- Experienced team members
- Independent workers
- Trained to provide technical and administrative support to other engineers and professionals
- Trained to provide technical and administrative support to subordinates

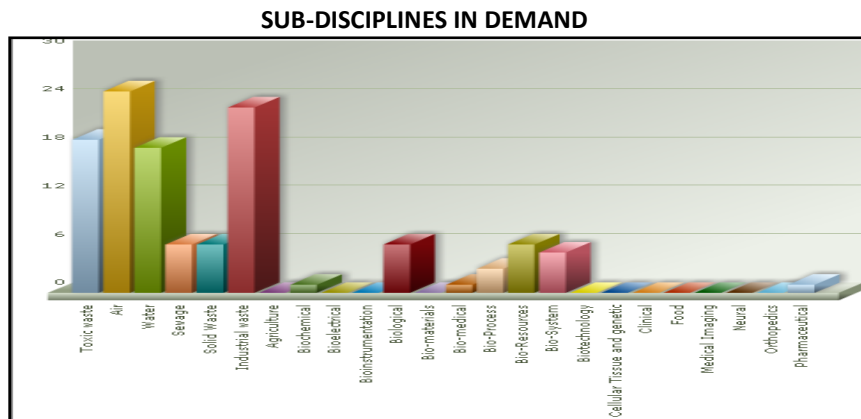


## b. Customized Training Needs for Selected Pilots

Real-time reports on function-related skills and competencies articulated by employers and job-developers for the selected pilots were generated using the gaps abstractor.

### i. Environmental Engineers

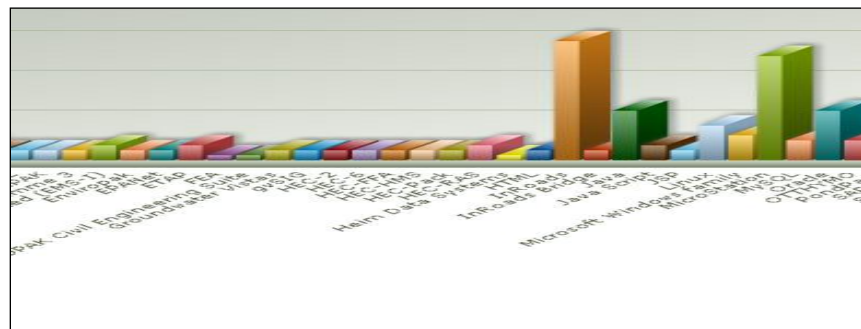
An analysis of 140 jobs revealed the following training Requirements



### TECHNICAL SKILLS IN DEMAND



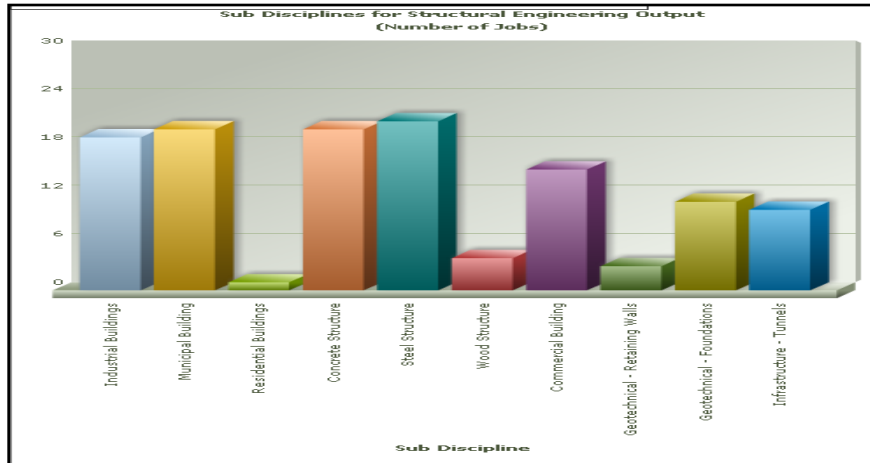
### SOFTWARE REQUIREMENTS



## ii. Civil Structural Engineers

An analysis of 120 jobs revealed the following training Requirements

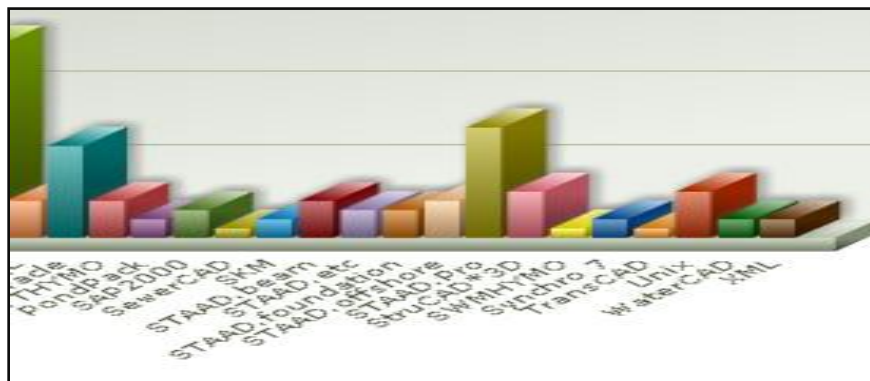
### SUB-DISCIPLINES IN DEMAND



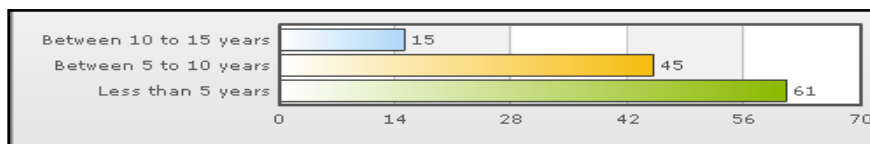
### TECHNICAL SKILLS IN DEMAND



### SOFTWARE REQUIREMENTS



### LENGTH OF EXPERIENCE



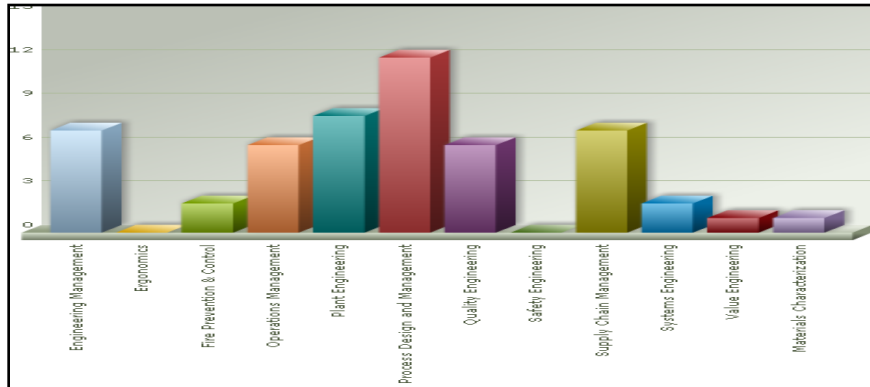
## EMPLOYER REQUIREMENTS HIGHLIGHTS

1. The majority of employers are looking for applicants holding a bachelor degree (72%) or higher (86%).
2. Training mainly needs to target engineering graduates from universities and those having a minimum of 16 years of full-time education
3. 50% of the jobs require less than 5 years experience while 45% require 5 to 10 years of experience.
4. The demand is highest for:
  - i. Concrete and Steel Structures
  - ii. Commercial, municipal and industrial buildings
  - iii. Foundations and tunnels
5. Major technical skills for structural engineers are:
  - i. Project management,
  - ii. Specifications and Documentation
  - iii. Site investigations,
  - iv. Financial and economic analysis
  - v. Design/survey oversight
6. A significant number of the jobs (17 out of the composite of 122) required specialized software knowledge in packages STAAD and StructCAD

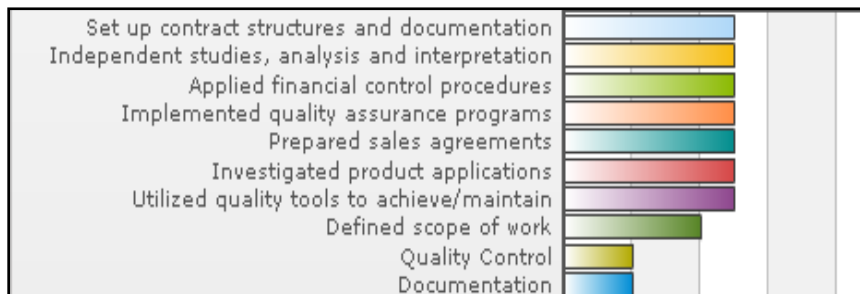
### iii. Industrial Mechanical Plant Engineering

An analysis of 46 industrial, manufacturing and production engineering jobs of which 8 jobs were in Plant engineering revealed the following training Requirements:

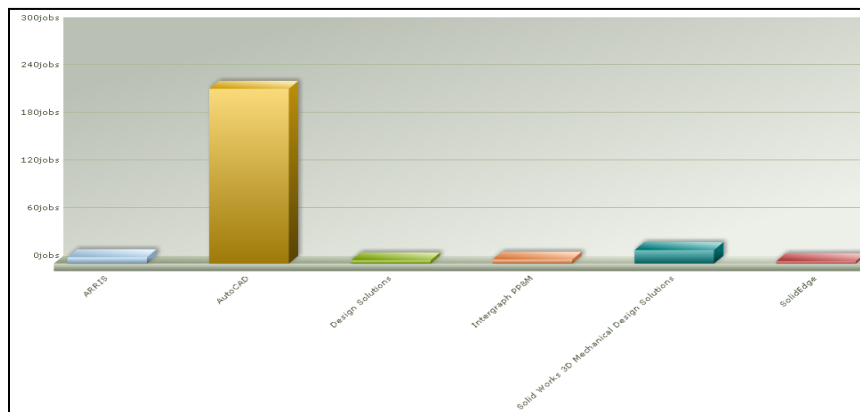
#### SUB-DISCIPLINES IN DEMAND



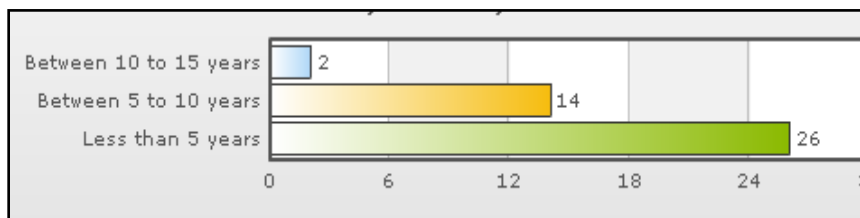
#### TECHNICAL SKILLS IN DEMAND



#### SOFTWARE REQUIREMENTS



#### LENGTH OF EXPERIENCE



### EMPLOYER REQUIREMENTS HIGHLIGHTS

- The majority of employers are looking for applicants holding a bachelor degree (72%) or higher (86%)
- Training mainly needs to target engineering graduates from universities and those having a minimum of 16 years of full-time education
- Over 60% of the jobs require less than 5 years experience while 35 % require 5 to 10 years
- The demand is highest for:
  - Process design and management
  - Plant engineering
  - Engineering Management
  - Supply chain management
- Major technical skills for industrial engineers are
  - Contract and financial management
  - Independent studies
  - Quality assurance
  - Sales and applications
- Significant number of jobs require knowledge of Microsoft Office but very few (5 jobs out of the composite of 46) require specialized knowledge of enterprise software such as Intergraph



### c. Best Fits for Employment Support Programs

#### i. Types of Employment Programs

The following are different transition-to-employment programs offered to immigrants with engineering backgrounds in Ontario:

- Internships combined with academic upgrading support aimed at licensure with PEO or certification with OACETT
- Academic upgrading and co-op programs lasting anywhere between one and three years inclusive of internships and academic modules. These are offered by community and private colleges or other similar formal education institutions
- Employment preparation and bridge training including job search workshops, resume writing, interview skills, language training, skills training, mentoring and work placements
- Workplace and occupation specific training programs

LGES engaged with all these types of programs.

#### ii. Pilot 1: Toronto Region and Conservation – TRCA (35 applicants for internships and 40 employers) – workshops and communications supports

Toronto and Region Conservation (TRCA) runs the Professional Access & Integration Enhancement (PAIE) Program for Internationally Trained Engineers and Geoscientists. PAIE is an Ontario bridge training program that works to provide professional internship/placement opportunities for Internationally Trained Engineers and Geoscientists in environmental sub-disciplines. The program helps applicants to fulfill Canadian experience requirements for a professional license with PEO and APGO. It includes:

- Professional, technical Language and communications training
- A 12-month, high-skilled work placement with a host employer in the field of Engineering or Geosciences

Under LGES we engaged with TRCA to:

- Use our candidate to job matching tools to identify entrants
- Registered all participants in this program and trained them to build complete portfolio of their skill sets
- Strengthen the candidate to internship matching by presenting and offering tutorial on job-development for the program
- Strengthened the content of the professional and skills training offerings through updated labor market reporting.

### CURRICULUM DEVELOPMENT

*This process can be categorized into five basic steps:*

- Needs assessment,
- Planning
- Content development
- Pilot delivery and revision, and
- Completed curriculum package

*The mode of knowledge transfer determines the nature of the training curricula to be developed*

- A Course Outline is the form of curriculum contract between a student and academic institution such as a college or University. It provides a description of the course, its content, requirements, learning resources and relationship to standards.
- Modular training is industry-driven skills training for a specific sector, that is usually delivered in incremental units (i.e. modules) of short duration
- Seminars are educational events that feature one or more subject matter experts delivering information primarily via lecture and discussion.
- Workshops tend to be smaller and more intense than seminars. often involving students in practicing new skills during the training

**iii. Pilot2: Humber School of Applied Technology:  
Engineering Software Skills Enhancement Program –  
Civil, Electrical and Mechanical Engineering - College  
and Course driven**

The Humber Institute of Technology and Advanced Learning offers a part-time, 2-semester program that provides internationally trained engineers with training in the latest technical and software skills in demand by Ontario employers:

The program focuses on MECHANICAL, CIVIL, AND ELECTRICAL Engineering and includes an AutoCAD competency assessment, academic credentials evaluation, job search assistance, educational counseling, enhancement of workplace communication skills and on-going assistance to help connect with employers. The program includes training in:

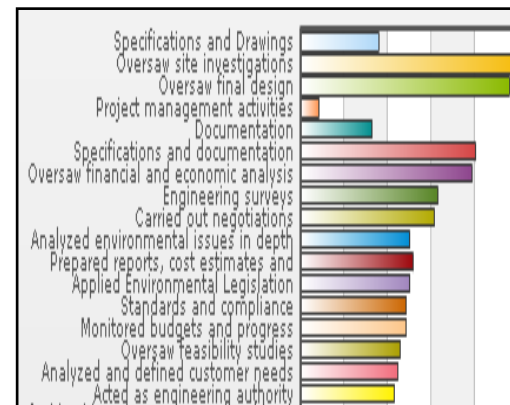
- AutoCAD (Electrical and Civil)
- Computer Aided Estimating
- PLC (Programmable Logic Control)
- Control Systems and Simulations
- Project Management
- WHMIS/Codes/Licensing and Professional Standards
- Career Planning
- Revit
- Canadian Electrical Codes
- Ontario Building Code (OBC) - Part 9

Through LGES we engaged with Humber College on this program :

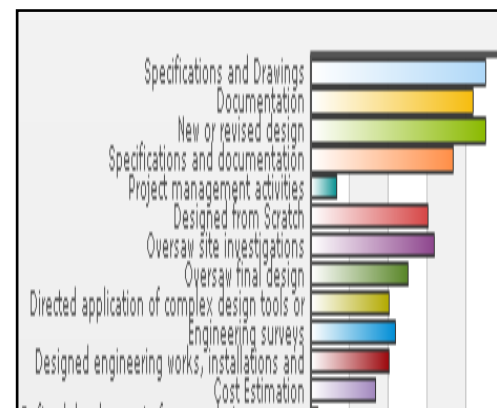
- To identify and register entrants to this program and trained them to build their portfolios of skills and competencies
- Access our real-time labor market information to help applicants to identify their individual software gaps upon entry to this program
- Identified the content of communications training for engineers and shared this with Humber College and ACCES Employment Services

## TOP SKILLS IN DEMAND

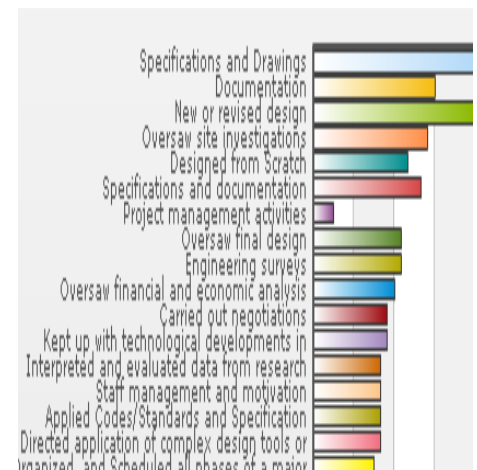
### a. Civil Engineering



### b. Electrical Engineering



### c. Mechanical Engineering





**iv. Pilot 3 : North American College (NAC)**

Under this pilot we engaged with NAC to strengthen training content on Communications, leadership, teamwork and design education for Electrical, electronic, mechanical, and civil engineering

**v. Pilot 4 : EITs Professional Development training – OSPE- Workshops and Seminar Driven**

Most OSPE workshops/seminars support technical examinations for licensure and grounding in engineering principles. OSPE offer these in partnership with EPIC Educational Program Innovations Center and others. LGES engaged with EPIC to pilot the employer-driven and function-based curriculum development process to develop modular curriculum for environmental engineers.

**Deliverable 4: Workplace Training Supported By Partners**

In addition to the above pilots that have been undertaken under LGES, we are currently engaged with the following **3** partners to support workplace training using the employer-driven job-function based curricula development process for curriculum building

**a. Consulting Engineers Ontario (CEO)**

A letter of understanding was signed with CEO to make available research on the employer-driven curricula process and engage with CEO on the feasibility of supporting the development of online professional development courses that CEO will offer its members.

**b. EPIC Educational Program Innovations Center**

A memorandum of understanding was signed with **EPIC Educational Program Innovations Center**, a career college to establish a collaborative partnership that will cover all environmental engineering training Programs. The Programs are to be modular.

**c. North American College HVAC**

A memorandum of understanding was signed with the North American College to establish a collaborative partnership that will result in the development of an employer-driven function-based Heating Ventilation and Air Conditioning mechanical engineering. This training program will be offered as a mid-career advanced competency stream of engineering for engineering technology graduates. The Program is to be modular.

**ABOUT CEO**

*Consulting Engineers of Ontario is the recognized voice of consulting engineering in Ontario. It is a not-for-profit, member-governed association representing over 250 consulting engineering firms in Ontario.*

**ABOUT EPIC**

*EPIC Educational Program Innovations Center is a leading technical training solution provider of engineering and technology programs in the private sector throughout North America. EPIC delivers short courses/seminars on specialized topics in an all-inclusive range of technologies.*

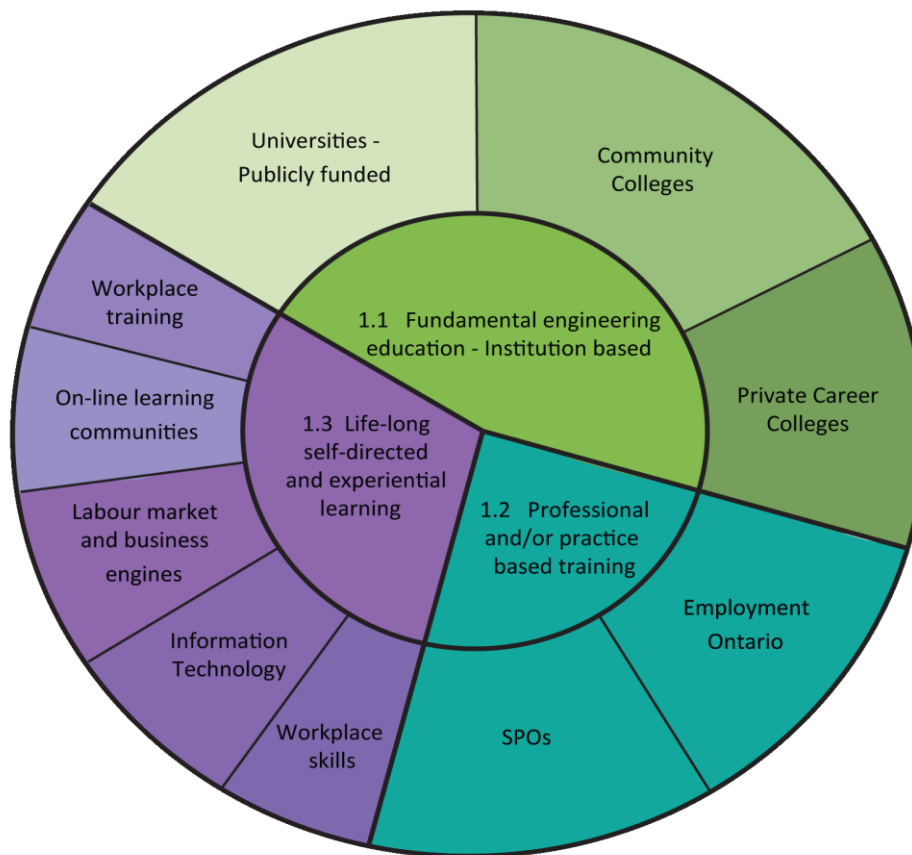
**ABOUT NAC**

*North American College Of Information Technology Inc., Toronto offers various diploma and certificate programs as well as bridge training to internationally trained professionals. The diploma programs are blended well with cooperative (co-op) education program wherein theoretical education is supported with practical work experience*

## KEY FINDINGS

The emerging model for engineering education in Ontario can be presented as shown below. Based on this it can be seen that an engineer's education today comprises three distinct components:

- a. Intense in-classroom education to attain firm grounding in the basis of science, principles of engineering and analytical capabilities
- b. A 'co-op', work placement or industrial professional and practice related training to fully ground theoretical knowledge gained in the classroom into the practice of engineering
- c. Life-long experiential and peer-to-peer learning to keep up with the rapidly changing workplace, technology, applications and knowledge.



### *Emerging Model of Engineering Education in Ontario*

Although learning for engineers is increasingly moving out of the classroom, into the workplace and online, one constant in engineering education is the need for sound academic grounding in the basis of science, engineering principles, and analytical capabilities. A strong grounding in the



fundamentals will remain the most important service that universities, colleges and other educational institutions provide through expertly conceived, well delivered lectures as teaching and learning experiences. Since immigrants with engineering backgrounds already hold higher academic education than is articulated by the employers, this component will not be a significant component of employment preparation for IEBs.

The need for immediate on-boarding, learning-by-doing, and connectivity to just-in-time information sources is the main need for IEBs. LGES analysis shows that engineers need to have high computer proficiency and ability to work in an AutoCAD environment. This is borne out by the real-time skills requirements analysis for all four pilots and indeed across all engineering disciplines which show that Proficiency in use of the Microsoft Suite of product and knowledge of AutoCAD are essential employer requirements. AutoCAD 3D related proficiencies are also on the increase. The skills gap analysis does not reveal deficiency in the skills of IEBs in this connection. Mandatory certification and testing for Microsoft suite and AutoCAD should be introduced for all immigrants with engineering backgrounds to enable entry into the workforce and prior to entry into software skills trainings.

A significant deficiency gap appears to exist between employer's requirements for communication, consultation and interpersonal skills and the competencies of IEBs in this area.

A significant deficiency gap also appears to exist between employer's requirements for team-leading, working independently, consulting with juniors over an assigned area and management roles. The employers favor a Leadership Culture that requires for instance supervision of staff and subordinates, leading design teams and working independently. On the other hand IEBs favor teamwork and responsibilities-driven culture so that tend to be experienced team members, independent workers trained to provide technical and administrative support to subordinates, other engineers and professionals. This clearly indicates a need for cross-cultural learning curricula in engineering practice in Ontario.

With the advent of web 2.0 applications strong communications are becoming a central requirement in engineering. virtual learning environments and communities cutting across time and distance are being created that allow engineers to include the following in their professional development:

- Collaborative, socially-relevant learning to develop the professional skills of teamwork, communication, and leadership
- Cross-cultural and multi-disciplinary competence for a global world where products are likely to be co-designed with someone in another country

These developments need to be integrated into engineering education.

Typical workplace based technical skills gaps that were identified in the discipline specific pilots revealed the following:

- Environmental engineers would benefit from a curricula that includes Intense grounding in environmental legislation , communications training , Teamwork, leadership and Inter-personal skills training and Computer proficiency tests
- Structural engineers would benefit from a curricula that includes business and financial management, design management and Communications training
- Industrial/manufacturing plant engineering can be strengthened through a curricula that includes business and financial management, report writing and preparation of studies, quality assurance training and Communications training
- Electrical/electronic switchgear and circuits engineers would benefit from a curricula that includes design management, documentation , cost estimation and practicum on site investigations

Engineering practice-based learning to support academic learning to fully ground theories taught in a classroom is a new dimension that is emerging in engineering education. This appears to be validated by the composite of discipline specific gaps that have been identified through the four LGES pilots. Engineers are being alerted to the need to develop attributes which in addition to the traditional essential technical grounding, analytical competencies and industrial training call for and require engineers to have functional skills such as practical ingenuity, creativity, business and management fundamentals, leadership, agility, resilience, and commitment to lifelong learning. This is required so that engineers can:

- Keep up with the fast changing and multi-disciplinary nature of engineering through life-long learning
- Develop design, creativity, and innovation skills as it is no longer acceptable for engineers to just analyze problems or mathematically derive models of problems. They have to be able to synthesize unique and innovative designs using their knowledge base.

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[http://www.capeinfo.ca/docs/ceris\\_paper\\_41november\\_2005.pdf](http://www.capeinfo.ca/docs/ceris_paper_41november_2005.pdf)

<sup>ii</sup> G. K Bambrah (2006) *Engineering Access Project Final Report: On Community Action Research To Engage Stakeholders In Documenting And Addressing Barriers To Effective Labour Market Integration And Participation Of Immigrants With Engineering Backgrounds Settling In Ontario* Published by CAPE and available on the following web-link: [http://www.capeinfo.ca/docs/final\\_report\\_june\\_15\\_2006.pdf](http://www.capeinfo.ca/docs/final_report_june_15_2006.pdf)

<sup>iii</sup> G. K Bambrah (2006). *From 'Canadian First' To 'Canada First': A Multi-Stakeholder Employment Strategy for Immigrants with Engineering Backgrounds*. Edited by Nikhat Rasheed, published by CAPE and available on the following web-link: [http://www.capeinfo.ca/docs/employment\\_strategy\\_may\\_18\\_2006.pdf](http://www.capeinfo.ca/docs/employment_strategy_may_18_2006.pdf)

<sup>iv</sup> G. K Bambrah (2008). *Final Research Report: Skills Commensurate Engineering Access Project*, published by CAPE and available on the following web-link: [http://www.capeinfo.ca/docs/employment\\_strategy\\_may\\_18\\_2006.pdf](http://www.capeinfo.ca/docs/employment_strategy_may_18_2006.pdf)

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