

Development of an Engineering Qualifications Recognition Program for Immigrant Professionals: a Case Study*

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This paper presents a case study of the development and evolution of a qualifications recognition (QR) program for immigrant engineering professionals at the University of Manitoba, Canada, within the framework of action research. Qualitative data were collected through participant-observation and through focus groups and follow-up questionnaires with participants from 2003 through 2008. The findings show the evolution of the program from a process narrowly focused on formal recognition of foreign academic credentials, to a program focused on holistic qualifications recognition goals of full professional integration, including labour market access and success, cultural understanding, professional networking, and language development. This evolution occurred within a framework of partnerships between university, regulatory body, and industry.

Keywords: immigration; foreign credentials recognition; qualifications recognition; action research; qualitative research

1. INTRODUCTION

SKILLED IMMIGRANTS are relied on in Canada to address labour market needs across the professions, including engineering. Yet when immigrants arrive in Canada with non-Canadian engineering credentials and experience, they are often surprised to learn that, by law, they must be registered with a provincial engineering association (regulatory/licensing body) in order to practice professional engineering and gain meaningful employment. Many Asian and South and Central American countries—which are also the top source countries for immigration to Canada—do not have a licensing system for professional engineering comparable to Canada's system. In many cases, the bachelor degree in engineering is both the right to title and the right to practice engineering. Two international agreements impact the licensing of professional engineers: the Washington Accord and the Bologna Process. However, the signatories to those agreements do not generally rank among the top source countries for immigration to Canada. The Washington Accord is an international accreditation agreement for engineering degrees, which subsequently serves to facilitate mobility and licensure between the signatory countries. The signatories include Australia, Canada, Ireland, Hong Kong, Japan, New Zealand, Singapore, South Africa, South Korea, Taiwan, Malaysia, the United Kingdom, and the United States. The Bologna Process creates a European Higher

Education Area, by working toward substantive equality between the academic degree standards throughout Europe. There are over 40 participating countries to the Bologna Process, including numerous non-EU nations.

Canadian regulatory bodies have always provided licensing pathways for these newcomers—formally identified as international engineering graduates (IEGs)—often in the form of an assigned set of Confirmatory Exams to confirm technical background and establish eligibility for licensure. However, with increasing immigration and with a higher proportion of immigrant professionals entering Canada, government is urging all professional regulatory bodies to develop alternative licensing pathways that integrate immigrant professionals more quickly and effectively while maintaining standards for public safety.

Within the Canadian engineering profession, IEGs confirm the need for new licensing pathways, citing difficulties in Foreign Credentials Recognition (FCR) and gaining Canadian engineering experience as the two primary obstacles to full labour market participation [1–3]. Engineering employers concur that the most important factors influencing IEGs' level of employment are prior related Canadian experience, communication skills, and professional licensure [1, 4]. Formal FCR is only one aspect under a broader umbrella of Qualifications Recognition (QR) for foreign-trained professionals, where QR also encompasses an employer's acceptance of and confidence in an IEG's credentials, skills, and competence, as manifested in labour market access and successful, sustained engineering employment. While FCR

* Accepted 15 April 2010.

can assist with labour market access, it alone does not guarantee access nor ongoing success. Simultaneously, there is recognition that QR issues can obscure the full potential of IEGs, including variations in educational quality, cultural issues, English language ability, working styles, and perceptions of work [5, 6]. Simple exposure to an environment does not cause language or intercultural competence to emerge naturally, and both language and cultural teaching are critical in preparing IEGs to navigate professional contexts successfully [7]. QR encompasses the programs and processes that seek to address the challenges that can keep IEGs from reaching their full potential and mainstream society benefiting from the same. There is fundamental recognition that engineering has much to gain from diversity among its practitioners.

The Internationally Educated Engineers Qualification Program (IEEQ) was developed in 2003 at the University of Manitoba, Canada, to address QR for newcomer IEGs to Canada. IEEQ was developed to serve as an alternative licensing pathway for IEGs, recognized by the provincial regulatory body (Association of Professional Engineers and Geoscientists of Manitoba, or APEGM). In the Canadian regulatory (licensing) system, Engineer-in-Training (EIT) is the first licensing stage, achieved on the basis of academic qualification, defined as an accredited undergraduate engineering degree or equivalent such as a set of Confirmatory Exams or completion of IEEQ. After four years' work experience and successful completion of a national ethics exam, EITs are eligible for the full Professional Engineer (P.Eng.) license). This paper presents a case study of the development and evolution of the IEEQ Program, as the outcome of a multi-year action research process.

2. BACKGROUND AND RESEARCH OBJECTIVE

Universities in Canada lack the mandate and thus the historical practice of facilitating licensure and QR for immigrant professionals in formal partnerships with regulatory bodies. Within the engineering education literature, also very little has been written on the processes of professional integration as professional engineers immigrate around the world. The intersection of culture and engineering education is predominantly discussed in terms of preparing North American graduate engineers for professional practice in an environment of globalization, defined as the internationalization and increased co-dependence between countries in economic, social, and cultural matters [8]. Occasionally, the need for engineers to be prepared to direct their career talents to global pressures brought on by population growth, energy challenges, and climate shifts is discussed [9]. More often, the pressures that globalization is

perceived to exert on engineering education revolve around preparing North American graduate engineers for careers that may take them across national boundaries, and will almost certainly involve working in physical or virtual teams with professionals in other locations and representative of other cultures. Accordingly, key curricular thrusts include increased international exchange experiences, a focus on second-language learning, and an explicit focus on appreciation of cultural values [10–12]. Only rarely do studies examine the social issues and second-order implications more broadly, as Nieuwma and Riley [13] do in their study on the social justice considerations inherent in interdisciplinary technical collaboration. Another exception is a study by Cholewka [7], motivated by a context similar to the IEEQ Program—that of increasing immigration to Australia, with preferential immigration selection criteria for skilled immigrants such as engineers. Cholewka investigates factors that influence immigrant engineers' language competency and abilities to (linguistically) navigate real-life situations in a professional context. Her findings highlight the frequent mis-estimation of an immigrants' overall professional competence on the basis of their language proficiency, and stress the importance of combining both language and cultural teaching in preparing foreign-trained engineers to navigate professional contexts successfully.

The knowledge base for university-based QR programs (in all professions) is predominantly experiential. Yet, since universities are increasingly called upon to partner with government and industry in the development and delivery of QR programs, the Association of Universities and College of Canada (AUCC) have embarked on initial efforts to develop a knowledge base of Canadian university capacity, expertise, and key issues in the area of FCR for immigrant professionals [14]. The overall objective of the study was to determine the capacity of and to provide a basis for further design, development, and delivery of programs in Canadian universities. Drawing on survey responses from 40 Canadian institutions supplemented by in-depth case studies at five Canadian universities—of which IEEQ was one—specific best practices and key elements of programs for immigrant professionals were identified:

- (1) A formal role for Foreign Credential Recognition, delivered in a manner that conveys respect for the professional status of participants;
- (2) A strong admissions process, at times involving multiple stakeholders, and the engagement of a wide variety of flexible methods within established admission standards to assess and identify individuals with the strongest chance of succeeding in the program;
- (3) Providing training in language and communication skills for professional environments,

- including the language and culture of the profession and the workplace;
- (4) A role for continuous formative assessment of program participants, in order to provide multiple snapshots of knowledge and skills, and to adjust individual learners' programs allowing them to complete their programs in the most effective and efficient manner;
 - (5) Active collaboration among all stakeholders including the university, regulators, professional associations, government, employers, and immigrant settlement agencies during program development and delivery;
 - (6) Access and/or referral to appropriate financial resources that make program participation a viable option for immigrant professionals;
 - (7) A professional work experience component, designed to provide tangible value in the form of credit toward licensure requirements and/or professional-level Canadian workforce experience;
 - (8) Leadership, in commitment of faculty members coupled with moral, policy, and financial support of the university and faculty administration in which programs are delivered.

While the core of the program may be general and technical subject matter, exemplary programs include diverse components that link participants to the community and the labour market, and address factors that influence labour market participation: language, and communication skills, Canadian work experience and knowledge of the professional culture, and professional licensure requirements [14]. However, the absence of established programs in engineering with which to compare delivery, assessment, evaluation, participants' experiences, and program outcomes have led to these frameworks being locally generated within IEEQ [15–17].

In order to extend the research and critical knowledge base in QR for immigrants in the engineering profession, a multi-year study was conducted as a participant-oriented evaluation of the IEEQ Program for both formative and summative purposes [18]. The study was intended to build a comprehensive understanding of the entire range of participants' experiences in IEEQ, and provide insights into the scope of the professional engineering body of knowledge and potentially broader epistemological concerns regarding knowledge, skills, or attitudes that hinder or enable the potential of IEGs as engineering professionals in Canada.

This paper focuses on aspects of the study that relate to the development and evolution of the IEEQ Program from a FCR initiative to a QR initiative through an action research process. Consistent with the study's qualitative methodology within an interpretive framework, the findings are reported narratively in a case-study style.

3. THEORETICAL FRAMEWORK

The study was based on action research, a research specialty associated with program evaluation research [19]. One of the most widely cited definitions of action research is that "action research aims to contribute both to the practical concerns of people in an immediate problematic situation and to the goals of [social] science by joint collaboration within a mutually acceptable ethical framework" [20, p. 499]. The development of the IEEQ as a new program became the 'immediate problematic situation' and the understanding of participants' experiences and that understanding's contributions to the engineering body of knowledge became the 'goals of [social] science.' On a practical level, action research consists of a family of research methodologies which pursue action [practice] and research [theory] at the same time [21]. The goals and outcomes of action research may include new knowledge, understanding of situations and practice, as well as change of social situations and practice [22].

Researchers whose primary goals include understanding and change of socially-conducted practice, or to "improve practice through the application of the personal wisdom of the participants" [23, p. 357], resonate with the view of 'practice as inquiry' and Schön's [24] exploration of the reflective practitioner. Further characteristics of action research include its cyclic or iterative nature, its focus on participation in which informants are involved and active in the research process, and its reflective stance in which critical reflection upon process and outcomes are an important part of each cycle [21].

Action research can be framed around quantitative, qualitative, or mixed methods for specific data collection and analysis. This study took an interpretive action research approach, seeking understanding and reconstruction of the views of participants, and identification of themes and patterns. A qualitative methodology was used to support this approach. Qualitative research reports detailed views of small numbers of participants and is conducted in a natural setting. The potential outcomes of qualitative inquiry include description, interpretation, understanding of actors' perspectives and experiences, hypotheses, and grounded theory [25].

4. METHODOLOGY

4.1 Research context

The research site was the IEEQ Program in the Faculty of Engineering, University of Manitoba, Canada. The University of Manitoba is a large research-doctoral institution, offering degree programs in civil, mechanical, electrical, computer, and biosystems engineering to an undergraduate enrollment of approximately 1100 students. As a

fledgling program, IEEQ enrolled small cohorts of approximately nine to 12 participants on an annual basis from 2003 through 2008 (the time period of the larger study). Successful completion of IEEQ leads to registration as Engineer-in-Training (EIT) with the regulatory body.

4.2 Study participants

The research employed purposeful sampling [25], in which participation was requested based on a direct relationship to the study context and participants' abilities to contribute to the goals of the study. The participants of the study consisted of all participants (IEGs) in the first four cohorts of the IEEQ program. The cohorts are hereafter identified as IEEQ1 through IEEQ4. Individual cohort sizes were approximately ten to twelve (total $N \approx 40$). Recruitment of all participants for all data collection events was done by the researcher via an initial email to the participants, followed by a letter outlining the nature and purpose of the research, the nature of the data collection activity, and solicitation of informed consent from the participants. All participation was voluntary, and no compensation was offered for participation.

4.3 Data collection and analysis

As an action research study, much of the data was collected by the researcher as a participant-observer. The researcher—who was also the program coordinator of the IEEQ Program over the period of the study—was intimately engaged in the program development and delivery. While much of the data was gathered via the lived, daily experience of coordinating the IEEQ Program and recorded in the documents created in the course the same, the researcher additionally and systematically created regular observational notes accompanied by written critical reflections and critiques of the observations, and regular peer debriefing of the same over the course of the study.

The IEEQ participants were invited to take part in the following data collection activities:

- (1) One focus group interview of 90-minute duration with each cohort IEEQ1 through IEEQ4, timed during the last month of their participation in the IEEQ Program (four focus groups in total). The focus groups were long interview format [26], and collected data on participants' perceptions and experiences in the academic portion, cultural training, and language development aspects of the program. A neutral third party moderated the sessions, which were held on campus; and,
- (2) Two mail-out follow-up questionnaires to all participants who successfully completed the IEEQ Program in cohorts IEEQ1 through IEEQ4, timed for nine months and 24 months after completion of the IEEQ Program (eight questionnaire distribution events in total). The questionnaires collected data on

participants' perceptions and experiences in the co-op work experience component of the program, and their subsequent career development post-IEEQ through closed- and open-ended questions.

All focus groups were audiotaped, and summary notes of the focus group interviews and questionnaire responses were provided to participants for member-checking. The notes employed a coded system to maintain anonymity, and all participants were invited to contact the researcher at any time to discuss the emerging findings and read interim and final drafts of the research publication. Content analysis was applied to the qualitative data. Data were coded, summarized, and related to one another in an emergent conceptual framework of patterns and themes. Reasoned judgments and interpretations were applied to the patterns and themes that emerged. The entire research protocol was approved by the University's Research Ethics Board before implementation.

5. FINDINGS: THE EVOLUTION OF IEEQ FROM AN FCR TO A QR PROGRAM

Consistent with the qualitative methodology and the action research approach, the findings are presented descriptively, reflective of a case study. The IEG participants in this study came from 20 countries on four continents (in descending order: Asia, Central/South America, Europe, and Africa), were generally between 30 and 45 years old, and typically had spouses and children. Five participants were female and the remainder were male. All participants had previously completed a bachelor-level engineering degree in their home country, and approximately one-third of participants had additional education, either in the form of partial or completed graduate degrees, certificates, or diplomas in engineering or other fields (e.g. management, accounting). Their years of professional experience in engineering before immigration to Canada generally ranged from three to 15. Approximately half of the participants had some Canadian employment experience; however, most participants had no engineering work experience in Canada before entering IEEQ. Table 1 summarizes the outcome statistics for the first six cohorts.

The process of designing the IEEQ Program began with a realization of the needs and pressures that IEGs encountered. The identified problem included the need for skilled labour in Canada and Manitoba and low engineering licensing rates and poor labour market outcomes for IEGs when compared to Canadian-educated engineers. This observed problem was supported by research that identified difficulties in foreign credentials recognition—FCR—and in gaining Canadian professional experience as the two primary obstacles to immigrant professionals' full labour market parti-

Table 1. Outcome statistics for cohorts IEEQ1 through IEEQ6

Cohort	Number Enrolled	Number Graduated	Registered as EIT upon graduation	Registered as P.Eng. at time of writing	Employed in engineering	Employed in engineering-related employment
IEEQ1	7	5	100% overall	63% overall	76% overall	19% overall
IEEQ2	14	13		(cohorts 1–5);	(Note 4)	(Note 4)
IEEQ3	9	7		Note 2		
IEEQ4	9	6		Note 3		
IEEQ5	10	9				
IEEQ6	16	15				
Total	91	77 (85%)				

Notes:

1. By virtue of successful completion of IEEQ, students are registered as Engineer-in-Training (EIT) with the regulatory body.
2. The number is expected to increase as graduates fulfill the years of Canadian engineering experience required for registration as a Professional Engineer (P.Eng.) with the regulatory body.
3. At time of writing, cohort IEEQ6 and beyond have not gained the requisite years of Canadian engineering experience to be eligible for P.Eng. registration.
4. Self-reported by graduates.

icipation. Further research substantiated that engineering employers considered Canadian experience, professional licensure, and communication skills to be key determinants of IEGs' levels of employment. Pressures from the Manitoba government on regulatory bodies to develop alternative licensing pathways all served to further establish and define a problem area. Out of these needs and pressures, the objectives of the IEEQ Program were initially conceived to:

- (1) Develop an alternative licensing pathway formally recognized by the regulatory body (APEGM) as leading to eligibility for licensing;
- (2) Address known challenges in the traditional licensing pathway (an assigned set of technical Confirmatory Exams), by providing an alternative pathway for IEGs that would be more time-effective, sustain higher completion rates and lower attrition rates than the traditional pathway, and decrease feelings of isolation that were anecdotally known to exist among IEGs pursuing licensing;
- (3) Include a degree of labour market integration for IEGs.

A number of specifications and constraints were imposed on the first iteration of the program design. These included:

- (1) A program design that would be deliverable within the physical, social, financial, and policy infrastructure of the University of Manitoba. The anticipated 'culture clash' consisted of offering a professional certification/licensing program in an environment tailored toward undergraduate education and graduate research;
- (2) A program design that APEGM would evaluate to be substantively equivalent in terms of IEGs' effort and outcome validity to the traditional licensing pathway of writing Confirmatory Exams;

- (3) In terms of process, all IEGs seeking professional licensure in the province begin by applying to APEGM for an assessment of their existing academic credentials. For non-Washington Accord applicants, the typical outcome of the APEGM assessment is the assignment of a set of technical Confirmatory Exams. Upon successful completion of the Confirmatory Exam program or successful completion of IEEQ as an alternative, the applicant is deemed eligible for licensure as an Engineering-in-Training. Eligibility to participate in the IEEQ Program was defined by APEGM as those IEG applicants assigned five or fewer Confirmatory Exams in their academic assessment. Although it was unknown at that time what proportion of total IEG applicants this criterion captured, APEGM perceived these applicants to be closest to achieving the licensing requirements and thus having the best chances to succeed in the IEEQ Program. Successful completion of IEEQ would serve as a full and complete alternative to a Confirmatory Exam program, for the purposes of eligibility for professional licensure.
- (4) A limited amount of funding provided by the Government of Manitoba to deliver the program, with funding offered on a project-basis, subject to annual review and renewal. This necessitated an initial focus on demonstrating near-term outcomes and hindered the ability to plan for long-term initiatives; and,
- (5) A very short timeline of two months between program approval and the first student intake. This required program development and delivery to occur concurrently for the first program cohort, IEEQ1. In addition, there were no local or broader precedents from which to create IEEQ, and no familiarity within industry of the IEEQ concept.

5.1 First iteration—IEEQ1

The initial program was solely defined around

two components within a fairly narrow FCR focus: eight months of senior-level undergraduate engineering courses and a four-month co-op work term. The goals were to confirm technical competency and to gain Canadian engineering work experience. The academic portion was set at eight courses for each individual, to provide an opportunity for a range of coverage of topics. Three courses were established as mandatory core courses: Engineering Economics; Technology and Society; and Practicing Professional Engineering in Manitoba. The first two mandatory core courses were selected on the basis of their absence in most IEGs' previous academic background.

The third core course, Practicing Professional Engineering in Manitoba, was developed specifically for the IEEQ participants and focused on the non-technical aspects of IEGs' professional integration in Canada. Topic areas included cultural differences and how they manifest themselves in professional engineering practice, the regulation and organization of professional engineering in Canada, engineering ethics, engineering law, and selected employment-related topics including project management, workplace safety and health, and quality systems. The course instructor was selected for a background in professional engineering practice, P.Eng. status, and formal education in post-secondary curriculum development and teaching.

The remaining five of eight courses were selected to address the topic areas of the Confirmatory Exams assigned by APEGM, and these courses varied for each participant. Except for the course Practicing Professional Engineering in Manitoba, IEEQ students were placed into available spaces in existing courses at the third and fourth year levels within the four engineering departments at the University of Manitoba. In this way, the IEEQ participants demonstrated technical competency in the same Canadian Engineering Accreditation Board (CEAB)-accredited courses and to the same evaluation standards as graduate engineers applying for EIT registration to APEGM. This decision, as opposed to creating new stand-alone technical courses specifically for IEEQ participants, was in direct response to the constraints outlined earlier.

In the initial iteration of the IEEQ Program, APEGM actively monitored the delivery of IEEQ and of individual participants' progress via regular presentations by IEEQ staff to the APEGM Academic Qualifications Committee (consisting of approximately 16 members). APEGM also maintained an active role post-IEEQ, by formally accepting successful completion of the IEEQ Program as demonstration of academic qualification and, thus, as eligibility for EIT registration. This approval for academic qualification was initially extended by APEGM to IEEQ on an annual basis.

IEEQ1, the first cohort of eight IEGs, began the IEEQ Program in September 2003 and by October

2003 the program coordinator identified participants feeling overwhelmed with the demands and the environment. An idea was proposed to participants to seek out industry-based professional engineering mentors, where the mentoring would be focused on personal and professional transitional issues. All participants accepted the offer of mentorship, and the program coordinator was able to successfully match all participants to a mentor external to the university. At the end of the academic year, the mentorship program was reviewed, and it was determined that the lack of physical proximity between mentors and IEEQ participants was a barrier toward regular and meaningful contact. Outside the mentorship program, no other support programs were in place. The program coordinator assisted with participants' academic, personal, social, and financial questions and barriers on a reactive and case-by-case basis, taking a referral approach to existing services on the university campus and in the community.

The focus groups that took place at the end of the IEEQ Program for cohorts IEEQ1 through IEEQ4 formed the basis of the findings from which the design of the IEEQ Program continued to evolve. The primary insight from the focus group with cohort IEEQ1 highlighted the need for a support structure for participants that would allow a proactive approach to academic and other challenges. Participants' responses revealed a sense of isolation, unfamiliarity ('lostness') in the Canadian university system, challenges in returning to studies many years after their first degree, and an awareness that their age and non-Canadian background made them stand out from the typical undergraduate student in their courses. These comments included, "The expectations coming into the program were not clearly explained or understood," "Not all gaps were identified so not all gaps were filled," and "We would like to be treated as an engineer or colleague in the classes, rather than as 'student X' like the others."

In developing a support structure, the starting point was to discern what the participants experienced as the critical value of the program. While the program had been conceived to address licensing with APEGM and labour market entry, the responses of participants in IEEQ1 identified the support in their cultural integration as the program's unique offering and benefit: ". . . the exposure to engineering concepts in the Canadian context . . .," "excellent information regarding cross-cultural issues and issues in engineering [in Practicing Professional Engineering in Manitoba]," and ". . . Before we didn't know, we just had to guess. Maybe guessed right, maybe wrong. Now we know!" The weekly contact to fellow IEEQ participants in the Practicing Professional Engineering in Manitoba course (unique also by the absence of any non-IEEQ students in the course) was identified as valuable: "The time together connecting with the other immigrant

students in this class was very important to encourage and inform each other.”

The key development in the IEEQ Program between the first and second cohorts was the implementation of a support structure for the second (and subsequent) cohorts of the IEEQ Program, highly modeled on the Aboriginal Access three-prong approach of academic, personal, and financial supports [27]. Specific initiatives included: the development of an IEEQ student handbook that highlighted relevant university policies and procedures and summarized IEEQ policies and procedures; an orientation day prior to the beginning of classes; four social events planned over the program duration which also included the participants’ spouses/partners and children; monthly come-and-go ‘coffee breaks’ for IEEQ participants and staff, at times with guest speakers for informal discussion around professional employment topics; four to five industry tours across a variety of industry sectors over the course of the year; establishing a lending library of resource texts for participants to refresh technical prerequisite knowledge; and, an ongoing review and networking between IEEQ staff and campus and community services for the purposes of offering appropriate referrals in academic support, financial assistance, and personal supports (e.g. counseling services).

Other program benefits identified by the participants helped define and refine IEEQ’s mandate: “. . . a great educational opportunity to gain new knowledge in the Canadian context . . .,” “. . . The immersion in English was very good although difficult . . .,” “. . . a ‘paper’ from Canada which validates your knowledge and makes you more competitive in job-finding . . .,” and “. . . It provides for different reasons for studying. For some it was to meet the requirements for APEGM and pursue employment, for others it was also to prepare for further [graduate] education.” These findings supported IEEQ’s function as a licensing pathway, delivered via existing senior-level undergraduate courses and alongside the CEAB-accredited bachelor degree programs.

Some responses from the focus group with IEEQ1 highlighted misconceptions and expectations that needed to be addressed through more explicit information and explanation. These comments included the misconception that the course load of eight courses over one academic year was higher than the typical bachelor program course load, and expectations that IEEQ students should be offered technical courses designed specifically for them and/or evaluated differently in the courses than undergraduate students.

The focus group findings from cohort IEEQ1 supported and validated many of the observations of the program coordinator over the academic year. In addition, the program coordinator observed that most participants found eight courses to be a very heavy load, given the length of time that most had been away from university

studies and/or the demands of studying in a second language. While eight courses provided comprehensive coverage of technical topic areas for those participants who had been assigned four or five Confirmatory Exams by APEGM, it provided ‘over-coverage’ for those participants assigned two or three Confirmatory Exams by APEGM. In response, the program coordinator proposed a formula for correlating the number of assigned Confirmatory Exams to the number of courses consequently required in IEEQ. This formula was approved by APEGM in time for cohort IEEQ2 and constituted a second significant change in the program. The new formula allowed the number of courses in IEEQ to range from three to eight, with an average load of six courses.

The third significant development after the first cohort was the addition of a language proficiency requirement to the eligibility criteria for the IEEQ Program. This was based on observed difficulties and, at times, poor outcomes by participants with observably poor English language skills. Upon a researched understanding of how language training occurs for newcomers in the province and the various language proficiency tests in use, IEEQ developed a professional relationship with a community-based English for Specific Purposes program entitled *English for Engineering Professionals*, and began referring interested applicants to this 12-week program as a good preparatory ground for further studies in the IEEQ Program. As well, the application criteria to IEEQ included a requirement to demonstrate language proficiency to approximately the same levels as required of international applicants to the university’s undergraduate programs.

The program coordinator also observed participants’ enthusiasm when opportunities to interact with Canadian professional engineers developed. This led to a deliberate effort to incorporate such opportunities within the program. These opportunities included an extensive use of guest speakers in the core course Practicing Professional Engineering in Manitoba, replacing the external mentor initiative with a focus on mentorship by on-campus Engineers-in-Residence, and regularly scheduled contact between the program coordinator and each IEEQ participant.

Constraints outlined earlier in this chapter were still in place after the first cohort of IEEQ, including a need to deliver the program within the university infrastructure, annual project-based funding, and a high level of scrutiny from APEGM. The formal program staff continued to consist of one part-time program coordinator; all other inputs to deliver the program came out of voluntary efforts and relational influence built up by the program coordinator.

Thus, the second iteration of the IEEQ Program (cohort IEEQ2) began with a program that continued to be defined around eight months of academics and four months of co-op work experience, and now augmented by a fledgling partici-

ment support structure, a more customized approach to academic requirements, and an emerging emphasis on language proficiency. While not clearly defined at the time, these developments also laid the groundwork for an emerging program philosophy. The program philosophy, defined in more detail in the following section included, firstly, the adoption of a 'difference' rather than a 'deficit' model and, secondly, a move toward a more holistic QR approach toward the integration of IEGs.

5.2 Second iteration—IEEQ2

Within the broader engineering profession during the time period of cohort IEEQ2, APEGM began offering a second licensing pathway as an alternative to Confirmatory Exams: for those IEG applicants with more than ten years' professional engineering experience, APEGM could—on a discretionary basis—invite them to an oral interview with a panel of professional engineers in their discipline, with the view to waiving some or all assigned Confirmatory Exams. This change required the IEEQ program to re-examine itself in order to have a clearer understanding of its unique role, value, and mandate in the licensing and professional integration of IEGs.

The focus group with cohort IEEQ2 and the first nine-month post-IEEQ follow-up questionnaire with cohort IEEQ1 provided the basis for findings at the end of the second cohort. Participants continued to express the challenges associated with the combination of being adult learners, newcomers to Canada, and studying again after a long period of being out of school: "After being out of university for so many years, it is difficult to come back to school," and "Added responsibilities impact the adjustment: children, job, and other responsibilities." Unlike the first cohort, the second cohort did not express the same degree of isolation. By contrast, cohort IEEQ2 expressed support and interaction with other students in the courses and program as strengths of the program: "IEEQ students met together and supported each other. We felt like [the program] was on our side, when at times it feels like everything is against you, politics, APEGM, university, etcetera." The focus group responses also recommended an expanded support structure that would include an element of mentorship by past IEEQ participants, the ability to complete the program over an extended period of time (part-time study), and additional English language supports.

The findings to this point served to validate and further refine the mandate of IEEQ as an expanding its focus beyond FCR to the broader integration into the Canadian engineering culture: participants highlighted "Exposure to Canadian businesses and local projects [. . .] were an excellent transition from [my] engineering background in my native country to Canadian academic and work contexts," and "[The course Practicing Profes-

sional Engineering in Manitoba] was excellent." The nine-month post-IEEQ follow-up questionnaire with cohort IEEQ1 also provided a retrospective view of the critical value of IEEQ. Here too the responses were decidedly non-technical in nature, further defining IEEQ's critical value as broader than professional licensing, an academic experience, and professional work experience. Participants cited "understanding Canadian culture," "developing communication skills," and "developing self-confidence to work as an engineer in Canada" as the preparatory value of the IEEQ Program.

For the program coordinator, the findings reinforced the value of the three-prong social, academic, and financial support structure and led to a renewed focus on how the support structure could be maintained and augmented within very limited staff and financial resources. The program coordinator observed that participants' challenges or poor outcomes in IEEQ were rarely due to technical deficiencies, but were rather associated with the challenges of cultural differences, the challenge of balancing multiple demands of studies, family, employment, and community, language proficiency challenges, and potentially health challenges of managing stress and anxiety.

5.3 Holistic new developments

One new development within IEEQ after cohort IEEQ2 was a further refinement of the English language proficiency requirement, to limit the demonstration of proficiency to the use of the Canadian Language Benchmarks (CLB) Placement Test and requiring a skill level of eight in at least three of four skill areas tested by the CLB Placement Test. Level eight is the beginning of the range of advanced fluency. The CLB was chosen over other language tests, such as TOEFL, CanTEST, and IELTS, due to the professional recommendation of language trainers that the CLBs test a wider range of language skills and test them in more realistic contexts, face-to-face with an assessor, than the other available tests.

A second new development during the second cohort was an emerging focus on the employment community and the IEEQ co-op employers specifically, as an audience for professional development around cultural differences and newcomer integration issues. Initial efforts were modest, again reflecting IEEQ's limited financial and staff resources, and consisted of gifting a book to all co-op employers related to managing cultural diversity in technical professions, and approaching the APEGM Professional Development committee as well as selected individual employers with an offer to facilitate professional development sessions on cultural diversity in the engineering profession.

Both new developments exemplified the now-explicit holistic philosophy and approach to the professional licensing and integration of an IEG, essentially moving IEEQ from a narrow FCR initiative to a more comprehensive QR approach.

A holistic approach acknowledged at least two things: for IEGs, professional integration is much broader than an assessment and confirmation of technical knowledge and skills; and, professional integration metrics of technical confirmation and career-related employment will not be achieved if other personal and cultural integration challenges cannot be addressed prior or concurrently. These insights are discussed more fully in the broader study in the context of social and cultural capital for immigrant professionals [28].

There are many examples in which a holistic approach affected program development and daily program delivery. For example, upon repeated observations of language proficiency challenges that were preventing participants from achieving to their full potential, a holistic philosophy embraced that challenge within the program by developing an appropriate support or resource, while a non-holistic approach may have asserted that language challenges are remedial, are outside the scope of engineering FCR, and are an individual's responsibility to address.

Linked to a holistic philosophy was the articulation of IEEQ adopting a 'difference' rather than a 'deficit' model toward its mandates. A difference model acknowledges differences between the participants' technical, professional, and cultural backgrounds and the norms of the Canadian engineering profession, and then builds and delivers the program components with a goal to bridge the differences. This approach takes full account of the knowledge located within the participants both individually and collectively, valuing this knowledge as an essential context from which to bridge to new knowledge, skills, attitudes, and understanding. The difference model also asserts that in bridging the technical, professional, and cultural differences, the onus lies at least partially on the mainstream community and not solely on the individual newcomer. By contrast, a deficit model sees the differences between the participants' technical, professional, and cultural backgrounds and the norms of the Canadian engineering profession as gaps that need to be filled or upgraded. The connotation is one of deficiency or inferiority, with an onus solely on the participant to prove themselves according to a (Canadian) norm implicitly defined as superior.

5.4 Third iteration—IEEQ3

In terms of program structure, the delivery components in the third iteration of IEEQ were very similar to the second iteration: academics, a co-op work term, and a deliberate support structure. In addition, the holistic program philosophy and discussion of the 'difference' model was deliberately brought into conversation, and program components were internally critiqued for the extent to which their structure and delivery reflected these values.

The findings of the focus group with cohort IEEQ3 and the post-IEEQ follow-up question-

naires with cohorts IEEQ1 and IEEQ2 provided the basis for findings at the end of the third iteration of IEEQ. The findings supported the program delivery and philosophy and further refined the mandate and value of the IEEQ Program. Participants expressed that the number of courses they were assigned in the program was manageable and, while there were challenging elements associated with coming back to school after a number of years, they also expressed that the challenges were manageable and that especially by the second semester, "Everything was fine." While the findings, and the pattern of the program's development to this point may be seen as an indication that the program had found its stride, an important consideration was whether the fledgling history of the program, the accumulated experiences of the program coordinator, the word of mouth of past participants, and small changes to eligibility criteria (i.e. in language proficiency requirements) also changed the nature of prospective applicants and participants, toward those that would be more likely to succeed. As a qualitative study, this possibility is important to consider and cannot be definitively answered at this time.

The cohort support and the focus on incremental cultural integration were identified as the critical value of the program. Representative responses included, "The information, support, and encouragement provided by [the program] was excellent," "[The course Practicing Professional Engineering in Manitoba] was very interesting and informative, but it was after starting in co-op that I realized how applicable the information was," and "I felt very prepared to address the realities of the Canadian engineering culture."

Program changes after the third iteration were relatively minor compared to the previous two iterations. One can envision that the spiral nature of the design process with respect to the IEEQ Program internally was closing or narrowing, as the program model became definite and refined. Concurrently, the initial design spiral relative to the IEEQ Program's position external to the university remained broad. Attention shifted from internal program development to a consideration of the relationship of the IEEQ Program to external stakeholders.

Internally, several new support items were added to the program, and a language tutor was hired on contract for the beginning of cohort IEEQ4, with the requirement added that each participant spend a minimum number of hours with the language tutor over the course of the year. Although the time requirement was nominal to begin, it reflected the program's resources in hiring additional personnel as well as a lack of experience with the level of contact that would be meaningful. The time was used for the tutor to assess individual language challenges and create a development plan that the participant could follow through on their own during and after their participation in the IEEQ Program.

5.5 Important influences

Key influences on the IEEQ Program during the third iteration shifted from internal to external influences. As a significant step toward IEEQ's credibility and recognition within the engineering community, the province's energy utility (the province's single largest employer of engineers) formalized its support to IEEQ by committing to a set number of co-op positions each year, several bursaries to IEEQ students, and opportunities for long-term employment on a competitive basis to IEEQ graduates.

A second significant external influence came when APEGM began offering another additional licensing pathway as an alternative to Confirmatory Exams. The new option allowed applicants to substitute University of Manitoba courses for the assigned Confirmatory Exams, where the appropriate substitute courses would be determined by APEGM. Third, during this time, the Government of Canada initiated a three-year window of funding opportunities for Foreign Credentials Recognition projects, directed specifically at professions (vs. skilled trades). Engineers Canada (the business name of the Canadian Council of Professional Engineers) applied for funding in order to enter into a project partnership with the IEEQ Program and APEGM, in which the goal of the project was to support local efforts to secure long-term, sustainable funding for the IEEQ Program, and to provide information and training to other engineering regulatory bodies and universities in Canada that might be interested in establishing an IEEQ-style program, in whole or in part. The funding application was successful, and a three-year project was initiated in September 2005, called eQRm (engineering Qualifications Recognition model, www.eqrm.ca). The eQRm project allowed for the hire of a full-time eQRm project coordinator who was located within the IEEQ Program at the University of Manitoba. This located the bulk of the project activities and deliverables within the IEEQ Program as well. The eQRm project funding also allowed for the hiring of a full-time administrative assistant to the IEEQ Program, thus increasing the formal IEEQ staff from one to three.

The new licensing pathway offered by APEGM to substitute university courses for Confirmatory Exams appeared structurally to be a very similar option as enrolling in the IEEQ Program. That, together with the eQRm initiatives, further drove the need to articulate a clear and unique purpose, scope, and philosophy of the IEEQ Program. These elements were expressed appropriately through the program components as delivered at that point in time, the holistic approach toward participants, and the philosophy of a 'difference' model toward professional integration.

However, while the program had defined itself well internally, there was a need to critique how this delivery and philosophy applied externally. The holistic view therefore grew from a view of

the participants alone to encompass an expanded view of the IEEQ Program within a framework of formal and informal partnerships with the provincial government, APEGM, the employment community, and immigrant-serving agencies.

5.6 Important connections

A key connection to the provincial government was their role as the program funder and the IEEQ Program's efforts to support the province's aggressive immigration strategy selectively targeted to immigrant professionals. In addition, the IEEQ program—since inception—had been lobbying the provincial government to extend permanent, sustainable funding to the IEEQ Program to support an increased enrollment as well.

Key ties to APEGM were APEGM's continued role in conducting the academic assessment to establish eligibility for the IEEQ Program, APEGM's commitment to accept successful completion of the IEEQ Program as a complete substitute for a Confirmatory Exam program, and the IEEQ Program's responsibility to demonstrate accountability to APEGM. The latter role was streamlined during this period by the establishment of an APEGM—IEEQ Liaison Committee, consisting of IEEQ staff and three members of the APEGM Academic Qualifications Committee. This smaller committee allowed a more timely review of participants' progress and more immediate consideration of complex policy issues.

Key ties to the employment community came through the provision of co-op placements to IEEQ participants. While this was the major role of the employers, they were also actively engaged as guest speakers in the program, as hosts of industry tours for IEEQ participants, and were otherwise engaged in networking opportunities. Key challenges with the employment community were to gain name recognition as a program and to position the program in such a way that it provided something of value to the employers that offset the perceived risks and additional training load associated with hiring a newcomer.

Key ties to the immigrant-serving agencies and the community-at-large came through relationship-building efforts, to understand the services available to newcomers (and immigrant professionals specifically) in order to make appropriate referrals and suggest appropriate preparatory streams for language training, cultural orientation, and/or employability orientation prior to entry into the IEEQ Program. Immigrant-serving agencies were also recruitment grounds for prospective IEEQ participants.

5.7 Fourth iteration—IEEQ4

The primary influences on the IEEQ Program during the fourth iteration continued to be external to the program. During this time period, the provincial government formalized an income support program, which provided income support and tuition support to immigrant professionals

who need to enroll in a certification or upgrading program in order to regain their prior professional certification in Manitoba. As well, the province introduced the *Fair Registration Practices in Regulated Professions Act* in the Manitoba Legislature, although it was not proclaimed into law until spring, 2009. Both initiatives represented a maturing of the government's own agenda toward increased immigration with a particular emphasis on immigrant professionals.

The fourth iteration of the IEEQ Program also revealed an emerging stability in the program's delivery and philosophy. The participants' responses from data collection during this period echoed earlier data, in that critical value of the program was identified in ". . . the co-op work term . . .," ". . . networking and communication . . .," and ". . . learning about cultural differences." By the end of the fourth iteration, the program's mandate was firmly defined, firstly, as a licensing pathway recognized by APEGM and, secondly, to further participants' goals around knowledge upgrading, labour market integration, and/or preparation for further studies. The program design was firmly grounded around academic courses and a co-op work term, overlaid by a sustained focus on cultural integration, professional networking, and English language development. The program's framework was firmly grounded in a view of formal and informal partnerships and outreach with the provincial government, the regulatory body, the engineering community, and immigrant-serving agencies. The program's philosophy was firmly grounded in a holistic approach toward professional integration beyond technical confirmation, and a 'difference,' as opposed to a 'deficit,' model of professional integration.

As well, after almost five years, the provincial government committed long-term baseline funding to the University of Manitoba to deliver the IEEQ Program and increase its enrollment. Concurrently, APEGM undertook a comprehensive review of its assessment and licensing practices for IEGs with a view toward enhancing consistency and transparency in the process. One of the outcomes of this review was the formal approval by APEGM of the IEEQ Program as a licensing pathway, no longer subject to annual review and approval by APEGM.

These milestones extended a degree of autonomy to the IEEQ Program, and allowed initiatives to be considered that may only exhibit long-term as opposed to near-term outcomes. Additionally, these milestones marked the beginning of a period of increased program growth and adaptation as participants numbers increased and program policies and processes were concomitantly drawn into review and adaptation. These undercurrents in the IEEQ Program are ongoing.

6. SUMMARY OF PROGRAM DEVELOPMENT

By the end of the fourth iteration of the IEEQ Program, the metaphorical spirals that represented the process of designing the IEEQ Program—both internally and externally—had closed, as the mandate, delivery, partnership framework, and philosophy of the IEEQ Program had now been defined. The tangible outcomes included a stand-alone IEEQ Program at the University of Manitoba with sustainable baseline funding, approved by APEGM as a formal licensing pathway, and with strong stakeholder support. Further outcomes included the deliverables of the eQRM project, including published documents that outlined the framework of an IEEQ-style program and the curriculum framework for the Practicing Professional Engineering in Manitoba course (available at eqrm.ca). The initiation of an IEEQ-style program at Ryerson University in Ontario, Canada in 2007, highly modeled on the IEEQ Program was a further direct outcome of the developments in Manitoba from 2003 onward.

Within the engineering literature, discussions on the intersection of culture and engineering education are predominantly focused on preparing North American graduate engineers for professional practice in an environment of globalization, defined as increased co-dependence between countries in economic, social, and cultural matters. North American graduate engineers are expected to prepare for a career that may take them across national boundaries, and will almost certainly involve working in physical or virtual teams with professionals in other locations and representative of other cultures. In this context, undergraduate curricula are integrating international exchange experiences, a focus on second-language learning, and an explicit focus on appreciation of cultural values [29,8].

However, ongoing migration and immigration worldwide, accompanied by mobility and recognition agreements such as the Washington and Bologna Accords present the engineering profession with new challenges of formally recognizing foreign credentials. Additionally, there is increasing recognition that integration processes need to focus beyond the recognition of institutional credentials (FCR) and include the acquisition of professional and personal skills that are encompassed under a more holistic umbrella of qualifications recognition. The evolution of the IEEQ Program demonstrates this shift in focus and was identified as its critical value. This shift responded to the interests of immigrants' personal and professional integration into the engineering profession and the concomitant ability for the mainstream society to benefit more fully from immigrants' individual and collective excellence.

7. CONCLUSIONS

Currently, the IEEQ Program at the University of Manitoba continues to be a unique model for qualifications recognition in the Canadian engineering profession. While there are other potential IEEQ-style programs in development or under consideration in other jurisdictions, the only Canadian parallel program exists at Ryerson University in Ontario, Canada. The IEEQ Program delivers a regulatory function within an

academic institution; this is a mandate for which the university and the profession have limited historical practice. To date, close to 100 IEGs have participated, with a graduation rate of approximately 85%, and high follow-on licensing rates. Through participants' observations and experiences, the program has expanded from a program of academic coursework and work experience, to include a holistic focus on language development, cultural orientation, and professional immersion.

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