Participant Outcomes, Perceptions, and Experiences in the Internationally Educated Engineers Qualification Program, University of Manitoba: An Exploratory Study

by
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Abstract

Immigration, economic, and regulatory trends in Canada have challenged all professions to examine the processes by which immigrant professionals (international graduates) achieve professional licensure and meaningful employment in Canada. The Internationally Educated Engineers Qualification Program (IEEQ) at the University of Manitoba was developed as an alternate pathway to integrate international engineering graduates into the engineering profession in Manitoba. However, universities have the neither mandate nor the historical practice to facilitate licensure for immigrant professionals and, thus, the knowledge base for program development and delivery is predominantly experiential.

This study was developed to address the void in the knowledge base and support the program's ongoing development by conducting a critical, exploratory, participant-oriented evaluation of the IEEQ Program for both formative and summative purposes. The research questions focussed on how the IEEQ participants perceived and described their experiences in the IEEQ Program, and how the participants' outcomes in the IEEQ Program compared to international engineering graduates pursuing other licensing pathways.

The study was built on an interpretivist theoretical approach that supported a primarily qualitative methodology with selected quantitative elements. Data collection was grounded in focus group interviews, written questionnaires, student reports, and program records for data collection, with inductive data analysis for qualitative data and descriptive statistics for quantitative data.

The findings yielded rich understandings of participants' experiences in the IEEQ Program, their outcomes relative to international engineering graduates (IEGs) pursuing other licensing pathways, and their perceptions of their own adaptation to the Canadian engineering profession. Specifically, the study suggests that foreign credentials recognition processes have tended to focus on the recognition and translation of human and/or institutional capital. Yet, access to and acquisition of social and cultural capital need to receive equal attention. Further, the study suggested that, while it is reasonable that language fluency is a pre-requisite for successful professional integration, there is also a fundamental link between language and cognition in that international engineering graduates are challenged to understand and assimilate information for which they may not possess useful language or the underlying mental constructs. The findings have implications for our collective understanding of the scope of the professional engineering body of knowledge.

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Table of Contents

List of Tables

List of Figures

List of Abbreviations

APEGM	Association of Professional Engineers and Geoscientists of the Province of Manitoba
EIT	Engineer in Training
FCR	Foreign credentials recognition
IEG	International engineering graduate
IEEQ	Internationally Educated Engineers Qualification Program,
P.Eng.	Professional Engineer (licensed)
QR	Qualifications recognition

Chapter 1

Introduction

Prologue

In his seminal 1990 work, Ernest Boyer called for an enlarged perspective on the meaning of scholarship. Acknowledging the current condition of equating academic scholarship with the 'scholarship of discovery', Boyer called for a vision of scholarship beyond research. He proposed the additional three scholarships of integration, application, and teaching as legitimate forms of scholarship that all support and inform one another within the overall scope of academic work.

The scholarship of discovery closely parallels what is commonly known as academic research: disciplined, investigative efforts that are meaningful in both process and outcomes. Closely related to the scholarship of discovery, the scholarship of integration seeks meanings, perspectives, and new insights from isolated facts and draws connections across disciplines and between specialists and non-specialists. The scholarship of application seeks to engage and apply the knowledge – discovered and integrated – to consequential problems of interest to the larger community beyond academia. Finally, the scholarship of teaching is consequential in that it transforms and extends the knowledge of the academic member as it becomes understood by others (Boyer, 1990). Boyer's four forms of scholarship intersect and inform one another as theory leads to practice, practice leads to theory, and teaching shapes both theory and practice.

Even within a given form of scholarship, disciplines "have contrasting ways of organizing themselves and defining the rules for making arguments and claims that others will warrant" (Shulman, 2002, p. vii). This is fundamentally an epistemological issue that relates to the nature and validity of knowledge and beliefs, to which problems are

considered worth pursuing, and to how truths are discovered and claimed. The epistemological issues filter into methodological concerns: which ways of discovering, acquiring, and validating knowledge are considered to be legitimate, rigorous, and valid within a discipline (Benson & Griffith, 1996; Kuhn, 2000).

Traditionally, academic work in engineering has been strongly rooted in a definition of scholarship that has emphasized and privileged the scholarship of discovery, and on an epistemology that subscribes to a correspondence theory of truth. In a correspondence theory of truth, objective truths are thought to exist and be available for observation and measurement, and observed facts lead to inescapable conclusions (Kuhn, 2000). In this epistemology, the scientific method exemplifies the appropriate methodology for knowledge discovery. While interpretation of facts, laws, theories, and explanations is a human process, the traditional epistemology in engineering and science holds that experimental and quasi-experimental tests provide objective results which apply objective and context-free judgment to human interpretation.

More recently, at least two strong influences are challenging the traditional epistemology. First, science philosophers argue that science – as observations that lead to facts, theories, and laws – is actually a circular process. Facts and observations are said to be less objective and more recursive than originally thought, and scientific interpretations leave room for disagreement (Kuhn, 1992). Some go so far as to say that science is relativistic, socially negotiated, and culturally grounded, and represents not "*the* way of knowing,…[but rather] *one* way of knowing" (Benson & Griffith, 1996). These influences challenge engineering as a discipline to become aware of its internal epistemology, and to consider other ways of knowing and understanding the world.

One alternative is a constructivist epistemology. As developed by major proponents such as Piaget and von Glasersfeld, constructivism asserts that knowledge, meaning, and truths are subjective rather than objective, and are actively constructed within each individual and/or among individuals. People are said to create, negotiate, and assimilate their own knowledge based on what they already know and believe. Constructivism sees knowledge as a self-organized construct that varies from individual to individual, and this epistemology is often applied to the social world (Benson & Griffith, 1996; Heywood, 2005; Bransford, Brown, & Cocking, 2000).

Second, the scholarship of teaching and learning is an emerging influence in all disciplines, and is slowly gaining visibility as a necessary endeavour in engineering (Huber & Morreale, 2002; Wankat, Felder, Smith, & Oreovicz, 2002). Approaching the study of teaching and learning in engineering in a scholarly way that assumes rigour and validity, engineering academics engage with highly subjective constructs such as '*understanding*', '*skills*', and '*attitudes*' that the traditional quantitative metrics are insufficient to capture. This in turn introduces engineering academics to constructivist epistemologies and qualitative methodologies with problems of concern, rules of inference and reasoning, and rigour and validity criteria that all differ from the traditional paradigm (Wankat et al., 2002).

This study challenged the traditional engineering perspective on multiple fronts. First, it asserted an integrated view of scholarship, in which the study was equally concerned with the scholarships of integration and application as with the scholarship of discovery, through an action research framework (Chapter 3). Second, the study relied primarily on a qualitative research methodology that invoked a constructivist perspective,

in which the goals of the study included detailed descriptions and deep understandings of phenomena from multiple points of view (Chapter 3). Through this enlarged perspective, the study contributed to a collective understanding of the nature of professional engineering practice in ways that traditional metrics do not address.

The remainder of this thesis is organized as follows. Chapter 1 continues by introducing the Internationally Educated Engineers Qualification Program (hereafter, IEEQ) at the University of Manitoba, Canada, which formed the research context of the study. The chapter ends with the research objectives for the study. Chapter 2 expands the relevant literature that surrounds the IEEQ program and the study. Chapter 3 outlines the theoretical perspective and methodological framework upon which the study was based. Chapter 4 presents the findings of the study, and Chapter 5 discusses the findings in relation to relevant literature. The thesis ends with a conclusion and postscript in Chapter 6.

Research Context and Problem

When immigrants holding non-Canadian engineering credentials arrive in Canada, they are often surprised to learn that, by law, they must be registered with a provincial engineering association (regulatory body) in order to practice engineering in Canada. Regulatory bodies have always provided licensing pathways for international engineering graduates (IEGs), often in the form of a set of assigned Confirmatory Exams, to determine eligibility for licensure. However, with increasing immigration, and with a higher proportion of immigrants *professionals* entering Canada, governments are urging all professional regulatory bodies to develop alternative licensing pathways that integrate

skilled immigrants, including IEGs, more quickly and effectively into their respective professions while maintaining standards for public safety.

Within the 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 (Canadian Council of Professional Engineers [CCPE], 2003; Statistics Canada, 2005, 2006; Canadian Labour and Business Centre [CLBC], 2003b). Engineering employers concur that the most important factors influencing IEGs' level of employment are prior related Canadian experience, communication skills, and professional licensure (CCPE, 2003; CLBC, 2003a).

In response to these pressures, IEEQ was developed in 2003 at the University of Manitoba to serve as an alternative licensing pathway for IEGs. IEEQ is recognized by the Association of Professional Engineers and Geoscientists of Manitoba (APEGM) as leading to IEGs' professional registration in Manitoba. The purpose of developing IEEQ included establishing an alternative licensing pathway that would address known challenges in the traditional route. Specifically, the alternative pathway was to be more time-effective, sustain higher completion rates and lower attrition rates, and decrease the pronounced feelings of isolation anecdotally reported among IEGs engaged in the traditional licensing route, all the while guarding the public welfare by upholding a rigorous licensing standard.

IEEQ was initially conceived as a 12-month program comprised of eight months of senior-level engineering courses, followed by a four-month engineering work term. The objective of the academic coursework was for IEG participants to confirm their

technical backgrounds and prior academic qualifications against senior-level courses in accredited Canadian programs. The objective of the engineering work term was for the participant to overcome a key integration challenge and gain Canadian engineering experience. Over the ensuing four-year pilot period (2003-2007), IEEQ evolved to develop a sustained focus on cultural orientation to the culture of Canada and the culture and ethics of professional engineering in Canada, professional networking, social and financial supports, and individualized English language support. The multi-year evolution from a program of academics and work experience to a multi-dimensional approach that includes culture, language, and support structures is one of the outcomes of the action research process over the pilot phase of the program.

IEEQ is now well-positioned relative to immigration, economic, and regulatory realities. In Manitoba, immigration has increased from 3,500 to 10,900 immigrants annually between 1999 and 2007, with a projected increase to 20,000 immigrants annually by 2017 (Manitoba Labour and Immigration [MLI], 2005, 2007a). Nationally, immigration is a powerful force in the Canadian economy. Immigrants made up 70% of labour force growth in the 1990s and are expected to make up 100% of labour force growth by the year 2011 (CCPE, 2003; Human Resources Development Canada [HRDC], 2002). In the regulatory context, a Professional Engineer (P.Eng.) license is a legal requirement to practice professional engineering and a necessary credential for career advancement and mobility. Legislation proclaimed in the Manitoba Legislature in 2008 mandates all professional regulatory bodies to implement registration practices for foreign-trained applicants that are transparent, objective, impartial, and fair. This

legislation increases the onus on the profession to demonstrate whether, and how, a program like IEEQ can contribute to this mandate.

While the motivations to develop IEEQ were relatively straight-forward, universities lack the mandate – and thus the historical practice – to facilitate licensure for immigrant professionals, as licensing is a provincial responsibility delegated through legislation to professional regulatory bodies. Possible models for consideration for IEEQ existed in post-secondary access programs for Aboriginal students in Canada and from community-based bridging programs for immigrant professionals. A literature also existed for the knowledge, skills, and values needed for engineering practice (National Academy of Engineering, 2004). However, IEEQ comprises a unique combination of characteristics for which there is an absence of existing models and of research-based literature, and for which the knowledge base is predominantly experiential: a *foreign credentials recognition (FCR)* program for *international engineering graduates* delivered as a *formal partnership with the engineering regulatory body* in a *university setting*. IEEQ was the first such program in Canada, and until fall 2007 – when Ryerson University began delivering the IEEQ Bridging Program, highly modeled on IEEQ in Manitoba – it was the only such program in Canada.

The knowledge base for *university-based FCR* programs (in all professions) is currently limited to identifying and describing FCR initiatives and capacity at Canadian universities (Association of Universities and Colleges of Canada [AUCC], 2006). Although similar initiatives exist in other professions, the lack of parallel programs in engineering with which to compare frameworks for delivery, assessment and evaluation, participants' experiences, and program outcomes have led to these frameworks being

locally generated within IEEQ (Friesen & Britton, 2006a, 2006b; Friesen, 2007). In addition, the literature that exists in related areas generally consists of industry- and public-sector-based studies, highlighting a void in the academic literature examining university-based FCR programs and a void in rigorous studies that examine programs from the perspectives of the participants themselves.

Research Objectives and Questions

This context highlights the timeliness of a critical appraisal of the IEEQ program. *The focus of this research was to address the void in the knowledge and to support the ongoing development of the IEEQ program, by conducting an exploratory, primarily participant-oriented evaluation of the IEEQ Program for both formative and summative purposes.* The study was intended to help build a comprehensive understanding of the participants in the IEEQ Program, support the development of beneficial practices for FCR programs for IEGs delivered in university settings, and subsequently make in-depth knowledge about the IEEQ program available to other engineering jurisdictions and other professions. It was also anticipated that the findings would provide insights into the scope of the professional engineering body of knowledge in response to epistemological concerns regarding knowledge, skills, or attitudes that hinder or enable the potential of IEGs as engineering professionals in Canada.

Specific research questions included:

1. How do IEEQ participants perceive and describe their experiences in the IEEQ Program? Specifically, how do IEEQ participants perceive and describe the availability of the major components of the program (academic confirmation, co-

op work experience, cultural training, language training, and support networks), and how do IEEQ participants perceive and describe their involvement in these same components?

2. How do participants' outcomes in the IEEQ Program compare to IEGs pursuing academic qualification with APEGM through other pathways, and/or how do participants' outcomes in the IEEQ Program compare to other APEGM members (Engineers-in-Training and P.Engs.)? Specifically, what outcomes are evident relative to IEEQ participants' program completion rates, time-to-program completion, post-program licensing status, timelines through the post-program licensing process, and post-program career development indicators?

As an exploratory evaluation, a further goal was to illuminate additional questions for further study.

Chapter 2

Literature Review

Introduction

The purpose of this literature review is to outline the environment in which IEEQ was conceived and developed, and to highlight the various areas of literature that informed the research objectives of this study. The literature review may be seen as spokes branching out from a hub, where the hub is the IEEQ program. The spokes branch out into a number of social, economic, and professional issues which influence and shape professional engineering practice. These issues, as reviewed in this chapter, include immigration; labour market issues; FCR for immigrant professionals; professional regulation (licensing); the engineering body of knowledge, and evaluation in post-secondary education. Each of these topics are discussed in terms of their impact on the engineering profession, of what they can contribute to the study, and of the gaps that remain.

Immigration to Canada

Immigration trends are a key context to which IEEQ responds. Popular sentiment indicates that Canada is considered to be a nation built on immigration. From welcoming approximately 90,000 immigrants annually in the mid-1980s, Canada has increased its numbers to the point of consistently accepting between 210,000 and 260,000 immigrants annually since 1990 (with the exception of two years in the late 1990s). The 262,200 immigrants that entered Canada in 2005 account for the single largest annual figure since at least 1980 (Citizenship and Immigration Canada [CIC], 2007a).

While the overall number of immigrants to Canada is increasing, the categories in which people immigrate to Canada are also shifting. In the early 1980s, the proportion of

immigrants entering Canada under the Family Class (those sponsored by a Canadian citizen or permanent resident already residing in Canada) was higher than those entering Canada as Economic Immigrants (those selected by the Canadian government for their skills and abilities to contribute to Canada's economy). Together, these two categories accounted for approximately 70-80% of all immigrants. By the late 1990s and continuing to the present day, those entering Canada as Economic Immigrants (approximately 55-60% of all immigrants) had overtaken those entering under the Family Class (approximately 25-30% of all immigrants), with the combined categories consistently accounting for over 80% of all immigrants to Canada (CIC, 2007a).

Related to the shifting categories under which people are immigrating to Canada, the trend is toward a better educated immigrant population. In the mid 1990s, 35% of immigrants had 12 or fewer years of schooling, while only 27% held a bachelor or master degree. As of 2007 statistics, approximately 30% of immigrants had 12 or fewer years of schooling, while 40% held a bachelor or master degree. Proportionally, the Economic Immigrants are a more highly educated group, with data since 2000 consistently reporting approximately 75% of Economic Immigrants holding a bachelor degree or higher (CIC, 2007a). These factors – Canada's increasing immigration numbers over the past two decades, combined with a shift toward Economic Immigrants who proportionally comprise a more highly educated group – combine to create concomitant changes in the settlement needs of Canada's immigrant population and in the services required to integrate highly-skilled immigrant professionals into Canadian society.

Immigration to Manitoba

At the provincial level, the increase in immigrants to Manitoba has been much more pronounced, in percentage changes, than at the national level. Due to an aggressive strategy initiated by the Premier's Economic Advisory Council in 2003 to increase immigration to the province, Manitoba went from welcoming approximately 3000 immigrants annually in the late 1990s to welcoming 10,950 immigrants annually by 2007 – the highest level in 50 years. Manitoba consistently ranks fifth in Canada in terms of overall numbers of immigrants received, and in 2006 surpassed its proportional share of the national population for the first time in 20 years (MLI, 2005, 2007a, 2007b).

In support of Manitoba's social and economic development, the province's goal is to continue to increase immigration by 1000 immigrants annually, to ultimately reach a target of 20,000 immigrants annually to the province by 2017 (MLI, 2005, 2007b). To that end, Economic Immigrants now account for over 70% of all immigrants to the province, with the percentage continuing to rise (MLI, 2007a).

To characterize the immigrants to Manitoba further, the Philippines, Germany, and India have consistently ranked as the top three source countries since the early 2000s, with China and El Salvador currently rounding out the top five. Consistently, over 75% of immigrants coming to the province choose to settle in Winnipeg. The trends in newcomers' education (all categories) also show a decrease in those with 12 or fewer years of schooling and an increase in those with a completed bachelor degree or higher (MLI, 2007a).

In 1998, Manitoba was the first province in Canada to establish the Provincial Nominee Program (PNP) as a tool to help meet provincially-defined economic

development goals. Immigrants can apply to the PNP from their home country and may be nominated (by the province) for Permanent Resident status in Canada. Provincial Nominees are one sub-category of Economic Immigrants, and successful applicants are skilled workers selected by the Province for their reported training, work experience, and language ability to be employed in Manitoba and potential to make a positive contribution to the provincial economy. Since the PNP's inception, Manitoba's reliance on Provincial Nominees has been substantial, accounting for 57, 66, and 70% of all immigrants to Manitoba from 2005 through 2007 respectively (MLI, 2007a; Province of Manitoba, 2007b).

Compared to other professions, the engineering profession is overrepresented among professions relative to increasing immigration to the province and relative to the PNP. Since at least 2003, "engineer" has ranked as one of the top-ranked self-declared occupations of Economic Immigrants to Manitoba. Overall, approximately 1000 IEGs immigrated to Canada between 1999 and 2007 (Economic Immigrants principal applicants only, not including spouses and/or dependents and not including Family Class or Other Immigrants that may also self-identify as "engineer"). That engineering is the one of the top-ranked self-declared occupations of immigrants to Manitoba is not surprising, given that electrical, electronics, mechanical, and computer engineers are all among the top 20 occupations selectively targeted by the PNP (MLI, 2005, 2007a). As a consequence, the settlement issues of FCR and labour market integration, as outlined in the next section, become particularly acute in the engineering profession.

The Canadian Labour Market

Immigrant professionals enter a Canadian labour market that should – by all appearances – be a very receptive environment to those with professional skills and qualifications. With decreasing fertility rates and fewer entrants in the labour force, Canada's labour force growth is expected to remain below 1% over the next three decades. Within 25 years, immigration is anticipated to be the only source of net population growth. Between 1991 and 2001, immigrants represented 70% of net labour force growth, and are expected to represent 100% of net labour force growth in Canada by 2011 (CLBC, 2003a, 2004; HRDC, 2002). In addition, the Canadian workforce is aging, the near-retirement population is growing, and unprecedented international competition is driving industry to be innovative and to build up a skilled workforce (CLBC, 2004, 2005). At the same time, skill shortages are consistently ranked among the most serious concerns of private and public sector managers and labour leaders, with 50% or more managers and labour leaders citing skill shortages as a "serious concern" (CLBC, 2003a).

These general demographic conditions and trends in the Canadian labour force nationally are also borne out in the engineering labour force specifically. Skilled labour, such as licensed engineers, experience less unemployment. While there have been pronounced cyclic variations in the size of the engineering labour force, the years between 1987 and 2002 saw an average annual increase of 4.3% in the size of the engineering labour force. Unemployment rates in engineering have also been consistently below the national average: while the national unemployment rate varied

between 7% and 11% between 1987 and 2002, the engineering unemployment rate exceeded 5% in only one year (CCPE, 2003).

In sectors that employ significant numbers of engineers, the same labour market challenges are mirrored. The 2007-2008 Management Issues Survey of the Canadian Manufacturers and Exporters (2007) cites shortages of skilled personnel as a key strategic challenge and a major constraint on the performance improvement, innovation, and overall growth potential that companies identify as necessary to their ongoing growth and success. Fifteen percent of companies cited difficulties finding and difficulties retaining engineers. The Canadian Electricity Association and the Electricity Sector Council have identified key demographic challenges manifested by an impending retirement wave (with 29% of staff eligible to retire by 2012, and 45% of staff eligible to retire by 2014), coupled with a decline in enrollments in university and college training programs that prepare students for careers in the electricity sector (Canadian Electricity Association, 2005; Electricity Sector Council, 2008). While regional reports of engineering workforce trends are sparse, data from Alberta – currently an extremely robust economy – indicate that engineering shortages are projected to reach 6200 engineers by 2016, with shortages in Alberta in some engineering fields having begun as early as 2007 (Western Management Consultants, 2007).

The immigration trends – and increasing immigrant population generally coupled with a proportionate increase in the numbers of skilled workers and immigrant professionals specifically – seem to be a perfect fit for the labour market trends and conditions outlined above. Yet, most immigrant professionals, including IEGs, as outlined in the next sections, experience significant integration challenges.

Labour Market Challenges for Immigrants

The primary challenge that immigrants are facing in the labour market is securing employment in their intended field. The mainstream media regularly highlights stories of internationally-educated professionals working in Canada as security guards, taxicab drivers, and convenience store clerks, and reliable statistics support this as the reality for many immigrants. While rates of employment for immigrants tend to improve over time during an individual's first two years of residence in Canada, the rate of employment remains 18% below the national rate (63% vs. 81%, respectively) at the two-year mark (Statistics Canada, 2005). The proportion of immigrants who have a university degree, and are holding a job in Canada not requiring a post-secondary education, also far exceeds the national rate (26% vs. 12%, respectively).

Across all classes of immigration, 80% of working-age immigrants generally find some form of employment during their first two years in Canada but, of those, only 42% of working-age immigrants (34% of all immigrants) have found work in their intended field (Statistics Canada, 2005). Skilled workers (a subset of Economic Immigrants, which captures many IEGs) fared slightly better: 90% of these immigrants had found employment during their first two years in Canada, but of these, only 48% (43% of all skilled worker immigrants) had found work in their intended occupation. Viewed another way, this statistic illuminates the fact that 57% of all skilled worker immigrants are either unemployed, underemployed, or working in an unrelated field after two years of residence in Canada (Statistics Canada, 2005).

While these figures are fairly consistent across regions in Canada, there are several notable variations. Overall employment rates and employment rates in the

intended field are considerably poorer for immigrants residing in Quebec than in the rest of Canada. Employment rates in the intended field are considerably better for immigrants residing in Atlantic Canada relative to the rest of Canada (Statistics Canada, 2006). The Canadian Labour and Business Centre reports that generally, of those immigrants who arrived in Canada holding at least one foreign credential, only 14% had their credentials assessed and fully accepted after six months in Canada (CLBC, 2004).

From immigrants' perspectives, the key barriers to labour market integration are a lack of Canadian workforce experience, difficulties with having foreign qualifications formally recognized in Canada, language barriers, and a shortage of jobs. While regional variations again persist, the lack of Canadian workforce experience and difficulties with recognition of foreign qualifications (FCR) are consistently named as the top two barriers, with the experience of job shortages found to be a very regional reality (Statistics Canada, 2005, 2006). Other findings indicate that, in addition to the above-mentioned difficulties, lower proficiency in the language of work, poor knowledge of practices and standards in the work world, cultural barriers, and poor knowledge of programs and sources of financial assistance and training are often impediments to immigrants' integration into the workforce (CLBC, 2003b).

The *From Consideration To Integration* project of Engineers Canada (the business name of the Canadian Council of Professional Engineers) gives the broadest and most recent glimpse at the labour market challenges identified by IEGs specifically. Echoing the experiences of immigrant professionals generally, IEGs also cite frustrations in gaining Canadian workforce experience and in FCR (both of which are required for professional engineering licensing) as key employment challenges. IEGs describe the

FCR / licensing process to be time-consuming, costly, and unfair or inappropriate in its requirements. They have further indicated that the requirement to obtain one year of Canadian engineering experience in order to be eligible for licensing is extremely frustrating, in that this type of workforce experience is found to be very difficult to obtain (CCPE, 2003).

Varma (2006) has described these concerns as a combination of: structural factors in science and engineering (prejudice or discrimination; lack of effort to understand newcomers; tendency to hire from the dominant group) and social factors (communication skills, cultural behaviours that do not translate well into North American contexts) that impede labour market access and professional mobility and success. Varma's study frames the issue in terms of human capital (what you know) and social capital (whom you know). While immigrants' human capital is often extensive, in the form of higher education, previous professional achievement, and technical skills, they are generally weak in social capital, whose networks tend to be personal and by-invitation-only. Lack of access to social networks is known to significantly impede career advancement, not only for IEGs, but also for female engineers and Canadian engineers of Aboriginal descent.

These challenges related to labour market access and success can be termed a transition penalty, and appear to hit the most-educated immigrants the hardest. The transition penalty described by IEGs highlights a context ripe for applied creativity and innovation in FCR and labour market access for engineers with non-Canadian qualifications. It is such a context that motivated the development of IEEQ. As a program that facilitates licensure for professional practice, the perspectives of industry

stakeholders were critical to understand. It is these views that are reviewed in the next section.

Perspectives of Industry on the Labour Market and Immigration

Immigration is widely recognized by industry as a practical response to contributing to current and future labour market needs in the context of skill shortages created by an aging population, slowing population growth, and impending retirement waves (CLBC, 2003a, 2005). In a survey of private and public sector managers and labour leaders, approximately two-thirds of respondents felt that Canada's current emphasis on increasing immigration levels was either appropriate or needed even more emphasis. At the same time, approximately one-half of respondents felt that more emphasis should be given to focusing immigration selection on areas of skill shortages (CLBC, 2003a).

Concurrently, industry also identifies some consistent challenges associated with integrating immigrants into the labour force. Private and public sector managers and labour leaders cited language difficulties as the most common obstacle to hiring immigrants, followed by difficulties in assessing foreign credentials and a lack of Canadian workforce experience (CLBC, 2003a). Turning again to specific sectors that employ a large proportion of engineers, the Canadian Manufacturers and Exporters Management Issues Survey (2007) revealed some of the most commonly cited reasons for refusing a job applicant: insufficient work experience; lower qualifications relative to other applicants; lack of credentials / certification; and, inadequate communication skills. At the same time, 26% of companies indicated that hiring recent immigrants with foreign

training was a part of their strategy to address future labour needs. Within the electricity sector, a majority of industry representatives concurrently see immigrants as a significant portion of new workers, but also identify challenges in hiring related to recognition of foreign credentials and language barriers (Canadian Electricity Association, 2005; Electricity Sector Council, 2008).

Employers that have experience working with IEGs in an engineering capacity consistently identify several key determinants (or conversely, barriers) to labour market success: an individual's ability to communicate in English (or in Quebec, French); an individual's prior employment experience in Canada; qualifications recognition / professional licensure; and, familiarity with the culture of Canadian workplaces (CCPE, 2003; CLBC, 2001, 2004). Employers identify the technical skills of IEGs to be equivalent to those of Canadian-trained engineers, although language weaknesses may at times mask technical competency, and educational systems outside North America and the United Kingdom are perceived to lack a strong practical component. Key language skills were linked further to the ability to function effectively in team-based organizational models with other engineers and non-engineers, as well as to the broader communication fluency in soft skills and North American business practices (business culture, health and safety, and environmental and labour standards). These areas were identified by employers as key training needs for IEGs (CCPE, 2003).

Employers understand that formal recognition of foreign credentials is the mandate and activity of the provincial regulatory body for engineering in each respective province or territory. As such, employers' experiences with a FCR process may be anecdotal, based on the observed or narrated experience of their employees, colleagues,

friends, or family. Employers often characterize the assessment process in engineering as overly complex and time-consuming, meaning that many immigrants are not willing or able to follow it to completion. Employers also express concern that licensing processes appear at times too restrictive, and that immigrants arrive in Canada with incomplete or inaccurate information regarding FCR (CLBC, 2001).

Laroche (2003) contextualizes these observed differences and challenges as examples of cultural differences. Cultural differences manifest themselves in concrete actions and behaviours that include the nature of interactions with colleagues and supervisors, approaches to team-based work, communication styles and preferences, and career development expectations and approaches. However, Laroche likens culture to personality at the level of a society, and ties these observed day-to-day differences to preferences in one's underlying paradigms of power distance (hierarchical vs. participative preferences), individualism vs. collectivism, risk tolerance vs. risk aversion, feedback, and context.

While IEGs' challenges with FCR and labour market access support the need for the development of alternative FCR pathways like IEEQ, engineering employers' perceptions and experiences also support the need for innovation in the professional settlement and integration process for IEGs. Furthermore, although employers are doubtful of their own capacity to assess foreign credentials, employers express high levels of support for government and policy initiatives that address the issue (CLBC, 2003a). It is a sampling of such initiatives that is addressed in the next sections. An overview of the professional licensing process in engineering is described first, in order to provide a context for the FCR initiatives.

Professional Regulation

Across Canada, professional engineering is a regulated profession. Holding a professional engineering license (P.Eng. license) is a legal requirement to practice professional engineering, regardless of engineering discipline, country of birth, or country in which the bachelor-level engineering degree was completed. The P.Eng. license is also generally accepted as a professional credential required for career advancement and mobility. Assessing qualifications toward and granting of the P.Eng. license, including the assessment of foreign credentials, is the mandate and activity of the engineering regulatory body (sometimes referred to as the engineering association) in each respective province or territory, as delegated by the provincial and territorial governments through Acts of legislature. On behalf of provincial and territorial governments, regulatory bodies are charged with serving and protecting the public by regulating the practice of professional engineering by ensuring that those who practice engineering are qualified to do so, encouraging those who are eligible to become registered, and disciplining those who practice in contravention of the Act. In Manitoba, the regulatory body is The Association of Professional Engineers and Geoscientists of the Province of Manitoba (APEGM).

The 12 provincial and territorial regulatory bodies are brought together under the umbrella of Engineers Canada, the business name of the Canadian Council of Professional Engineers. As opposed to a mandate as an authoritative parent body for the provincial and territorial regulators, Engineers Canada is the daughter organization of the provincial and territorial regulatory bodies. As such, it has no regulatory status nor authority on its own, and it cannot mandate regulatory practice or policy to its constituent

members. Many of Engineers Canada's activities are carried out through the Canadian Engineering Accreditation Board to ensure substantive equity in the content, breadth, and depth of undergraduate engineering education across the country, and through the Canadian Engineering Qualifications Board, which develops national guidelines on professional engineering qualifications, standards of practice, ethics and professional conduct. Engineers Canada fosters consistency and continuity of provincial and territorial regulatory policy and practice across Canada, and acts as a unified voice for the Canadian engineering profession to the federal government, industry, the Canadian public, and internationally.

The granting of a P.Eng. license follows a substantively similar process in each province or territory. The two major requirements for licensing (applied to all applications regardless of country of birth or country in which the engineering degree was obtained) are *academic qualification* (a four-year engineering degree from an accredited Canadian university program, or equivalent), and four years' of supervised engineering practice experience. In addition, each province or territory generally requires some combination of a nominal amount of professional development and professional service on an annual basis, and the successful completion of a closed-book engineering ethics and law exam. Figure 2.1 outlines the typical licensing process with APEGM in Manitoba.

Step 1: Requirements to be registered as an Engineer-in-Training (EIT) in Manitoba

1. Academic qualification: a four year engineering degree from an accredited Canadian university program, or equivalent)
2. The APEGM Professional Practice Test: a 40-question, open-book, time-unlimited test ensuring the candidate's familiarity with the Manitoba Engineering and Geoscientific Professions Act, By-Laws, and the Engineering Code of Ethics.

Step 2: Requirements to be registered as a P.Eng. in Manitoba

Registered as an EIT, and successful completion of:

1. A minimum of four years of refereed engineering work experience with acceptable coverage in application of theory; practical experience; engineering management; communication skills; professional and ethical responsibilities; and social implications of engineering. At least 12 months of the four years' work experience must be in Canada or a Canadian environment
2. Professional Development – nominally 12 hours annually
3. Professional Service – nominally 12 hours annually
4. National Professional Practice Exam: a 100-question, closed-book, time-limited test ensuring the candidate's familiarity with concepts in engineering regulation, ethics, and law.

Figure 2.1. **Professional engineering licensing requirements with APEGM in Manitoba**

There are three primary routes to meeting the first major requirement of *academic qualification.* Graduates of accredited undergraduate engineering programs at Canadian universities are considered to be *academically qualified* for registration. Immigrants to Canada holding undergraduate engineering degrees from countries covered under an international agreement called The Washington Accord are considered to be *academically qualified* upon a verification assessment, on the basis of reciprocal agreements between the respective countries' accreditation bodies. A verification assessment requires an application to the regulatory body and review of past transcripts by the regulatory body; however, no further demonstration of competency or qualifications is required of the individual applicant. Countries covered under the Washington Accord and eligible for verification assessment include the United States, Ireland, Australia, Great Britain, New Zealand, Hong Kong, Japan, and South Africa.

Immigrants holding undergraduate engineering degrees from all other countries must submit their academic credentials (copy of original degree, transcripts, and course syllabi) to APEGM for case-by-case *Assessment of Academic Credentials.*

For these applicants, the *Assessment of Academic Credentials* is carried out by an APEGM staff member (prior to 2008, by an APEGM committee), who examines the applicant's background relative to syllabi set by Engineers Canada outlining the desired breadth and depth of coverage for undergraduate engineering degrees. Upon completing the *Assessment of Academic Credentials* of an IEG with non-Canadian, non-Washington Accord engineering credentials, APEGM will generally assign an exam program by which the IEG confirms the applicant's technical background and/or fills identified gaps in the technical background. Exams typically cover material found in the final two years of a bachelor-level engineering program. Across Canada, confirmation by technical exams has been the long-standing pathway for *academic qualification* for non-Washington Accord applicants, and may be colloquially called 'the traditional route'. In the last five years, an increasing number of regulators have been instituting alternative pathways for non-Washington Accord applicants to achieve *academic qualification*, often in the form of oral interviews to assess and confirm an applicants' background. Oral interviews, and other licensing pathways that an individual regulator may institute, are considered relatively new processes.

Figure 2.2 outlines the possible outcomes of the *Assessment of Academic Credentials* and pathways to fulfill requirements for *academic qualification* with APEGM in Manitoba. Since 2003, the IEEQ program has been considered one acceptable pathway for *academic qualification* for a subset of non-Washington Accord

applicants who were assigned five or fewer Confirmatory Exams as a result of the *Assessment of Academic Credentials*. At program inception, the IEEQ program was the only available alternative to the traditional route of writing the Confirmatory Exams. Since 2003, the other two pathways – oral interview or a set of defined university courses in lieu of exams – have been developed by APEGM. Upon successful completion of the assigned examination program via one of the available pathways outlined in Figure 2.2, the applicant is deemed *academically qualified* and is able to proceed in the licensing process (as per Figure 2.1).

APEGM has seen its caseload of immigrant applicants increasing steadily in recent years, from approximately 60 new applicants annually in 2002 to approximately 100 new applicants annually in 2005 and 2006 (Association of Professional Engineers and Geoscientists of Manitoba [APEGM], 2007). Of these, consistently two-thirds to three-quarters of assessed applicants are assigned Confirmatory Exams, and would therefore generally have a choice of multiple pathways toward *academic qualification* as per Figure 2.2. While the anticipated time to complete a Confirmatory Exam program is calculated as six months per Confirmatory Exam, plus a six-month grace period (e.g. 30 months for four Confirmatory Exams), it is anecdotally known that many or most applicants take significantly longer to complete, or abandon, the process along the way. Since ongoing contact with APEGM is at the initiative of the applicant, the association does not currently have means to track attrition rates. For those applicants who received the results of an *Assessment of Academic Credentials* in 2002 and 2003, only 38% and 45% of applicants respectively had completed their assigned examination programs as of December 31, 2006. It is anticipated that those completion rates will remain fairly static,

while the completion rates for applicants assessed in 2004 and onward are not presented here, since many of those applicants remain in progress in completing their requirements.

The preceding paragraph related to the progress of applicants who had been assessed by APEGM in a given year. It is also instructive to briefly examine the progress of applicants who complete their examination programs in a given year, regardless of the year they were assessed. Understanding that applicant numbers have increased substantially in recent years, one would nonetheless look for the number of applicants completing an exam program in any given year to be approximately equal to the number of new applicants to APEGM in a given year. However, data provided by APEGM show relatively low numbers for completion of *academic qualification.* In the years from 2002 through 2006, the numbers of applicants who successfully completed a Confirmatory or Proficiency Exam program (regardless of the year in which they were assessed and began the exam program) were 20, 10, 29, 38, and 41, respectively. It is worthwhile to note that the figures for 2004 through 2006 include graduates of the IEEQ program: five of 29 files in 2004, 10 of the 38 files in 2005, and eight of the 41 files in 2006 were IEEQ graduates.

A further breakdown of the data shows that those applicants assigned more than five Confirmatory Exams and those applicants assigned any number of Proficiency Exam had significantly poorer completion rates than those applicants assigned between one and five Confirmatory Exams. Between 2002 and 2006, only one applicant who had been assigned more than five Confirmatory Exams and only three applicants who had been assigned Proficiency Exams completed the examination programs.

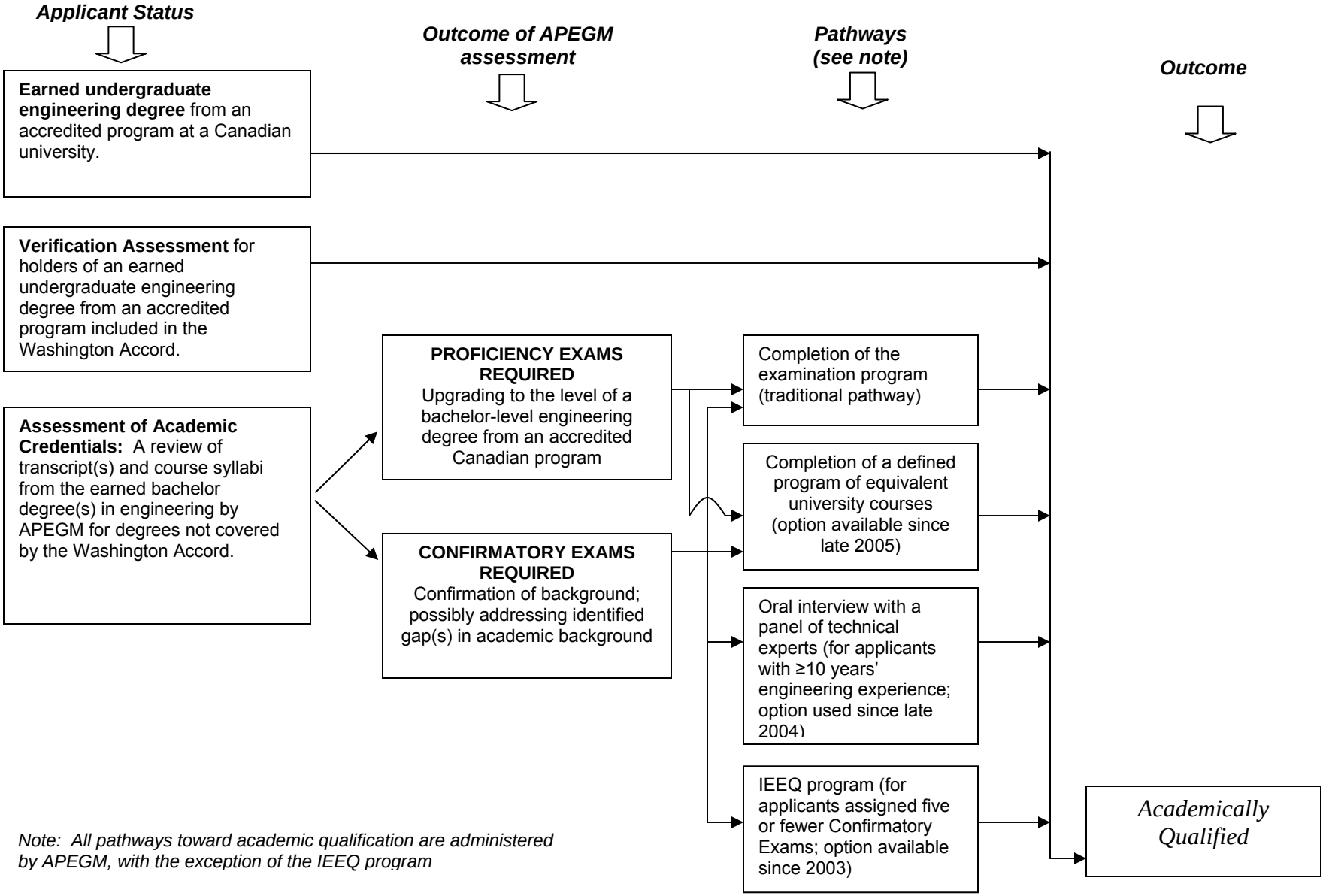

Figure 2.2. **Pathways to *academic qualification* with APEGM**

These data imply low licensing rates for IEGs despite the availability of licensing pathways and options, especially for a select group of applicants with a specific assessment outcome. To date, APEGM has not engaged in a systematic evaluation to understand the underlying causes of high attrition rates from the licensing process. Anecdotally, immigrants report the experience of an examination program as an isolating experience that requires an enormous degree of self-discipline and self-motivation, given the absence of organized support networks within APEGM, the engineering community at large, and immigrant circles. One of the motivations to develop IEEQ was to address these anecdotal low rates of *academic qualification* through the traditional route, and the perceptions of isolation among IEGs. In conceiving of the IEEQ concept, a review of related initiatives was warranted, and this is summarized in the following section.

Responses in Public Policy and Legislation

The Government of Canada has increasingly recognized the importance of addressing the professional integration of immigrants, and addressing national labour market trends, for the ongoing economic prosperity of the country. In 2005, it launched the Foreign Credential Recognition Program, which committed $73 million over six years to sector councils, professional associations, industry groups, regulatory bodies, government, universities and colleges, and other organizations. Since credentials assessment and recognition and professional licensing are mainly a provincial responsibility (delegated in legislation to individual regulatory bodies), the federal program plays a facilitative role with provinces and territories to support consistent, national approaches. Interested organizations may apply for funding under the program

for activities that may range from research and process development, design and implementation of new tools and systems, and development and dissemination of information. All activities funded under the program must demonstrate an objective toward fair, accessible, coherent, transparent, and rigorous foreign credential recognition processes to enhance the labour market outcomes of foreign-trained individuals (Human Resources and Social Development Canada, n.d.).

Another federal initiative is the Foreign Credentials Referral Office, intended to be a comprehensive information portal for immigrants prior to and upon entry to Canada, to access timely, accurate, and relevant labour market information and referrals to appropriate regulatory bodies. Still a fledgling initiative, its approaches to reaching immigrants include a significant on-line presence at www.credentials.gc.ca, as well as dedicated phone services and in-person services through Service Canada outlets in major Canadian cities (CIC, 2007b).

A related federal initiative is the Enhanced Language Training Initiative, involving up to 14 federal departments, and co-led by Human Resources and Social Development Canada and Citizenship and Immigration Canada. This initiative involves approximately $50 million of funding, between 2003 and 2010, to provide job-specific language training to immigrants. However, to qualify for funding, language training projects must also include a bridge-to-work component (for example, internships or work placement opportunities), a mentorship / networking component, or assistance with professional licensure. The federal government's stated objectives in this initiative are to facilitate employment for immigrants commensurate with past education and experience, and to support skilled workers commensurate with labour market demands

(http://www.cic.gc.ca/english/resources/publications/horizontal-2006_e.asp#elt, accessed 01 November 2007).

Provincially, the Government of Manitoba has spent considerable effort in defining a strategic direction to their overall immigrant settlement programs, particularly as immigrant settlement dovetails with labour market issues and other strategic economic objectives defined by the province. The Manitoba Immigrant Integration Program (MIIP) provides funding, coordination, and/or staff support for services that facilitate the economic and social integration of immigrants and refugees in Manitoba. Under the MIIP umbrella in 2005/2006, Manitoba spent $2.8 million for settlement services, including general settlement, labour market integration, health and wellness, and qualifications recognition projects. An additional $5.3 million was spent on Adult English as a Second Language projects, and $580,000 was spent on Enhanced Language Training projects, wherein the definition of Enhanced Language Training again includes labour market integration (MLI, 2005).

Within the qualifications recognition projects, Manitoba's priority is to facilitate immigrants' entry into the workforce in areas in which they already have training and experience. The Manitoba Qualifications Recognition Initiative operates from the perspective that the Government of Manitoba should take a leadership role to address the issue of qualifications recognition and entry to practice of highly skilled immigrants. Through funding, coordination, and staff support, the initiative is intended to facilitate new approaches to provide fair and efficient assessment processes, opportunities for immigrants to understand Canadian workplace culture and occupational roles, opportunities to gain experience and demonstrate skills, and strengthen employment

outcomes (MLI, n.d., 2005). The focus is on programming that supports economic objectives, is facilitated by government but 'owned' by stakeholders (regulatory bodies, educational institutions, community agencies), provides support for the immigrant, and helps develop partnerships across and among professions that will lead to cohesive approaches in the short term and system changes in the long term (MLI, n.d., 2005). A summary of the seven principles and nine-point action plan upon which the Manitoba Qualifications Recognition Initiatives and Strategy are based is included as Appendix A.

The issue of improving FCR processes for immigrant professionals is also beginning to find focus directly in legislation. In 2006, the Province of Ontario passed the *Fair Access to Regulated Professions Act* (Province of Ontario, 2006), and in fall 2008, the Province of Manitoba passed the *Fair Registration Practices in Regulated Professions Act* (Province of Manitoba, 2006). In both cases, the purpose of the Act is to "help ensure that regulated professions and individuals applying for registration by regulated professions are governed by registration practices that are transparent, objective, impartial, and fair." Following approximately comparable structures, both Acts call for a general duty of regulated professions to provide registration practices and assess qualifications in ways that are transparent, objective, impartial, and fair. Both Acts include corresponding duties to provide: comprehensive information to applicants; timely decisions, responses, and reasons; methods of internal review or appeal; and, the appointment of a Fairness Commissioner to monitor, evaluate, and resource the registration practices of professional regulatory bodies. The Ontario Act additionally calls for the establishment of an Access Centre for Internationally Trained Individuals to provide information and conduct research for the benefit of all stakeholders.

Finally, the issue of improving FCR pathways for immigrant professionals also finds focus in non-governmental forums. As example, at both local and national levels, conferences regularly bring together the diverse stakeholders – business, sector councils, immigrant serving agencies, regulatory bodies, government, and educational institutions – to highlight foreign credential recognition issues by showcasing and comparing best practices, brainstorming strategic directions, and facilitating networking and information sharing. Recent initiatives include the following seminars and conferences:

- Teachers of English as a Second language (TESL Canada and TESL Manitoba, now TEAL Manitoba, www.teslmanitoba.ca), *Program Considerations for Internationally Educated Professionals: Learning from New Initiatives for Engineers*, October 2006;
- Citizenship and Immigration Canada (www.cic.gc.ca), *Second National ELT Conference: From Vision to Action: The Enhanced Language Training Initiative*, October 2006;
- Canadian Network of National Associations of Regulators (www.cnnar.ca), *Future of Professional Regulation in Canada*, April 2007;
- Public Policy Forum (www.ppforum.ca), *Comparing Approaches to Recognizing the Skills and Credentials of Foreign-Trained Workers*, April 2007;
- Manitoba Prior Learning Assessment Network (www.mbplar.ca), *The Power of PLAR*, May 2007; and,
- Electricity Sector Council (www.brightfutures.ca), *Bright Futures in Canada Conference: Integrating Internationally Trained New Canadians in the Energy Industry*, November 2007.

Responses in Direct Programming for International Engineering Graduates

An integrated approach to the issues of governments' economic strategies relative to labour market issues, social responsibility for the integration of immigrant professionals, and regulatory issues in the engineering profession have led to direct programming for IEGs. The most over-arching of such initiatives in the engineering profession is the *From Consideration To Integration* (FC2I) project, an initiative of Engineers Canada and the provincial and territorial engineering licensing bodies. The goal of FC2I is to develop new processes and/or improve current processes by which IEGs are able to obtain an engineering license without compromising public safety or lowering professional standards, and are able to find meaningful engineering employment (www.engineerscanada.ca/fc2i).

FC2I is a three phase project. In Phase I (completed in 2003), work focused on understanding the IEG experience, examining provincial and territorial engineering licensing procedures, and learning from those who work with and employ IEGs. The findings of this phase, which have been included in the previous section *Labour Market Challenges for Immigrants*, are consistent with the issues identified for immigrant professionals generally. In Phase II (completed in 2004), the FC2I Steering Committee analyzed the information, determined where the process of integration needs improvement and began to build consensus among stakeholders on possible solutions. The inception of the IEEQ program happened concurrently with the development of Phase II of FC2I, rather than as a direct response to FC2I. Both FC2I and IEEQ closely watched each others' development, and retroactively confirmed similar perspectives toward the integration of IEGs. Specifically, the IEEQ program, as conceived and

developed internally, addressed five of the 17 recommendations for action that came out of Phase II of FC2I. These five recommendations are:

- Studying the feasibility of alternative systems of evaluating an applicant's professional competency for licensure in comparison with the current Canadian system;
- Creating a "Working in Canada" seminar for IEGs;
- Promoting the concept of cross-cultural training to be taking by licensing body volunteers and staff, IEGs, and employers;
- Undertaking a study to determine best practices in the employment area for integrating IEGs into the workplace (e.g. internship, job matching, job fairs, job boards); and,
- Developing a mentoring program for IEGs.

The complete set of 17 recommendations that arose out of Phase II of FC2I, with explanatory notes, are included as Appendix B.

In Phase III (2005 and ongoing), Engineers Canada and its partners are working with key stakeholders to implement the recommendations and to develop supporting communications materials. By securing funding through federal government initiatives and other sources, Engineers Canada is working with local partners to strengthen existing, and to develop new initiatives, that address the overall goals of FC2I and the specific recommendations of Phase II of FC2I.

Each province and territory in Canada is also addressing professional integration issues of IEGs through various forms of gap training and bridging programs. Often delivered by community agencies and colleges, bridging programs usually focus on

general information about professional and cultural integration, occupation-specific language training, skills upgrading, job search skills, and/or employment facilitation. However, IEEQ was the first bridging program in Canada to operate directly within the licensing system of the jurisdiction and to lead to a formal Canadian engineering credential legally required for professional practice. Two subsequent programs that also operate directly within the licensing system and play a role in formal FCR are:

- *Internationally Educated Engineers Qualification Bridging Program*, offered by Ryerson University and Professional Engineers Ontario. With its first intake in September 2007, this program is highly modeled after the IEEQ program in Manitoba, both in its delivery features (components) and its role within the regulatory (licensing) process. (http://www.feas.ryerson.ca/styles/1/ieeqb_program/index.html).
- *Communication and Orientation Program for Internationally Educated Engineering Professionals*, offered by the Halifax Immigrant Learning Centre. This is a three-month program that counts toward the one year of Canadian professional experience required for registration with the Association of Professional Engineers of Nova Scotia. (www.hilc.ns.ca)

Other bridging programs that offer excellent programming, but do not play a formal role in qualifications recognition with the provincial or territorial regulatory body are included as Appendix C. IEEQ has always filled a unique niche in IEG programming, and this is also one additional reason to investigate it more closely.

Best Practices in Qualifications Recognition

The issue of qualifications recognition, professional integration, and cultural adaptation of immigrants transcends the engineering profession, and it is instructive to look at programs that are similar in a given structural feature or as to some aspect of the target audience. These include qualifications recognition programs for other types of immigrant professionals (outside of engineering), as well as programs that focus on integration of minority populations, and programs designed for adult learners. The medical profession was one of the professions with early experiences in the integration of international medical graduates (IMGs), and there is a more extensive literature (compared to the engineering profession) related to the challenges experienced by IMGs and concomitant program initiatives related to the licensure process for IMGs in North America. Similar to the conceptual framework of the IEEQ program, key challenges of IMGs are found to be language and professional communication skills, an understanding of the culture of the medical profession in North America, and the lack of support structures for IMGs undertaking an FCR process upon immigration to North America. Program initiatives appear to be focussed on the development of additional assessment tools for IMGs, such as the Clinical Skills Assessment in the U.S. and the addition of specific training pieces (for example, workplace communication) to existing training regimens for IMGs (Hall, Keely, Dojeiji, Byszewski, & Marks, 2004; Andrew & Bates, 2000; Whelan, 2000; McMahon, 2004).

However, the widespread delivery of qualifications recognition programs finds neither a mandate nor a history within universities. Yet, since universities are increasingly finding themselves called upon to partner with government and industry in

the development and delivery of the same, 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 foreign credential assessment and recognition (FCAR) for internationally-educated professionals (AUCC, 2006). The overall objective of the study was to determine the capacity of, and identify possible roles for Canadian universities to deliver targeted FCAR programs and services to immigrant professionals both prior to and upon their arrival to Canada. Further aims of the study were to influence federal policy relative to foreign credential recognition and provide a basis for further design, development, and delivery of FCAR programs in Canadian universities.

Drawing on survey responses from 58 academic and administrative units at 40 Canadian institutions, supplemented by in-depth case studies of FCAR programs at five Canadian universities, specific best practices and key elements of programs for immigrant professionals were identified (AUCC, 2006):

1. A formal role for Foreign Credential Assessment and 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.

Taken together, the best practices are termed "a holistic approach" to program design and delivery. 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 (AUCC, 2006). In this sense, exemplary FCAR programs focus on the readiness and ability for a participant to practice their profession in Canada, rather than focusing narrowly on the

assessment and recognition of paper-based foreign credential documents. The IEEQ program also fits well into this vision articulated by the AUCC.

These best practices for FCAR programs for immigrant professionals can be compared to similar representative studies that focus on Canadian Access programs, Recognition of Prior Learning (RPL), and adult education. However, it is also instructive to highlight differences in function and objective that limit a complete transferability of best practices from these programs to foreign credential recognition programs for immigrant professionals such as IEEQ. Part of these differences hinge on nuanced differences between the terms 'qualification recognition' and 'FCR', which are often used interchangeably. In this study, FCR for immigrant engineers was considered to be the formal recognition of the foreign credential (e.g. degree) by the engineering regulatory body as satisfactory qualification for licensing as a professional engineer. Qualifications recognition encompasses FCR, but more broadly also includes successful and sustained engineering employment which FCR facilitates but does not guarantee on its own. Full qualifications recognition generally requires FCR *together with* concerted transitional support in cultural bridging, knowledge of professional culture, and language development in order to fully realize an immigrant professional's potential.

Conversely, qualifications recognition in unregulated professions is able to target assessment to knowledge, skills, and experience gained in informal ways and applied in informal contexts, which current licensing processes in engineering do not accommodate. Appendix D outlines the relationship between qualifications recognition and FCR in more detail.

Further differences also exist in target audience and key issues of concern. Table 2.1 broadly outlines some of these differences.

Table 2.1
Comparison of Applicability of Qualifications Recognition Programs to FCR for IEGs

Program / Organization type	Similarities to Foreign Credential Recognition Programs for Immigrant Professionals	Differences to Foreign Credential Recognition Programs for Immigrant Professionals
Access programs for aboriginal students	University setting; minority population with cultural barriers to overcome; may enter university with non-standard entry requirements	Target audience differs; key issues include student recruitment and retention/perseverance
Recognition of Prior Learning (RPL) initiatives	Adult learners;	Not necessarily newcomer and/or minority participants; not necessarily a university setting; significant focus on knowledge, skills & experience gained through non-formal pathways (hobbies, volunteer experience, work, and life), which are currently not applicable to or integrated into regulated professions
Adult Learner Friendly Institutions (ALFI)	Adult learners; may have non standard entry requirements	Not necessarily newcomer and/or minority participants; not necessarily a university setting

With these qualifiers in mind, best practices from representative studies in related fields are presented in Table 2.2, aligned thematically with the outcomes of the AUCC (2006) study. While studies articulating specific best practices for Aboriginal Access programs were not located, common structural features between qualifications recognition programs for immigrant professionals and Access / minority programs – in Canada and the U.S. – include acknowledgement of, and adaptations for, participants' characteristics that set them apart from the general undergraduate population (age, culture, family responsibilities), and the critical role of financial, social, and academic supports in their ability to persevere and succeed (R.A. Malatest and Associates Ltd., 2004; Unruh, 1992;

Kisst Hackett & Martin, 1998; Reichert & Absher, 1998; Van Aken, Watford, & Medina Borja, 1999).

Table 2.2
Comparison of Proposed Best Practices in Programming

Best Practices and Key Elements of Foreign Credential Assessment and Recognition (FCAR) Programs (AUCC, 2006)	Principles of Exemplary Recognition of Prior Learning (RPL)[1] Organizations (Riffell, 2004)	Principles of Effectiveness for Adult Learner Friendly Institutions (ALFI)[2] (HRSDC, 2007; Zakos, 2007)
Formal Outcomes		
A formal mandate and outcome for formal recognition of foreign credentials (for example, by regulatory / licensing bodies), delivered in a manner that conveys respect for the professional status of participants.	Transferability – recognition awarded through an RPL system is accepted within the appropriate context in other jurisdiction, allowing foreign-trained individuals mobility across Canada.	
Client-responsive and adaptive institutional processes		
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.	Pre-Advising / Counselling – the RPL system considers the life and career goals of foreign-trained individuals prior to the RPL assessment process, and provides information and resources to prepare for appropriate RPL and entry into practice in a timely manner.	Life and Career Planning – adult learners' life and career goals are addressed before or at onset of enrollment, in order to assess and align institutional capacities to help learners reach their goals.
	Transparency – clear, well-articulated RPL processes; processes and outcomes are easily accessed by foreign-trained individuals.	Outreach – the institution conducts outreach to adult learners by overcoming barriers in time, place, and tradition, in order to create lifelong access to educational opportunities.
Continuous assessment and evaluation of clients and program		
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 and allow them to complete their programs in the most effective and efficient manner.	Evaluation / Measurement of formal and informal learning acquired by foreign-trained individuals in the field of practice.	Assessment of Learning Outcomes – the institution defines and assesses the knowledge, skills, and competencies acquired by adult learners both from the curriculum and from life/work experience, in order to assign and confer degrees with rigour.
	Quality Assurance – policies and procedures for providing quality services, and a systematic process of reviewing and changing procedures to ensure the system continuously meets needs of stakeholders.	Teaching / Learning Process – faculty use multiple methods of instruction for adult learners, in order to connect curricular concepts to useful knowledge and skills.
Partnerships and Collaboration		
Active collaboration among all stakeholders including the university, regulators, professional associations, government, employers, and immigrant settlement agencies during program development and delivery.		Strategic Partnerships - strategic relationships, partnership, and collaborations between the institution, employers, and other organizations in order to develop and improve educational opportunities for adult learners.

Best Practices and Key Elements of Foreign Credential Assessment and Recognition (FCAR) Programs (AUCC, 2006)	Principles of Exemplary Recognition of Prior Learning (RPL)[1] Organizations (Riffell, 2004)	Principles of Effectiveness for Adult Learner Friendly Institutions (ALFI)[2] (HRSDC, 2007; Zakos, 2007)
Supports and programming to facilitate formal outcomes		
Access and/or referral to appropriate financial resources that make program participation a viable option for immigrant professionals.	Client-Responsive – an RPL system that is sustainable, cost-effective, and efficient for both the client and the organization.	Financing – the institution promotes choice in payment options, to expand equity and financial flexibility. Student Support Systems – comprehensive academic and student support systems, in order to enhance students' capacities to become self-directed, lifelong learners.
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. Providing training in language and communication skills for professional environments, including the language and culture of the profession and the workplace.		
Core Leadership and Values		
Leadership, in commitment of faculty members coupled with moral, policy, and financial support of the university and faculty administration in which programs are delivered.	Values – the RPL system reflects an organization's willingness and ability to promote barrier- and bias-free accessibility and services to foreign-trained individuals.	
Other		
		Technology – information technology is used to provide relevant and timely information and to enhance the learning experience.

Notes:

1 In this study, researchers examined 31 organizations with promising RPL systems for foreign-trained individuals. RPL was used as an umbrella term for Prior Learning Assessment and Recognition (PLAR), FCR, and qualifications recognition (See Appendix D).

2 In this study, 115 faculty, staff and administrators from 15 educational institutions and community-based organizations participated in a study to develop a set of principles to act as benchmarks for best practices for institutions and organizations serving adult learners.

Within the academic engineering literature, discussions on the intersection of culture and engineering education are predominantly focussed on 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 (Valiulis & Valiulis, 2006), globalization is considered a reality that cannot be avoided. In the U.S., the percent of the economy exposed to international competition is said to have increased from 7% in the 1960s, to over 70% today (Sheppard, Dominick, & Aronson, 2004). Globalization is increasingly the theme of engineering education conferences, such as the American Society for Engineering Education annual conference (Chicago, IL) in 2006, and the Frontiers in Education Conference (Milwaukee, WI) in 2007. The pressures that globalization is perceived to exert on engineering education generally revolve around preparing North American graduate engineers 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. Key curricular thrusts include increased international exchange experiences, a focus on second-language learning, and an explicit focus on appreciation of cultural values (Sheppard et al., 2004; Valiulis & Valiulis, 2006; Vest, 2006; Fruchter & Townsend, 2003; Riemer, 2002; Hirleman, Groll, & Atkinson, 2007).

One notable exception is a study by Cholewka (1997), 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's scope is limited to an investigation of 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 that contrary to belief, simple exposure to an environment will not cause language or intercultural competence to emerge naturally. Finally, her findings stress the importance of combining both language and cultural teaching in preparing foreign-trained engineers to navigate professional contexts successfully, particularly those contexts with unpredictable elements (job interviews, client meetings, etc.).

All of the referenced studies have insights to offer, and it is this body of literature on a wide range of allied program types that informed the iterative development process of IEEQ. Simultaneously, constant vigilance to the unique characteristics of IEEQ to referenced studies was, and continues to be, required as program development evolves.

The Engineering Body of Knowledge

In addition to the best practices and success factors that can be gleaned from the programming initiatives described in the previous sections, there is also an emerging consensus on the required engineering body of knowledge for graduate engineers, both to enter professional practice and to be adequately prepared for career advancement opportunities. This discussion is also instructive when applied to the context of assessing potential knowledge and skill gaps of IEG newcomers.

In the first reference, the accreditation bodies for undergraduate engineering programs define a body of knowledge for graduate engineers. The Canadian Engineering Accreditation Board (CEAB) does so by specifying curriculum content for accredited

undergraduate engineering programs. This content includes mathematics and basic sciences, engineering sciences, engineering design, and complementary studies in humanities, social sciences, arts, management, and communication. Besides these knowledge components, the CEAB also specifies behavioural components of the body of knowledge by including appropriate laboratory experience, as well as attitudinal components of the body of knowledge by including awareness of the role and responsibilities of the professional in society, ethics, equity, safety and health, sustainable development, environmental stewardship, and a capacity for independent learning (Canadian Engineering Accreditation Board [CEAB], 2008).

In the U.S., ABET Inc. has articulated the minimum engineering body of knowledge as student outcomes in eleven key areas. These eleven areas span knowledge, skill, and attitudinal attributes (ABET Inc., 2008):

(a) an ability to apply knowledge of mathematics, science, and engineering;

(b) an ability to design and conduct experiments, as well as to analyze and interpret data;

(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability;

(d) an ability to function on multi-disciplinary teams;

(e) an ability to identify, formulate, and solve engineering problems;

(f) an understanding of professional and ethical responsibility;

(g) an ability to communicate effectively;

(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context;

(i) a recognition of the need for, and an ability to engage in life-long learning;

(j) a knowledge of contemporary issues; and,

(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Individual disciplines have also made efforts to define, or re-define, the required body of knowledge for their graduates, often in response to perceptions of the changing nature of engineering practice in an environment of rapid technological and societal changes, blurring of discipline boundaries, and increased complexity in engineered systems. The American Society of Civil Engineers (American Society of Civil Engineers [ASCE], 2004) published a comprehensive report that addressed the civil engineering body of knowledge in terms of what should be taught and learned, how it should be taught and learned, and who should teach and learn it. In terms of the content ('what should be taught and learned'), ASCE defined the body of knowledge as the eleven ABET outcome criteria, plus four additional outcomes. These four additional outcomes include: added depth in a specialized technical area; added breadth by the inclusion of project management, construction and asset management; business and public policy and administration; and, leadership to the civil engineering body of knowledge (ASCE, 2004).

In other engineering disciplines, the American Society of Mechanical Engineers (ASME) and the IEEE Computer Society have articulated the body of knowledge for graduate engineers in their respective disciplines. The ASME vision statement remains

non-specific, based on the premise of a body of knowledge gained through an undergraduate curriculum based on technical breadth and flexibility, and intellectual skill development necessary for life-long learning (American Society of Mechanical Engineers [ASME], 2004). The Computing Curricula report (IEEE Computer Society, 2001) focuses heavily on discipline-specific topics, although inclusion of social contexts, professional and ethical responsibilities, and economic issues receive mention as three topics in a list of 132 topics.

Whether the engineering body of knowledge is defined as curriculum criteria, student outcomes, or learning outcomes, the delineation between knowledge, skill, and attitude outcomes are rarely well articulated. Many of the attributes that are varyingly characterized as 'non-technical' or 'soft skills' relate to skill and attitudinal outcomes. In addition to the skill and attitude outcomes embedded in the accreditation criteria and discipline-specific body of knowledge reports, the perspectives of industry in relation to the required body of knowledge often relate to these areas as well. Although vocabulary and priority may change from stakeholder to stakeholder, the literature is full of references of the required characteristics of graduate engineers – which are indirect references to a desired body of knowledge.

In the skill domain, stakeholders refer to the necessity for graduate engineers to possess effective oral and written communication skills, strong teamwork skills, be capable of managing information and operating engineering systems and tools, be capable of self-management, and possess strong analytical capabilities and strong design skills. In the attitude or value domain, the literature refers to the need for graduate engineers to be adaptable, creative, socially and culturally aware, possess a strong sense

of professionalism and professional ethic, value ongoing professional development and life-long learning, and exhibit leadership (CEAB, 2008; ABET Inc., 2008; IEEE Computer Society, 2001; ASME, 2004; Kennedy, 2006; ASCE, 2004; National Academy of Engineering, 2004; Lang, Cruse, McVey, & McMasters, 1999).

Intuitively, it is difficult to draw boundaries around the body of professional engineering knowledge and to determine where it overlaps or transitions into other professional bodies of knowledge. Canadian professional engineers that responded to a 2002 national survey (n=27,120) added negotiation skills, business skills, personnel management, financial analysis, contract administration, additional languages, project management, and asset management to the needed skill requirements for successful professional practice. This same sample was asked to report on their primary job functions, and the largest proportion of members (42%) reported management / administration. This job function was followed (in declining order) by design tasks and technical support (33%), and engineering consulting (25%). Apart from primary job functions, professional members in the survey sample listed their formal position descriptions as engineers / geoscientists (36% of members), engineering managers (20%), and engineering executives (17%) (EKOS Research Associates Inc., 2003).

Trevelyan (2007) reviews the literature on the nature of engineering practice, much of which carries this perspective of a dichotomy between the role of an engineer (solely technical) and that of a manager (solely non-technical). Trevelyan challenges this dichotomy by his research findings, which highlight that 'technical coordination' – that is, working with and influencing other people so they perform necessary work to a mutually agreed schedule – is integral to engineering practice *and is indeed fostered by*

technical expertise. In his view, engineering practice includes all tasks of planning, analysis, design, organization, and administration. A further significant conclusion of Trevelyan's work is the lack of solid empirical research into the nature of engineering practice and, by extension, the engineering body of knowledge.

Beyond the unclear boundaries between the bodies of knowledge of engineering and other professional endeavours such as management, it is also intuitively difficult to decide where the engineering body of knowledge overlaps with or transitions into the general body of knowledge needed for adult humans to engage maturely in society. For example, ASCE articulates values conducive to professional civil engineering practice, which include commitment, fairness, honesty, integrity, optimism, persistence, respect, sensitivity, and thoughtfulness (ASCE, 2004). ASCE further links professional attitudes with the corporate or professional culture in which an engineer operates. A natural extension of this position is that attitudes and their manifestation in daily practice are also shaped by national culture (to the extent that national culture can be defined). This latter point is of particular importance when considering how the IEEQ program can or should foster the affective or attitudinal domain outcomes in the IEGs participating.

Taking a broader and more philosophical view, Koen (1985) acknowledges overlap in the body of knowledge between engineering, other professions, and society at large, as well as the constantly evolving state of engineering knowledge. The literature from outside the engineering profession also provides possible frameworks for an engineering body of knowledge. For example, Thomas Green (1985) provides a broad view of professional knowledge and practice, with vocabulary that parallels many concepts already in use in engineering. Green's focus is on moral education, that being

the development of moral practice and moral practitioners. This development is articulated as the formation of conscience, or the capacity of each person to be their own judge. According to Green, conscience speaks in five 'voices':

1. Conscience as craft: one's technical skill, extended by the ability to judge one's own performance (for example, satisfaction, pride, shame, embarrassment, etc.).
2. Conscience as membership within a community and acquisition of the norms of the community. Norm acquisition is said to be strong when one's behaviour conforms to a certain pattern, and when the departures from normative behaviour have the capacity to elicit moral emotions such as guilt, shame, anxiety, fear, embarrassment, or sorrow.
3. Conscience as sacrifice, or the necessity of "experiencing the performance of acts that fall beyond the limits of mere duty" (p. 19), defined not necessarily as self-sacrifice but rather as indifference to self.
4. Conscience as memory: addressing the human need for rootedness and knowledge of one's social inheritance. Beyond mere commitment (a choice of will) and beyond knowing one's history, conscience as memory speaks to claiming it as one's own and working upon and from it.
5. Conscience as imagination: a vision and voice from within the community, carrying a critique-ful tone that speaks to the disconnects between what could be and what is.

These five consciences bridge to engineering notions of technical skill, professional membership, service, history, and leadership, respectively.

Dressel and Marcus (1982) define "six humanizing competencies" (p. 46) of an educated person, including:

(1) An ability to acquire knowledge and use it;

(2) A high level of mastery of the skills of communication;

(3) An awareness of his or her own values and value commitments, and a realization that other individuals and cultures hold contrasting values that must be understood and, to some extent, accepted in interaction;

(4) An ability to cooperate and collaborate with others in studying, analyzing, and formulating solutions to problems and taking action on them;

(5) An awareness of, concern for, and a sense of responsibility about contemporary issues, events, and problems; and,

(6) An ability to relate his or her development of competencies into a coherent, cumulative, and somehow unified experience and to apply these competencies to further development as an individual and to the fulfillment of obligations as a responsible citizen in a democratic society.

Engineering Epistemology

The discussion to this point has moved from a consideration of a distinct and definable engineering body of knowledge to a general body of knowledge applicable to professions. A further extension of the discussion is a consideration of the epistemology of engineering. As a distinct branch within philosophy, epistemology is concerned with nature, methods, and limits of knowledge, and becomes a person's way of knowing and understanding the world. One's epistemology then defines which problems are worth

pursuing, and which methodologies are considered legitimate (Borrego & Newswander, 2008). In other words, the body of knowledge as articulated is a partial manifestation of an engineering epistemology.

While literature abounds on the philosophy of higher education, and a literature is slowly developing around a discussion of potential philosophies of engineering (Florman, 1994; Koen, 2003; Heywood, 2008), very little overt exploration of an *epistemology* of engineering currently exists in the literature. Epistemologies are often reflective of a discipline, and individuals are often not aware of their epistemological beliefs, assuming them to be universal for all people and all disciplines. An epistemology of engineering then requires understanding and identifying one's own epistemological framework, learning about different ways of knowing, and understanding the strengths and weaknesses inherent in each (Borrego & Newswander, 2008). The Journal of Engineering Education recently published a research agenda for the emerging discipline of engineering education, which summarized the work of the National Engineering Education Research Colloquies in setting out five priority research areas. The first research area is engineering epistemologies, described as "research on what constitutes engineering thinking and knowledge within social contexts now and into the future" (National Engineering Education Research Colloquies, 2006).

Vincenti's work (1990) is a self-acknowledged preliminary exploration and setting down of an epistemological framework for engineering. Vincenti sees engineering knowledge as a "distinct epistemological species" (p. 326) relative to science knowledge, and his framework is summarized below. Vincenti, however, gives little overt attention to the affective or attitudinal domain of engineering knowledge.

Definition of knowledge: 'knowing that' (the cognitive or knowledge domain) and 'knowing how' (the behavioural or skill domain).

The defining problems in engineering: a problem is deemed valid and worthy by an assessment of its centrality within some larger technological system, and the likelihood of its being solvable.

Categories of engineering knowledge:

- Fundamental concepts (operational principles and normal configurations);
- Criteria and specifications (technical terms derived from general qualitative goals);
- Theoretical tools (for example, mathematical methods, theories, and language to express);
- Quantitative data (for example, physical constants, properties of substances, process specifications, engineering standards); and,
- Practical considerations derived from experience (rules of thumb, heuristics).

These categories of knowledge are augmented by design instrumentalities – that is, ways of thinking, judgment, and procedures to carry out the first five categories – as well as knowledge of how to generate new knowledge when the 'stored body' does not contain what one needs.

Source of engineering knowledge: Knowledge generation comes from within the engineering community. Activities that generate engineering knowledge include:

- Transfer from science: at times reformulated or adapted;

- Invention;
- Theoretical engineering research (mathematically oriented): generate analytic tools, results, and design procedures, ways of thinking;
- Experimental engineering research (physically oriented): major source of quantitative data on materials and processes (performance data); produces analytical concepts and ways of thinking;
- Design practice: the problems that are revealed are the knowledge generated;
- Production: knowledge generation of practical considerations and design instrumentalities; and,
- Direct trial: proof tests and everyday operation.

Purpose of engineering knowledge generation: for design ends.

Criteria for use and validity of engineering knowledge: "does it contribute to how things 'ought to be'" as judged by the engineering community (p. 237).

Vincenti's epistemological framework for engineering knowledge remains largely rooted in an empirical framework, which is characteristic of positivism as the defining theoretical framework of engineering education and practice (see Chapter 3 Methodology). It provides an excellent basis for further discussion and elaboration of an engineering epistemology, but does not explicitly discuss the nature of engineering knowledge. For example, engineering tends to hold a correspondence theory of truth, in which there is one universal truth that exists and is available to be uncovered by empirical methods. In contrast, other disciplines value constructivist epistemologies which hold that truth and knowledge are social constructs that may involve multiple

realities, are dependent on context, and are negotiated between individuals and groups (Kuhn, 2000; Benson & Griffith, 1996; Heywood 2005; Bransford et al., 2000).

Vincenti also does not address the boundaries or limits of engineering knowledge, and the associated concern of who is given the privilege to define the engineering epistemology (and by extension, who and what is excluded). These questions are considered non-trivial and are widely discussed by critical theorists, who explore – among other things – the role of power, culture, and gender in constructing the epistemology of a field (Benson & Griffith, 1996; Lederman & Bartsch, 2001; Kuhn, 2000). By exploring engineering knowledge through the experiences and practice-readiness of a non-traditional student population in a non-traditional engineering program, this study had the potential to contribute to the epistemology of engineering education and practice as well. This is relevant to programs like IEEQ.

Program Assessment and Evaluation

This chapter concludes with a review of assessment and evaluation practices in engineering curricula and programs, and an introduction to the field of program evaluation research. In this work, assessment is defined as the systematic gathering and analyzing of information, or the measurement of an attribute of interest (Walvoord & Johnson Anderson, 1998; Olds & Miller, 1998). Evaluation is defined as a systematic process of interpreting assessment data in order to determine, or make a judgment or interpretation of the measurement (Gronlund, 1981; Olds & Miller, 1998; Stark & Lattuca, 1997).

In the engineering literature, scholarly discourse around assessment and evaluation has largely been triggered by the introduction of the Engineering Criteria 2000 (EC2000) by ABET in 1996. The engineering literature includes discussion, information-sharing, and clarification of the roles and processes of outcomes assessment of (in this case) the student learning outcomes in the undergraduate engineering curricula as mandated by EC2000 (Heywood, 2005; Lattuca, Terenzini, Volkwein, & Peterson, 2006; Rogers, 2000; Scales, Owen, Shiohare, & Leonard, 1998). However, the emphasis on assessment and evaluation, and particularly outcomes assessment, seen in the last 10 years also reflects the broader context acting upon all higher education disciplines, including growing demands for public accountability, internal pressures to become more productive, changes in the way instruction is design and delivered, and paradigmatic shifts from delivering teaching to creating student learning (Ewell, 1998; Olds & Miller, 1998). Additional triggers for assessment and evaluation include program planning and improvement, a vehicle for faculty interchange, to gain theoretical understanding of how students change and develop, and (in professional fields) external practitioner influences (Stark & Lattuca, 1997).

Bucciarelli, Einstein, Terenzini, & Walser (2000) assert that understanding the need for, and process of, assessment of curriculum initiatives is a major challenge to the engineering tradition. In that vein, over the decade since the introduction of EC2000, some trends in assessment and evaluation of engineering programs in colleges and universities have emerged. Heywood (2005) and Stark and Lattuca (1997) discuss the emergence of qualitative assessment and evaluation approaches generally, motivated by an "attention to process […] that implied a more described approach […] in order to

understand [it]" (Heywood, 2005, p. 395), and this in reaction to scientific (experimental, quasi-experimental) approaches that disregarded process and failed to illuminate directions for improvement.

Currently, assessment and evaluation efforts of engineering curricula commonly use mixed method designs (qualitative and quantitative) and multiple methods (for triangulation of data) that focus on indicators of knowledge, performance, attitudes, and/or behaviours. The obtained findings often inform an iterative process of ongoing program development (structure and delivery, curriculum, teaching practices, and further assessment and evaluation) and the extent to which objectives have been achieved. Commonly-used instruments and methods include: stakeholder (student and others) surveys, interviews and focus groups implemented individually, cross-sectionally, and/or longitudinally; observation and ethnographic studies; content analysis of participants' documents and portfolios; standardized tests; and comparative (hard) measures of participation, retention, academic success, program completion, and post-graduation indicators (for example, employment, further study). Data are often collected from multiple stakeholders in the process, including faculty and administrators, students (self-evaluations), and industry or employers (Heywood, 2005; Van Aken et al., 1999; Adams, Atman, Nakamura, Kalonji, & Denton Adams, 2002; Olds, Moskal, & Miller, 2005; Richards-Kortum, Dailey, & Harris, 2003; Olds & Miller, 1998; Lattuca et al., 2006; Sehitoglu & Saint, 1998; Scales et al., 1998). This study reflected these general assessment and evaluation purposes and methods, and similar to this study, Lattuca et al. (2006) describe a study designed to obtain detailed data on the *views and experiences* of *participants* relative to a particular engineering educational reform.

Program Evaluation Research

Program evaluation, also called evaluation research, emerged in the early 1970s as a distinct specialty field. With early links to action research, program evaluation has been defined as "the use of social research methods to systematically investigate the effectiveness of social intervention programs in ways that are adapted to their political and organizational environments, and are defined to inform action" (Rossi, Lipsey, & Freeman, 2004, p. 16). In the field of evaluation research, social science techniques and standards for methodological quality around research design have been developed and refined in order to produce valid, reliable, and precise characterizations. However, program evaluation research presents an inherently inhospitable environment for research purposes, since the settings are inherently dynamic contexts, and the validity of the research depends to a large extent on a responsiveness to changes in the environment and a sensitivity to political context. While initially an interest of social scientists, program evaluation research is now also heavily impacted by the interests of funders and policymakers, as well as the clients and administrators of programs and the general public. This is reflective of the tension for program evaluation to be scientific on the one hand, and pragmatic on the other. This reality is also evidenced in the development of a sub-sector of evaluation research commonly known as policy analysis (Rossi et al., 2004).

Similarly, Ewell (1998) proposes that "done well, assessment […] is a form of scholarship" (p. 107). Seen more broadly than merely collecting information or demonstrating the attainment of objectives, assessment is "embodied in the *use* of

information as part of essential decision processes, where decisions may occur" (p. 107, emphasis added). Assessment further resembles scholarship in that it is never really completed. In this view, assessment is part of the scholarship of teaching and learning (Chapter 1).

Within the field of program evaluation research, various frameworks have been proposed, by which one can compare alternative evaluation approaches. Stark and Lattuca (1997) have summarized eight types of evaluation – formative, summative, illuminative, goal-free, sociopolitical, authoritative, responsive, and experimental – and their corresponding purposes. They elaborate further by describing the typical components of five traditional evaluation models (summarized below). Models one through four are often applied at the course, program, and curriculum level, while model five is often applied at the student level.

Model 1: Professional expert process (accreditation tradition). Propose standards; obtain agreement from relevant peer experts on standards; require self-study assessment against standards; have peer expert team examine self-study; reports results of examination; have peer experts decide whether standards are met.

Model 2: Naturalistic evaluation (proponents – Guba and Lincoln). Gather descriptive information regarding the evaluation object, setting, and surrounding conditions; determine the information desired by relevant audiences; gather information about relevant issues; gather information about values; gather information about standards for worth and merit; share with relevant audiences; negotiate decisions.

Model 3: Context, Input, Process, Products (CIPP) model (proponent – Shufflebeam). Describe program goals, program design, program implementation,

program outcomes. Heywood (2005) notes that the CIPP evaluation approach of Model 3 is also often applied at the individual design project level (design context, inputs, process, and products) within engineering education.

Model 4: Countenance model (proponent: Stake). Describe prior conditions, implementation, outcomes.

Model 5: Traditional evaluation (proponent: Tyler). State goals and objectives in behavioural terms; develop measurement instruments; measure achievement of goals and objectives; compare objectives with measured achievement; interpret findings; make recommendations (Stark & Lattuca, 1997).

Rossi et al. (2004) categorize the evaluation hierarchy, from bottom up, to include assessment of need for a program, assessment of program design and theory, assessment of program process and implementation, assessment of program outcomes / impact, and assessment of program cost and efficiency.

Finally, Worthen, Sanders, and Fitzpatrick (1997) compare and contrast the purposes, distinguishing characteristics, criteria, benefits and limitations of objectives-oriented, management-oriented, consumer-oriented, expertise-oriented, adversary-oriented, and participant-oriented evaluation approaches. This study, within an action research framework that further reflects the iterative nature of assessment-as-scholarship, was aligned with the characterization of participant-oriented evaluation of Worthen et al. In general terms, participant-oriented evaluation is carried out in order to understand and portray the complexities of a program, and respond to an audience's requirement for information and understanding. It is distinguished by reflecting multiple realities, using inductive reasoning and discovery, and relying on first-hand experiences on site.

Typically, participant-oriented evaluation is used to examine innovations or programs about which little is known. Participant-oriented evaluation recognizes multiple realities and its focus is on description and reasoned and reasonable interpretation (judgment), with a concern for context. Participant-oriented evaluation falls into the realm of naturalistic inquiry, whose proponents include Guba and Lincoln. The methodology for this evaluation approach in this particular study is detailed in Chapter 3.

This chapter situates the development and the implementation of the IEEQ Program within a number of seemingly-disparate bodies of literature, including: the immigrant professional in the labour market; qualifications recognition, including professional regulation and public policy; assessment and evaluation of engineering curricula, including program evaluation research; and, the engineering body of knowledge, as a component of an engineering epistemology. A part of the significance of IEEQ is that it lies within all of these areas, continually negotiating a dynamic tension between private and public concerns and between practical and theoretical goals.

Chapter 3

Methodology

Introduction: A Program Evaluation Study

As outlined at the end of Chapter 1, the focus of this research was to address the void in the knowledge and to support the ongoing development of the IEEQ program, by conducting an exploratory, primarily participant-oriented evaluation of the IEEQ Program for both formative and summative purposes.

Specific research questions included:

1. How do IEEQ participants perceive and describe their experiences in the IEEQ Program? Specifically, how do IEEQ participants perceive and describe the availability of the major components of the program (academic confirmation, co-op work experience, cultural training, language training, and support networks), and how do IEEQ participants perceive and describe their involvement in these same components?
2. How do participants' outcomes in the IEEQ Program compare to IEGs pursuing academic qualification with APEGM through other pathways, and/or how do participants' outcomes in the IEEQ Program compare to other APEGM members (Engineers-in-Training and P.Engs.)? Specifically, what outcomes are evident relative to IEEQ participants' program completion rates, time-to-program completion, post-program licensing status, timelines through the post-program licensing process, and post-program career development indicators?

First, the study employed both a formative and a summative approach. Rossi et al. (2004) define formative evaluation as "an evaluation intended to furnish information for guiding program improvement" (p. 34), and summative evaluation as "evaluation

conducted to determine whether […] expectations are met" (p. 36). In addition, the study was also planned and designed to contribute to new knowledge in the area of university-based FCR programs for internationally-educated professionals.

Second, the study encompassed both a process evaluation and an outcomes evaluation. A process evaluation focuses on the integrity of the program's activities, operations, and component parts to assess "fidelity and effectiveness," (Rossi et al., 2004, p. 56) and to provide evidence as to whether the program is being delivered as intended. In this study, the process evaluation focused on the overall question as to whether the program's delivery was consistent with objectives and administrative standards. Process evaluation is also a natural complement to outcomes assessment, providing a context for understanding and interpretation of outcome findings.

Outcomes assessment focuses on "the extent to which a program produces the intended improvements […] and whether those changes included unintended side effects" (Rossi et al., 2004, p. 58). Outcomes assessment may focus on one or both of proximal, or 'take-away' outcomes, which are generally easy to identify, measure, and attribute, as well as distal outcomes, which are more difficult to measure and attribute and yet are typically of the greatest practical and political importance (Rossi et al., 2004). The program theory, or conceptual framework of the program, identifies and lends authority to the objectives and administrative standards that form the evaluative criteria in both process evaluation and outcomes assessment studies. Therefore, the findings of the study also include an articulation of the conceptual framework, or design, of the IEEQ program.

Third, the study used a mixed-method design, in which both quantitative and qualitative data were collected. Quantitative data was related to observable and

measurable program outcomes, and reported as descriptive statistics. However, the bulk of the study focused on an in-depth understanding of participants' perceptions and experiences in the IEEQ program and, thus, the bulk of data collection and analysis were focussed on a participant-oriented, qualitative approach discussed at the end of Chapter 2.

Additionally, the study gained strength through its mixed-method design. Specifically, the mixed-method approach enabled triangulation, complementarity, and expansion. Triangulation, complementarity, and expansion refer – respectively – to the ability to gather data via multiple methods, the ability to elaborate and clarify the results from one method with the results of another method, and the ability to extend the breadth and range of inquiry by applying multiple methods. The use of a mixed-method approach allows for both exploration (a qualitative orientation) and confirmation (a quantitative orientation) to take place within a given study (Worthen et al., 1997).

The remainder of this chapter outlines the specific methodology and protocols used. However, the chapter begins by taking a step back and discussing the role of theory in research design.

Conceptual and Theoretical Perspectives

The Grounding of Research in Theory

Each research study is grounded in a theoretical approach and a methodological framework that reflects the theoretical approach. In engineering, the default theoretical approach is positivism, exemplified by the scientific method as the dominant methodological framework. Specific methodologies characteristic of the scientific method include experimental and quasi-experimental designs.

While the grounding in a theoretical approach is central to all research, it generally goes unreported in engineering research, since the use of a positivist paradigm has been an almost universal assumption. Disciplinary research is organized around "rules for making arguments and claims that others will warrant, [… or the] inherently ambiguous…*method*" (Shulman, 2002, p. vi-vii). While *method* varies from discipline to discipline, engineering research carries the equally almost universal assumption of the scientific paradigm: "phenomena to be studied are objectively defined and observable, and the validity of the proposed theoretical and empirical models can be tested and the results replicated" (Wankat et al., 2002, p. 226).

The positivist paradigm is so deeply engrained in engineering thinking that most engineering researchers have never explicitly considered their theoretical approach, the need to articulate one (Borrego, 2007), nor have they given explicit attention to alternative theoretical frameworks that can be used to conduct research (Waller, 2006). The emerging attention to the scholarship of teaching and learning in engineering has highlighted the opportunities for alternative theoretical approaches, with – for example – most educational evaluation methods derived from social science methods (Stark & Lattuca, 1997). However, an awareness of alternative theoretical approaches that can be applied to subjective constructs like *understanding, skills, attitudes, and values* has also highlighted engineering researchers' skepticism toward the validity and rigour of alternative approaches (Wankat et al., 2002).

A discussion of theoretical approaches quickly becomes circular, focusing attention back on the engineering epistemology. Theoretical approaches reflect value orientations toward key epistemological questions such as: what problems are worthy of

investigation, and by which range of methods are knowledge, fact, and truth legitimately uncovered and established? Even a seemingly objective criterion such as 'empirical investigation,' - that is, taking an evidence-based approach to knowledge generation – becomes open to multiple interpretations when acknowledging that the definition of 'appropriate evidence' varies across theoretical approaches. In common use, *empirical* has come to mean the ability for verification through scientific investigation and scientific constructs and, thus, again reflects "a mindset that favors a certain class of knowledge over others" (Taleb, 2007, p. 84), or "*the* model of describing reality rather than *one* of the ways of describing life around us" (Franklin, 1999, p. 31).

Theoretical Approaches

Waller (2006) outlines three dominant theoretical approaches that may be applied to engineering research: positivism, interpretivism, and critical theory. Table 3.1 summarizes the theoretical approaches, highlighting commonalities and differences. Among the alternatives to positivism, critical theory assumes – like positivism – that there is a problem to be solved and a need for change. This important commonality gives critical theory an advantage over interpretivism, in terms of acceptability to engineering researchers. Engineering researchers tend to resonate with the positivist-sounding goals of critical theory (problem-solving, attributing responsibility), relative to interpretivist goals of rich description, explanation, and theory-building (personal communication, Alisha Waller, 07 September 2007).

Table 3.1
Summary of Theoretical Frameworks for Research in Engineering and Engineering Education (Waller, 2006)

	Positivism	Interpretivism (Constructivism)	Critical Theory (Emancipatory)
Aim of Inquiry	Explanation, ultimately enabling the prediction and control of phenomena, whether physical or human	Understanding and reconstructing the views that people (including researcher) hold, and identifying themes and patterns	Critique and transformation of the social, political, cultural, economic, gender, and other oppressive structures that exploit and constrain humankind
Ontology *(Nature of Reality)*	• One reality: knowable within probability. • Reality is driven by immutable natural laws and mechanisms. • Knowledge can be summarized in time and context-free generalizations.	• Reality is multiple and socially constructed. • Constructions are alterable, as are their associated realities. • Context dependent: socially and experientially based, local and specific.	• Multiple realities are shaped over time by society, culture, politics, economics, ethnic identity, gender, and disability factors.
Epistemology *(Theory of knowledge)*	• Objectivity is paramount. • Researcher manipulates and observes dispassionately. • Researcher and researched are assumed to be independent entities.	• Researchers and research participants are interactively linked. • Values are explicit. • Findings are created as investigation proceeds.	• Interactive link between researchers and participants. • Knowledge is historically and socially situated. • Findings are value mediated. • Challenges traditional distinction between epistemology and ontology.
Methodology	• Primarily quantitative. • Experimental & manipulative. • Context-free. • Questions and/or hypotheses stated in propositional form and subjected to empirical test.	• Primarily qualitative. • Contextual factors are described. • Constructions elicited and refined by interaction between researchers and participants.	• Emphasis on qualitative. • The dialogic and dialectical nature of research is used to expose how structures can be changed. • Historical and contextual factors are described in relation to oppression.

The Study as Action Research

As a further grounding in theory, the study was an example of action research, which is another research specialty with early-development links to program evaluation research (Rossi et al., 2004). 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 (Rapoport, 1970, p. 499).

In the case of this study, 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 more practical level, one can say that

> Action research consists of a family of research methodologies which pursue action [practice] and research [theory] at the same time (Dick, 2000). 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 (Masters, 1995; Newman, 2000).

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" (Grundy, 1982, p. 357), resonate with the view of 'practice as inquiry' and Schön's (1983, 1987) exploration of the reflective practitioner. Action

research finds further resonance with the definitions of the engineering design process, in that the characteristics of action research process include:

- A cyclic or iterative nature, in which similar steps recur in a similar sequence;
- A participative activity, in which informants are involved and active in the research process; and,
- A reflective stance, in which critical reflection upon process and outcomes are an important part of each cycle (Dick, 2000).

In following a spiral of cycles of planning, action, and evaluation of the results of actions (Masters, 1995; Dick, 2000), action research can be framed around quantitative, qualitative, or mixed methods for specific data collection and analysis. Further sub-types of action research have been defined (Masters, 1995) based on the goals and methodologies implemented, which correspond approximately to the positivist, interpretivist, and critical theoretical approaches outlined in the previous section.

This study took an interpretivist action research approach which, in turn, supported a qualitative methodological framework. The nature of qualitative methodology is discussed in the following section. The discussion is presented by comparing and contrasting qualitative methodology to quantitative methodology (which supports a positivist theoretical approach, and which is the familiar default paradigm in engineering and natural sciences research).

Qualitative Methodologies

As a manifestation of an interpretivist worldview and a participant-oriented approach, qualitative methodology is an inquiry of understanding a social or human

condition, experience, phenomenon, or dilemma. It is based on building a complex, holistic picture, formed textually and analyzed inductively (Creswell, 1994). Qualitative research reports detailed views of small numbers of participants regarding an activity or practice and is conducted in a natural setting. The goals and outcomes of qualitative inquiry include description, interpretation, hypotheses, and grounded theory (Bogdan & Biklen, 1998; Hittleman & Simon, 1997; Glesne & Peshkin, 1992). By contrast, a quantitative methodology – the default paradigm in engineering and the natural sciences – is (in very broad strokes) often an inquiry into a social, human, or technical problem, based on testing a theory composed of variables. Often (but not exclusively), actions or outcomes of relatively large numbers of randomly selected subjects are reduced to numerical values and analyzed via statistical procedures. Frequently, goals and outcomes of quantitative inquiry are to establish fact, show statistical relationships, or determine whether predictive generalizations of a theory hold true (Creswell, 1994; Shulman, 1997; Bogdan & Biklen, 1998).

The purpose of a qualitative methodology is motivated by the keywords ‘interpretation’ and ‘meaning’. Qualitative research aims to develop a holistic, complex, and rich description of a situation in order to provide interpretation and to develop meaning, to understand and relate actors’ perspectives and experiences as they live and feel them, to develop concepts, to describe multiple realities, and/or to develop grounded theory (Glesne & Peshkin, 1992; Bogdan & Biklen, 1998). The purpose of a quantitative model of research is motivated by keywords ‘verification’ and ‘generalization’. Quantitative research is carried out to provide statistical description, to establish fact, to test theory, to predict, to attribute causality, and to facilitate generalizability of findings to

the larger population. In general, qualitative inquiry may be described as having an overarching concern with process, while quantitative inquiry has an overarching (although not a singular) concern with outcome or product (Hittleman & Simon, 1997; Glesne & Peshkin, 1992; Ely, Anzul, Friedman, Garner, & McCormack Steinmetz, 1991). Qualitative inquiry works with developmental hypotheses, while quantitative inquiry works with predetermined hypotheses.

Qualitative methodology is described as iterative, interactive, hermeneutic, intuitive, and open (Guba & Lincoln, 1989). The research design is flexible and continues to be developed as the research progresses. The design is continually influenced by the emerging understandings of the researcher, the data provided by the participants, and by the research context. By contrast, quantitative methodology is described as linear, closed, and deductive. Data collection and analysis techniques have been defined before any data collection occurs (Guba & Lincoln, 1989).

While quantitative methods have dominated science and engineering research, the qualitative model emerged in the social sciences in the late 19th century and has become a respected and widely used inquiry paradigm in the last half of the 20th century (Glesne & Peshkin, 1992; Creswell, 1994; Ely et al., 1991). Emerging initially out of anthropology and sociology, the qualitative tradition has proven valuable and unique in its ability to investigate research topics inaccessible to traditional quantitative norms, by providing interpretations and meanings and answering questions of ‘why’ that quantitative inquiry cannot provide (Taylor & Bogdan, 1998). In doing so, the qualitative tradition has established its own set of norms that govern how research is carried out, to ensure that the researcher engages in a systematic, rigorous inquiry of sufficient depth and commitment

into the subject matter. This ensures that the researcher can extract real meaning from the participants and develop credible interpretations and theory (Creswell, 1994; Taylor & Bogdan, 1998).

In the following section, the protocols for data collection and analysis are outlined.

Research Design

Research Site

The research site was the IEEQ Program in the Faculty of Engineering, University of Manitoba. The University of Manitoba offers undergraduate and graduate degrees in arts, sciences, and numerous professional fields. It is categorized as a large Canadian research-doctoral institution. The University operates on two campuses and serves a total student enrolment (undergraduate and graduate) of approximately 27,000 in 2007/2008 (at time of writing).

The university delivers the province's only accredited undergraduate engineering degree programs. Four departments offer a total of five distinct degree programs in civil, mechanical, electrical, computer, and biosystems engineering to a combined undergraduate enrollment of approximately 1100 students. In addition to the four stand-alone departments, the Faculty of Engineering also houses a Design Group, ENGAP, and IEEQ. The Design Group facilitates and supports design education initiatives in all departments. ENGAP is an access program for Aboriginal students in engineering, providing additional remedial aids and a comprehensive support structure to enhance students' perseverance and success in the engineering curriculum.

The IEEQ Program, outlined in Chapter 1, has existed in the Faculty of Engineering as a pilot program since summer 2003, and gained permanent program status in summer 2007. IEEQ's *raison d'etre* is to deliver foreign credentials recognition to international engineering graduates pursuing academic qualification with APEGM in Manitoba. As a one-year program, IEEQ enrolled small cohorts of approximately nine to 12 participants on an annual basis from 2003/2004 through 2006/2007, and these are the cohorts that comprised the participants in this study. The participants are described further in the following section.

Selection and Recruitment of Participants

In all research, effective inquiry depends on the selection of an appropriate sample. In contrast to random sample selection which is critical to valid quantitative inquiry, this research employed purposeful sampling (Caudle, 1994; Bogdan & Biklen, 1998). In purposeful sampling, the researcher selects participants, and requests their participation in the study, based on their direct relationship to the evaluation context and questions, their willingness to participate, and/or their ability to contribute to the goals of the study. The targeted participants of the study are outlined below.

1. All participants (IEGs) in the first four (4) cohorts of the IEEQ program. The cohorts are hereafter identified as IEEQ1 through IEEQ4. Individual cohort sizes were approximately 10 (total N ≈ 40).
2. Six to 10 practicing professional engineers who supervised an IEEQ participant in the course of the co-op work experience component of the IEEQ program. Supervisors / employers were recruited who had an ongoing employment

relationship with the IEEQ participant, of minimum 18 months' duration post-IEEQ.

Recruitment of all participants for all data collection events was done by the researcher via an initial email to the participants. The initial email was written in jargon-free language, outlined the nature and purpose of the research, the nature of the data collection activity, and advised that full information on the research was following. The initial e-mail was followed by distribution of a written letter, complying with Research Ethics Board content and phrasing, sent electronically. The letter again outlined the nature and purpose of the research and data collection activity, and solicited informed consent from the participants. In the recruitment for the focus groups, participants were also given a general idea of the discussion topics as part of the recruitment process. All participation was entirely voluntary, and no compensation was offered for participation.

Data Collection Methods

The participants in the first four cohorts of the IEEQ Program were invited to take part in the following data collection activities:

- One (1) focus group interview of 90-minute duration with each individual cohort IEEQ1 through IEEQ4, timed to take place in the last month of their participation in the IEEQ Program (four focus groups in total). The focus groups were open-ended long interview format, and were used to collect data on participants' perceptions and experiences on the availability of, and their involvement in, the academic confirmation, cultural training, language

training, and support networks within the program. A sample interview guide is included as Appendix E.

- Two (2) follow-up questionnaires to all participants who successfully completed the IEEQ Program in each cohort IEEQ1 through IEEQ4, timed for nine months and 24 months after completion of the IEEQ Program (eight questionnaire distribution events in total).

  The follow-up questionnaires combined open-ended questions as well as quantitative data. The questionnaires was used to collect data on participants' perceptions and experiences on the availability of, and their involvement in, the co-op work experiences component of the program, and their subsequent career development post-IEEQ. Sample questionnaires are included as Appendix F.

- One (1) focus group interview of 60 to 90-minute duration with participants from combined cohorts IEEQ1 through IEEQ4, timed to occur anywhere from 12 to 48 months after completion of the IEEQ Program (depending on the cohort from which the participant graduated). Based on the number of participants that expressed willingness to participate, two (2) separate focus groups were held with different participants each time.

  The focus groups were open-ended, long interview format, and they were used to collect data on participants' retrospective perceptions of the availability of, and their involvement in, the major components of the program, their perceptions and experiences of career development post-IEEQ, and their perceptions and experiences of engineering knowledge and skill gaps that

IEGs need to bridge. An outline of a sample interview guide is included as Appendix E.

- Participants of the last focus group (12 to 48 months after completion of the IEEQ Program) were also asked to voluntarily submit the written reports of the co-op work term that they prepared while in the IEEQ Program. For those that consented (100%), the written reports were used to collect data on participants' co-op work term experiences and their perceptions of their integration as engineering professionals, at the time of writing of the reports.

Selected professional engineering supervisors / employers of IEEQ participants were invited to participate in one (1) focus group interview of 90-minute duration, timed for approximately 18 to 24 months after the IEEQ participant's (employee's) completion of the co-op work term. Two large organizations were selected, based on the number of IEEQ participants from IEEQ1 through IEEQ4 that had completed co-op work terms with the organizations (four and nine IEEQ participants, respectively). Two focus groups were held, with different supervisor / employer participants each time. The focus groups were open-ended, long interview format, and were used to collect data on supervisors' perceptions and experiences in supervising IEEQ participants in their employ, and supervisors' perceptions and experiences of the challenges facing IEGs in the engineering workplace. An outline of a sample interview guide is included as Appendix E.

Finally, quantitative data regarding program participation, completion rates, and post-program licensing status was obtained from publicly available data collected by the University of Manitoba (Office of Institutional Analysis and/or the Faculty of Engineering) and the APEGM.

The specific data collection protocols are outlined in the next section.

Focus group interviews. A focus group can be defined as a "carefully planned discussion designed to obtain perceptions on a defined area of interest in a permissive, non-threatening environment. […] Group members influence each other by responding to ideas and comments in the discussion" (Krueger, 1988, p. 18). A focus group is a formal and directed approach to group interviewing, while maintaining a relaxed and conversational atmosphere. Within the discussion, the topics are carefully predetermined, sequenced, contextualized, and framed within open-ended questions and probes (Krueger, 1988). The data produced is qualitative, in which participants provide insights into their attitudes, perceptions, and opinions. It is considered an appropriate technique in the evaluation of existing programs (Taylor & Bogdan, 1998; Krueger, 1988).

The sessions with individual IEEQ cohorts at the end of their participation in the IEEQ Program took place in a conference room in the Faculty of Engineering. Since the researcher held a position of institutional power (as program coordinator / director) relative to the participants at that time, a neutral third party was engaged as the interview moderator to lead the conversation. This role entailed presenting the focus group questions and following up with probing strategies, guiding the discussion and transitions, and maintaining a relaxed and open atmosphere that invited both positive and negative perspectives.

The sessions with combined IEEQ cohorts, timed for 12 to 48 months after completion of the IEEQ Program, took place in a conference room at the APEGM. Since

the position of institutional power between the researcher and the participants had ended by this time, the researcher also acted as the interview moderator to lead the conversation.

The sessions with supervisors / employers took place in the conference rooms of the respective employer organization. The researcher acted as the interview moderator to lead the conversation.

The focus group interviews were audio-taped, and the researcher created summary notes after the event, which were returned to focus group participants for member checking. In this way, participants were given the opportunity to review the summary notes for accuracy and offer supplementary comments on the data. A coded system was employed to maintain anonymity of the participants. The audiotapes tapes were held in a secure location in the moderator's home, in case of the unanticipated loss of the written notes. Data analysis relied on the information as recorded by the moderator, and included content analysis of the participants' conversation.

Follow-up questionnaires. Follow-up questionnaires represent a form of survey research, where survey research encompasses mail-out surveys, telephone surveys, and face-to-face interviews. In this research, the follow-up questionnaires took the form of mail-out surveys. Jaeger (1997) discusses surveys as an appropriate data collection method when the target group is well-defined and when an understanding of present conditions – "an inquiry into a population parameter" (p. 450) – is being sought. Both conditions applied to the evaluation study. Survey research can also be contextualized within the broader category of field research, in which "the researcher doesn't 'do' anything to the subjects of research, except […] ask them to provide data. The research

consists of collecting data on […] people as they are, without trying to alter anything" (p. 453). As such, follow-up questionnaires complemented the focus group interviews well.

The follow-up questionnaires were sent to the entire population of interest (successful graduates of the IEEQ Program, cohorts IEEQ1 through IEEQ4), rather than a sample of the population, since N is a relatively small number and manageable for survey administration. In effect, the goal was to make the population N equal to the sample n. Questionnaires require great attention to detail in the phrasing of questions, definitions, and the instructions to respondents, in order to reduce ambiguity, ensure understanding, and foster willing participation (Jaeger, 1997). In developing the follow-up questionnaires, attention was given to presenting both closed- and open-ended questions that were clear, appropriate to the research questions, and free of specialized jargon. In addition, the follow-up questionnaires were kept straight-forward, self-explanatory, and a reasonable length.

Data analysis included both descriptive statistics of closed-ended responses, and content analysis of open-ended responses.

Participants' written co-op work term reports. In addition to interviews and follow-up questionnaires, using existing documents as a data source represented another important source of data. Existing documents are also encompassed within ethnographic research techniques, in which – similar to follow-up questionnaires – nothing is being asked of the participants except to provide data, and nothing is being altered. Existing documents represent a rich and valuable source of data, and complement other techniques very well (Jaeger, 1997).

The IEEQ graduates that participated in the focus group interview that took place after their completion of the IEEQ Program were also asked to voluntarily submit a copy of the report they wrote at the end of the IEEQ Program (as a program requirement). These reports detailed the participants' experiences during the co-op work term in their own words, including the projects they worked on, new experiences encountered during the work term, their reflections on how the work term contributed to personal and professional goals, and their reflections on new insights gained during the work term relative to the practice of professional engineering in Canada.

All focus group participants agreed to submit a copy of their co-op report, and the reports were collected by a neutral third party from the IEEQ Program archives. The third party photocopied the report and returned the original to the archive. The third party then obscured all identifying information on the photocopy, including but not limited to the participant's name, the employer's name, details of the employee's position, dates, and any other identifying features or phrases. This 'marked-up' copy of the report was provided to the researcher and became the basis for data analysis. Data analysis included content analysis of the reports.

Program records. For data on program completion and attrition rates, time-to-complete, post-program licensing status, and the timing of post-program licensing progress, data were obtained from the IEEQ Program records and from the APEGM database of members. An IEEQ staff member was asked to provide the following information for each cohort IEEQ1 through IEEQ4, with no identifying information (name, student number, etc.): for a given cohort, the number of participants that entered the program; the number that completed the program and their time-to-complete; and the

number that did not complete the program and their reasons (voluntary exit, involuntary exit from IEEQ). In addition, the IEEQ staff member was requested to provide the full names of all IEEQ graduates in cohorts IEEQ1 through IEEQ4. These names were cross-referenced by the researcher with the APEGM database, by which members of the public can confirm the licensing status (Engineer-in-Training (EIT) or Professional Engineer (P.Eng.)) of any member of the association. This database is publicly available at http://www.apegm.mb.ca/askget/onpeng/register.html.

Common methods. The data collection techniques outlined in this chapter did not preclude commitment to the qualitative inquiry norm of allowing for an emergent research design and analysis as the research unfolded, which may subsequently affect further data collection strategies. Additionally, in all data collection activities, participants were apprised of the context, motive, and intention of the researcher and the research, given assurance of confidentiality, and provided with details on how confidentiality would be maintained. Summary notes of the focus group interviews and questionnaire responses were offered to participants for member-checking, and all participants were invited to contact the researcher at any time to discuss the research, the emerging findings, and read interim and final drafts of the research report.

Data Analysis

Descriptive statistics. Due to low N value, the quantitative data gathered relative to program completion and non-completion, status within the post-program licensing process, and timing through the licensing process were analyzed and presented as simple summaries. Descriptive statistics typically report a measure of central tendency and a

measure of statistical variability associated with the data. Taking into account the low N value in the study, the analysis was limited to reporting of means and medians (central tendency measures) and reporting of ranges (variability measure).

Analysis of qualitative data. Qualitative data processing tends to be inductive, generative, constructive, and subjective, in which the analysis process is "essentially a synthetic one, in which the emergent patterns and themes are reconstructed into meaningful wholes" (Lincoln & Guba, 1985, p. 333). Working with data in a qualitative paradigm is not a mechanical or technical process, but rather one of intuition, inductive reasoning and ongoing theorizing.

Worthen et al. (1997) outline the organizing, interpretive, and verificatory components of qualitative data analysis in a five-step process. This process is summarized as (1) exploring and forming impressions; (2) identifying themes; (3) creating working hypotheses as focal points for further observation; (4) moving toward verification by giving working hypotheses the status of tentative conclusions, and using rich, detailed descriptions to develop the hypotheses. These hypotheses are then checked for authenticity through member checks with research subjects, triangulation, and peer debriefing and, (5) the assimilation of conclusions into the broader context of the evaluation.

Content analysis was applied to the qualitative data collected through focus group interviews, follow-up questionnaires, and the participants' written co-op work term reports. Content analysis provides procedures to describe, analyze and summarize data in written documents (Worthen et al., 1997). Primarily, data are coded, summarized, and related to one another in line with an emergent conceptual framework, or set of patterns

and themes (Caudle, 1994). The constant-comparative method of content analysis initially described by Glaser and Strauss (Lincoln & Guba, 1985),

> combines inductive category coding with a simultaneous comparison of all social incidents observed. As social phenomena are recorded and classified, they are also compared across categories. Thus, the discovery of relationships, that is hypothesis generation, begins with the analysis of initial observations, undergoes continuous refinement through data collection and analysis process, and continually feeds back into the process of category coding. As events are constantly compared with previous events, new typological dimensions, as well as new relationships, may be discovered (p. 335).

An evaluation study also includes an interpretive component, in which the findings must be evaluated in relation to something else. In the study, quantitative findings were evaluated against administrative standards for program performance developed by stakeholder consensus, and compared to similar statistics for IEG applicants in a traditional Confirmatory Exam Program. Reasoned judgments and interpretations were applied to the patterns and themes that emerged from the qualitative data.

Trustworthiness or evaluation criteria. A major concern in any research design is the trustworthiness of the design itself and the results it has yielded; evaluating the quality and credibility of the data is a distinct step of data analysis (Taylor & Bogdan, 1998). Since the majority of data in the study was expected to be qualitative in nature, this section focuses on measures to ensure the credibility, transferability, and dependability of the results. The credibility of qualitative inquiry parallels the concept of

internal validity in quantitative inquiry. Credibility is enhanced by a combination of factors, including prolonged engagement (spending an adequate amount of time on the study); persistent observations; using peers and colleagues for debriefing and checking; negative case analysis (seeking out and pursuing alternative explanations); continual alertness to one's own biases and subjectivity as the researcher; member checks; and, triangulation (Guba & Lincoln, 1989; Creswell, 1994; Glesne & Peshkin, 1992).

The transferability of qualitative inquiry parallels the term external validity in quantitative inquiry. Transferability is likewise enhanced by a combination of factors, including thick description – that is, the setting out all the working hypotheses and providing extensive and careful description of settings and contexts, in order to provide the reader with as complete a protocol as possible to replicate the study in another setting. This includes full factual documentation and the apparent logic of observations and analyses.

The dependability of qualitative inquiry parallels the term reliability in quantitative inquiry. Several factors influence dependability, including the use of an established and documented process; stating one's own central assumptions and positions (theoretical perspective); providing a detailed and logical protocol for data collection; and, providing an accurate and comprehensive data set (an abundance of evidence) (Guba & Lincoln, 1989; Creswell, 1994; Glesne & Peshkin, 1992).

All of these factors received attention in the design of data collection and data analysis in the research.

Timing and Length of the Study

The study's participants were the participants in the first four cohorts of the IEEQ Program, which spanned the academic years 2003/2004 through 2006/2007. Table 3.2 summarizes the timing of the various data collection events.

Table 3.2
Timing of Data Collection Events

Participants	Focus Group at end of academic term	Follow-up questionnaire at nine months post-IEEQ	Follow-up questionnaire at 24 months post-IEEQ	Focus group(s) at 12-48 months post-IEEQ	Focus group(s) at 18-24 months post-IEEQ
IEEQ1	Spring 2004	Spring 2005	Fall 2006		
IEEQ2	Spring 2005	Spring 2006	Fall 2007	Fall 2008 (2 focus groups)	
IEEQ3	Spring 2006	Spring 2007	Fall 2008		
IEEQ4	Spring 2007	Spring 2008	(note)		
Employers					Fall 2008/ Winter 2009 (2 focus groups)

Note: Data collection event fell beyond the end of the study period.

Ethical Considerations

The study was a 'minimal risk' study. There are some common ethical issues that arise in this type of evaluation, which were considered in the design and implementation of the study. These include anonymity measures in the quantitative data related to program completion and licensing status, confidentiality measures for participants in the focus groups and follow-up questionnaires, and consideration of the researcher's relationship to the participants with respect to position of institutional power and/or potential biases based on familiarity between the participants and the researcher. Typical

methods to address these issues are to engage a third-party facilitator where positions of power exist, including sourcing student data (student records), moderating and summarizing the focus group interviews when participants are still enrolled in the IEEQ Program, and word-processing the questionnaire responses. Identifying features in the data were obscured by the third party through participant coding schemes, transcription, and paraphrasing prior to handing the data to the researcher. Except for the first focus group with each cohort, the remaining data collection events were timed so that any position of institutional power between the participants and the researcher has ended. The entire protocol was approved by the University's Research Ethics Board prior to implementation, with approval certificates and letters of consent included as Appendices G and H.

Role of the Researcher

A defining characteristic of qualitative research is the researcher's role as the primary instrument for data collection and analysis (Hittleman & Simon, 1997; Creswell, 1994; Glesne & Peshkin, 1992; Ely et al., 1991). Within the field of program evaluation, Rossi et al. (2004) discuss how program administrators are often best positioned to carry out evaluation activities, as they can notice nuances and subtleties in the research process and the data that may otherwise escape a neutral third party. However, within the field of qualitative research generally, a key concern is for the researcher to be aware of her own biases and perspectives relative to the subject matter, and to actively work against imposing them on the data collected from participants (Creswell, 1994; Ely et al., 1991; Glesne & Peshkin, 1992).

It is important to acknowledge that I, as the principal investigator, already had intimate familiarity with the IEEQ Program as the original designer of the program, working from broad-based specifications provided by the originators of the concept (Faculty of Engineering and APEGM executives). As such, I had a great deal of freedom to shape and re-shape the program since 2003. While this provided an invaluable body of tacit knowledge and understanding of the program, it also forced me to acknowledge a potential vested interest in a finding of the program as being 'successful'. In addition, I brought existing professional relationships with the participants based on my role as Program Coordinator, and later Director, while they participated as either IEGs enrolled, or as supervisors / employers of IEGs enrolled in IEEQ.

Specific research norms relative to data handling can address the personal perspectives or biases of the researcher. These include the use of third parties for specific aspects of data collection (e.g. focus groups), and writing analytic memos during the research process. Analytic memos are a method by which to regularly stand back from the data and record what one is learning; they include summaries of major findings of the study to date, comments on specific aspects of the study, and strategies for additional data that may need to be collected (Taylor & Bogdan, 1998). Finally, well-planned questions with disciplined and defined prompting procedures invite the participants to articulate and elaborate what otherwise the researcher may have taken for granted. This is another method by which the researcher can establish distance from personal interpretations and perspectives (McCracken, 1988).

The personal motivations to carry out this research were two-fold. Primarily, while there was a general and broad-based community consensus that the IEEQ Program

is successful, there was a need to supplement these understood sentiments with a systematic methodology of evaluation that supported the credibility of the findings – whatever they may be. Second, a program evaluation study provides a unique opportunity to apply qualitative approaches within an engineering context, uncovering perspectives of why and how something works that quantitative approaches are less effective at addressing.

Limitations of the Methodology

This chapter concludes with a discussion of the known limitations of the techniques and procedures in the research design. As an emerging field, evaluation research is still refining its methods and techniques, although "contemporary social science techniques of systematic observation, measurement, sampling, research design, and data analysis represent rather highly evolved procedures for producing valid, reliable, and precise characterizations of social behaviour" (Rossi et al., 2004, p. 16). Still, Rossi et al. point out that

> social programs are inherently inhospitable environments for research purposes. The circumstances surrounding specific programs, and the particular issues the evaluator is called on to address, frequently compel evaluators to compromise and adapt textbook methodological standards. The challenges to the evaluator are to match the research procedures to the evaluation questions and circumstances as well as possible and, whatever procedures are used, to apply them at the highest possible standard feasible to those questions and circumstances (p. 17).

Besides this dynamic tension between volatility of social programs and a fixed evaluation plan, additional dilemmas within program evaluation research include the tension to conduct evaluations in a 'scientific' manner on the one hand, while striving for a pragmatic focus on the other hand. The field of evaluation research offers a great deal of diversity and little consensus, and is considered at least as much art as science (Rossi et al., 2004).

A limitation associated with the quantitative data is the small sample size, which precludes extensive statistical analysis and limits generalizability beyond basic descriptive statistics. Additionally, there are standard limitations associated with the qualitative research methods. Some limitations are inherent in the technique and are not amplified in the research design. Examples of such limitations relative to focus group interviews include the effects of audio recording of the interviews and the effects of group dynamics. Other limitations arise out of the specifics of the research design. One such limitation relative to focus group interviews includes the use of established (existing) groups instead of groups of strangers. These limitations are discussed further in the following paragraphs.

Participant-observation is seen by some as the normative qualitative data collection method, or the method against which all others are measured (Taylor & Bogdan, 1998). In contrast to the first-hand observations gained through participant-observation, focus group interviews rely on second-hand (verbal) accounts of participants. Since people act by nature inconsistently, saying and doing slightly different things in different situations, the researcher must be aware of the interview setting as one particular type of situation. What the participants claim as their thoughts

and actions may not exactly coincide with their actual thoughts and actions in other situations. Secondly, the limitation of interview methods relative to participant-observation is said to be the researcher's lack of context necessary to understand many of the perspectives that emerge. This limitation may manifest itself in different ways. The researcher may be likely to misunderstand participants' language (vocabulary and terminology), and participants may be unwilling or unable to articulate things that could have been observed through direct observation. Mitigation of these potential limitations includes spending a sufficient amount of time with the participants to understand what they mean, creating an atmosphere conducive to free and open conversation, eliciting rich description from the participants, and getting to know participants outside of the interview situation (Taylor & Bogdan, 1998).

A second potential limitation of focus group interviews is the conscious or unconscious effect that audio recording has on both the researcher and the participant. Taylor & Bogdan (1998) warn that it is naïve to assume that recording will not alter what some people are prepared to say or do; few people want to claim negative or socially offensive views on the permanent record (e.g. racism, sexism). Mitigation of this limitation includes establishing rapport with the participant through the moderator's presence (presentation of self). In addition, interview questions are planned to put the participant at ease and allow for true meanings and thoughts to emerge in non-defensive and non-argumentative ways. Mitigation also includes obtaining consent for audio recording the interview, and placing the audio recorder so as to be as unobtrusive as possible.

An important potential limitation of the focus group interview method is the effect of group dynamics on the data collected. The group dynamic is simultaneously seen as a strength of the method, as influence among group participants is acknowledged and sought after in the focus group strategy. However, the researcher must be aware that participants may not say things in the context of the group that they may have been willing to share in private. In addition, less vocal participants may defer to those who are most outspoken, thus leading to a superficial consensus within the group (Krueger, 1988; Taylor & Bogdan, 1998). Therefore, it is important for the researcher to have some way of tracking who said what within the group, to guard against being faced with an overwhelming amount of data without being able to discern whether the perspectives represent repeated comments by one or two individuals, or truly represent the comments of the majority of the group.

A potential limitation amplified in the research design was the use of established groups (IEEQ cohorts) for focus group sessions. The focus group is described as a robust method that allows for minor variations in technique while still yielding strong results (Krueger, 1988). In this research, the participants in the focus group were familiar with one another as they progressed through the program simultaneously. Considerations of using focus groups with established groups include the need to acknowledge that existing groups may have formal or informal ways of relating that can influence their responses. In addition, it is important to consider whether participants are selective in what they say in front of others in the group. Participants' positions on issues and ideas may reflect a need to relate to other group members in a certain way.

Finally, an essential concern for the researcher in any methodology is the risk of imparting one's own contexts and conceptualizations onto the terms, vocabulary, and comments provided by the participants. The researcher may be particularly vulnerable to this potential limitation when a degree of familiarity exists with the subject of the research, participants, and/or settings, as in this study. Mitigation of this potential limitation relies on the researcher's awareness of the risk, the formulation of well-planned questions, and the researcher's preparation and discipline in probing for meaning and clarification, rather than assuming the same.

Conclusion

This chapter has outlined the conceptual and theoretical perspectives and the research design applied to a study of the IEEQ Program at the University of Manitoba. The study used a combination of focus group interviews, follow-up questionnaires, participants' reports, and existing program records to collect primarily qualitative, but also quantitative data. The objective of the research was to explore four IEG cohorts' outcomes, perceptions and experiences in the IEEQ Program, as well as the perceptions and experiences of the employers of the IEEQ cohorts. The findings were used to assess both the delivery process and program outcomes of the IEEQ Program, and to contribute to a broader understanding of the nature of engineering practice and an epistemology of engineering.

Chapter 4

Findings

Program Framework: An Engineering Design Process

This chapter begins by addressing the qualitative research goal of rich description and explanation: rationalizing or explicating the IEEQ Program, which is the context within which all other findings are understood. In the framework of both engineering design and action research, this explanation is a critical narrative of an identified problem, the investigation of the problem, the development of a solution to the problem, the implementation of the solution, and a re-assessment of the situation. The iterative development of the IEEQ Program, the investigation that contributed to it, and the logic that drove it, is itself a significant design outcome of this work. Taking audience into account, this section borrows from the language of the design process to express the program theory of the IEEQ Program.

Adopting a holistic definition of engineering design (Friesen, 2003), this section addresses both the process of design, which can be viewed as systematic, and the context of design, which includes environmental information dealt with from an intentional perspective and leading to a varied set of outcomes. This design definition is summarized as Appendix I.

The process of designing the IEEQ Program began with a realization of the needs and pressures that motivated its establishment. As detailed in the Introduction (Chapter 1) and Literature Review (Chapter 2), the identified problem included the need for skilled labour in Canada and Manitoba, low engineering licensing rates, and poor labour market outcomes for IEGs when compared to Canadian-educated engineers. This problem was supported by research that identified difficulties in foreign credentials recognition and in gaining Canadian professional experience as the two primary obstacles to immigrant

professionals' full labour market participation. Further research substantiated that engineering employers considered Canadian experience, professional licensure, and communication skills to be key determinants of IEGs' levels of employment. Poor licensing outcomes based on data from APEGM, and 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

- Develop an alternative licensing pathway formally recognized by APEGM as leading to academic qualification for licensing;
- Address known challenges in the traditional licensing pathway for IEGs, by providing an alternative pathway 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; and,
- 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:

- 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;

- A program design that would be considered by APEGM to be substantively equivalent in terms of individuals' effort and outcome validity to the traditional licensing pathway of writing Confirmatory Exams;
- Relatedly, eligibility to the IEEQ Program was defined by APEGM as those IEG applicants assigned five or fewer Confirmatory Exams in their *Assessment of Academic Credentials*. 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;
- 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,
- 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.

IEEQ Program Participant Characteristics

The IEGs that applied to, and were accepted into, the IEEQ Program for the first four cohorts had the following characteristics:

- Participants came from a total of 20 countries on four continents[1];
- Participants were generally between 30 and 45 years of age;

[1] Countries of origin, in descending order, are India (6), Argentina (5), Pakistan (4), China and Colombia (3 each), Russia, Ukraine, and Macedonia (2 each), and Bangladesh, Afghanistan, Sri Lanka, Mexico, Cuba, Trinidad, Bulgaria, Romania, Poland, Iran, Ethiopia, and Nigeria (1 each).

- Of a total of 39 participants that began the program in the first four cohorts combined, five were female and 34 were male;
- All participants had previously completed a bachelor-level engineering degree at a non-Canadian university (in their home country or another country);
- Approximately one-third of participants had additional education, either in the form of completed or incomplete graduate degrees, certificates, or diplomas in engineering or other fields (e.g. management, accounting);
- Participants' years of professional experience in engineering in their home countries (or another country) prior to immigration to Canada generally ranged from three to 15. A minimal number of participants had either less than three or more than 15 years' experience prior to immigration;
- Approximately half of participants had some Canadian employment experience (non-engineering); however, most participants had no engineering work experience in Canada prior to entering IEEQ; and,
- Most participants were married and were parents to children living at home.

First Iteration

The initial program was solely defined around two components: eight months of senior-level undergraduate engineering courses and a four-month co-op work term. The academic portion (courses) was set at eight courses for each individual, to provide an opportunity for a range of coverage of topics, but to keep the course load lighter than the 12 courses per year that a typical undergraduate degree student takes. 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 supporting integration into the Canadian engineering context and the absence of these courses in most IEGs' previous academic background.

The third core course, Practicing Professional Engineering in Manitoba, was developed specifically for the IEEQ Program students, 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, employment maintenance, 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, already offered by the four engineering departments at the University of Manitoba. In this way, the IEEQ Program facilitated a demonstration of 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 described earlier.

In the initial iteration of the IEEQ Program, APEGM carried an active role in conducting the *Assessment of Academic Credentials* of prospective IEEQ students in order to determine eligibility for the IEEQ Program, and in active monitoring of the delivery of the IEEQ and of individual participants' progress by regular presentations by IEEQ staff to the APEGM Academic Review 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.

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 between mentor and mentee. Outside of the mentorship program, no other support programs were in place for the first cohort of IEEQ. 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 each of the first four program cohorts formed the basis of the findings from which the design of the IEEQ Program continued to evolve. Figure 4.1 summarizes key developments around IEEQ, both in terms of the external context to which IEEQ remained responsive (APEGM and government, shown above the timeline) and the internal development and delivery of the program (shown below the timeline).

The primary finding of the focus group with the first IEEQ cohort, held at the end of the academic portion of their program, highlighted the need for a support structure for participants that would allow for a proactive approach to academic and other challenges. Participants' responses revealed a sense of isolation, unfamiliarity ("lostness") in the 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 key value of the program. While the program had been conceived to address licensing with APEGM and labour market entry, the responses of participants in the first cohort identified the support in their cultural integration as the

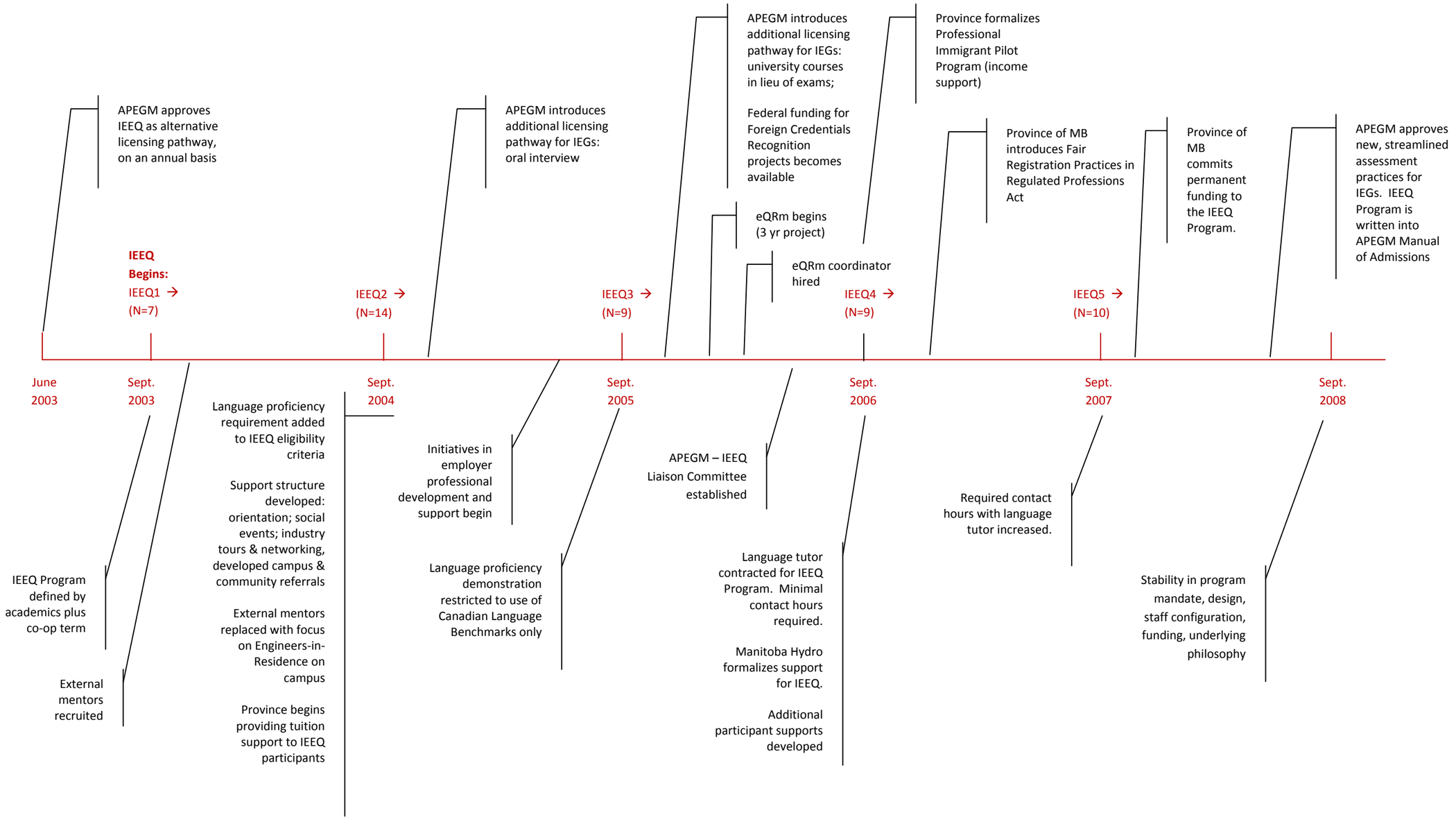

Figure 4.1. **Timeline of key internal and external developments in the IEEQ Program**

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 the core course],"* 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. Specific initiatives included: the development of a student handbook specifically for IEEQ participants 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 the first IEEQ cohort highlighted misconceptions and expectations that needed to be addressed through more explicit information and explanation by IEEQ staff to participants. 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 the first cohort 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 for IEEQ participants, 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 reviewed and approved by APEGM in time for the second IEEQ cohort, and constituted a second significant change in the program. The correlation procedure allowed the number of courses in IEEQ to range from three to eight, with the average course load reduced from eight to 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 in the first cohort on what were 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 (ESP) 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 as defined in the university's undergraduate calendar.

The program coordinator also observed positive expression and openness in participants when opportunities to interact with other practicing professional engineers developed. This led to a deliberate identification of those opportunities within the program and a program commitment to maintain these contacts. 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 the on-campus Engineers-in-Residence, and deliberately maintaining regular 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 on the program's substantive equivalency and validity compared to the Confirmatory Exam pathway. The formal program staff continued to consist of one part-time program coordinator; all other inputs to deliver the program within the university came out of voluntary efforts and relational influence built up by the program coordinator.

Thus, the second iteration of the IEEQ Program (second cohort) began in September 2004 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 participant 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, which could be seen as the context of the design (as per Appendix I). 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 holistic (whole-person) approach toward professional licensing and integration of IEGs. These emerging perspectives were also the initial findings and design outcomes that sparked attention to the epistemology of engineering practice in the latter stages of the research.

Second Iteration

Within the broader engineering profession during the time period of the second IEEQ cohort, 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 prior to application to APEGM, 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 clear understanding of its role, value, and mandate in the licensing and professional integration of IEGs.

The focus group that took place at the end of the academic portion of the IEEQ Program of the second cohort, and the first nine-month post-IEEQ follow-up questionnaire with the first cohort 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, this cohort 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 at this point in the data collection served to validate and further refine the mandate of IEEQ as a broad-based program with an increasing focus on the 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 Professional Engineering in Manitoba] was excellent."* The nine-month post-IEEQ follow-up questionnaire with the first cohort also provided a retrospective view of the value of IEEQ. Here too the responses were decidedly non-technical in nature, further defining IEEQ's value as more 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 program staff, the findings reinforced the value of the three-prong social, academic, and financial support structure put into place, and led to a renewed focus on

how the support structure could be maintained and augmented within very limited staff and financial resources. This was done in the context of observing 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.

For example, one new development within the IEEQ Program after the second cohort 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. The CLB was chosen over other language tests, such as TOEFL, CanTEST, and IELTS, due to the professional recommendation of the language training community 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 the limited financial and staff resources of the IEEQ Program, and consisted of gifting a book to all co-op employers[2], and approaching the APEGM Professional Development committee as well as selected individual

[2] *Managing Cultural Diversity in Technical Professions*, by L. Laroche, P.Eng., Ph.D. © 2003, Butterworth Heinemann, and/or *Recruiting, Retaining, and Promoting Culturally Different Employees*, by L. Laroche, P.Eng. and D. Rutherford. © 2006, Butterworth Heinemann.

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 of IEEQ, denoting a whole-person approach to the professional licensing and integration of an IEG. A holistic approach drove an expanding emphasis on the non-technical aspects of professional integration, including the topics discussed in the core course Practicing Professional Engineering in Manitoba, and the support structure developed for participants. 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 as demonstrated by technical confirmation and career-related employment will not be achieved if other personal and cultural integration challenges cannot be addressed prior or concurrently. 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 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 in such a way as 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 'host' community – in this case, the Canadian engineering profession – 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.

Third Iteration

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 they reflected these values.

The findings of the focus group with the third cohort, and the nine-month post-IEEQ follow-up questionnaires with the second cohort 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 – including new terminology and new computer software, they also expressed the feeling 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.

Key strengths of the program were identified as the group support and the focus on incremental cultural integration. 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 forces.

Internally, several new support items were added to the program, and a language tutor was hired on contract for the beginning of the fourth iteration, with the requirement added to the program that each participant spend a minimum of three hours with the language tutor over the course of the year. Although the time requirement was extremely low, 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 worthwhile and appropriate. The three hours were a minimum, with the opportunity for participants to spend more time with the language tutor as required. The three hours were to be 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.

Key influences on the IEEQ Program during the third iteration shifted from internal to external influences on the program. As a significant step toward program credibility and recognition within the engineering community, Manitoba Hydro – Manitoba's single largest employer of engineers – formalized its support to the IEEQ program 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. This commitment was set for two years and, then, subject to review and renewal.

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, referred to as eQRm (engineering Qualifications Recognition model). 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.

In contrast to approximately a year earlier when an oral interview option was introduced for selected applicants, 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 be able to articulate a clear 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, to encompass an expanded view of the place of the IEEQ Program itself in formal and informal partnerships with the provincial government, APEGM, the employment community, and immigrant-serving agencies. 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 role in conducting the *Assessments of Academic Credentials* which established 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 Review Committee. This smaller committee allowed for a more timely review of participants' progress and more immediate consideration of complex or unusual policy issues that arose in the program.

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 offsets 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.

Fourth Iteration

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 the Professional Immigrant Pilot Program, which provided income support and, potentially, tuition support to immigrant professionals who need to enroll in a certification or upgrading program in order to achieve their professional certification in Manitoba. As well, the province introduced the *Fair Registration Practices in Regulated Professions* Act in the Manitoba Legislature during this time, although it was not

proclaimed into law until approximately 18 months later. 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 key value of the program was identified in *"…the co-op work term…," "…networking and communication…," "…learning about cultural differences…,"* and *"…courses and [learning new computer software] will be useful for future work."* 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 (with increased emphasis as compared to the third iteration). 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 of sustained lobbying efforts on the part of the Faculty of Engineering that gradually grew to include efforts by the engineering community and former IEEQ participants, the provincial government committed long-

term baseline funding to the University of Manitoba to deliver the IEEQ Program and increase its enrollment potential. Concurrently, APEGM undertook a comprehensive view 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 Council of the IEEQ Program as a licensing pathway, written into the APEGM Manual of Admissions, and no longer subject to annual review and approval by the APEGM Academic Review Committee.

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.

Summary of Program Development

By the end of the fourth iteration of the IEEQ Program, the metaphorical design spirals that represented the process of designing the IEEQ Program – both internally and externally – had closed, as the mandate, delivery, partnership framework (including funding) and philosophy of the IEEQ Program had now been defined. The tangible design 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 design outcomes included the deliverables

of the eQRm project, including published documents[3] that outlined the framework of an IEEQ-style program and the curriculum framework for the Practicing Professional Engineering in Manitoba course. The initiation of an IEEQ-style program at Ryerson University in 2007, highly modeled on the IEEQ Program at the University of Manitoba, was a further direct outcome of the developments in Manitoba from 2003 onward.

The chapter to this point has demonstrated how the design of the IEEQ Program met the stated objectives to:

- Develop an alternative licensing pathway formally recognized by APEGM as leading to academic qualification for licensing; and,
- Decrease feelings of isolation that were anecdotally known to exist among IEGs pursuing licensing (stated earlier as part of the second objective for the program's development).

In doing so, this chapter has also begun to address the first research question, namely "How do IEEQ participants perceive and describe their experiences in the IEEQ Program? Specifically, how do IEEQ participants perceive and describe the availability of the major components of the program (academic confirmation, co-op work experience, cultural training, language training, and support networks), and how do IEEQ participants perceive and describe their involvement in these same components?"

The following sections of this chapter present findings related to the remaining objectives in designing the IEEQ Program, namely to:

- Address known challenges in the traditional licensing pathway for IEGs, by providing an alternative pathway that would be more time-effective, sustain

[3] *Implementation Framework*, ISBN 1-894284-31-3, © Canadian Council of Professional Engineers, 2008. *Instructor Curriculum Framework for a Working in Canada Seminar*, ISBN 1-894284-29-1, © Canadian Council of Professional Engineers, 2008.

higher completion rates and lower attrition rates than the traditional pathway; and,

- Include a degree of labour market integration for IEGs.

In doing so, the findings will address the second research question, namely "How do participants' outcomes in the IEEQ Program compare to IEGs pursuing academic qualification with APEGM through other pathways, and/or how do participants' outcomes in the IEEQ Program compare to other APEGM members (Engineers-in-Training and P.Engs.)? Specifically, what outcomes are evident relative to IEEQ participants' program completion rates, time-to-program completion, post-program licensing status, timelines through the post-program licensing process, and post-program career development indicators?"

Participant Outcomes: Quantitative Results

Findings related to participant outcomes relative to program completion rates, time-to-program completion, post-program licensing status, timelines through the post-program licensing process, and post-program career development indicators were primarily extracted from program records as well as post-program follow-up questionnaires with participants in the first four cohorts of the IEEQ Program. Due to low participant numbers, the presentation of findings is limited to descriptive statistics (means and ranges where appropriate). Tables 4.1 through 4.7 summarize these findings for the first four cohorts.

Table 4.1
Response Rates to Data Collection Events

Cohort (yrs in IEEQ)	Number of participants / respondents			
	Focus group at end of academic portion of IEEQ Program	Nine-month post-IEEQ questionnaire	24-month post-IEEQ questionnaire	Post-IEEQ focus groups (fall 2008 / winter 2009)
IEEQ1 (2003/2004)	5	2	4	
IEEQ2 (2004/2005)	9	10	11	9 (Note 2)
IEEQ3 (2005/2006)	3	6	6	
IEEQ4 (2006/2007)	4	3	(Note 1)	
Employers				6 (Note 3)
All cohorts	21	21	21	

Notes
1 Timing of data collection event fell beyond the end of the study period.
2 Nine participants in two focus groups. Cohorts represented: 1 x IEEQ1; 6 x IEEQ2; 1 x IEEQ3; 1 x IEEQ4.
3 Six participants in two focus groups.

Table 4.2
Program Completion and Time-to-Completion Outcomes of IEEQ Graduates

Cohort	Number of participants that started program	Number of participants that successfully completed program[1]	Average time to completion, mths (range, mths)
IEEQ1	7	5	12 (12)
IEEQ2	14	13	14 (12 – 24)
IEEQ3	9	7	13 (12 – 20)
IEEQ4	9	6	13 (12 – 16)
All cohorts (% or range as noted)	39 (100%)	31 (79%)	13 (12 – 24)

Notes
1 Of those that did not complete IEEQ:
3 of 39 (8%) voluntarily withdrew
5 of 39 (13%) were exited due to failing to meet program requirements.

Table 4.3
Post-IEEQ Activities of Respondents

Cohort	Engineering employment[1]		Engineering-related employment[1]		University studies in engineering		Unemployed		Other[2]	
	9 mths post-IEEQ	24 mths post-IEEQ	9 mths post-IEEQ	24 mths post-IEEQ	9 mths post-IEEQ	24 mths post-IEEQ	9 mths post-IEEQ	24 mths post-IEEQ	9 mths post-IEEQ	24 mths post-IEEQ
IEEQ1	0	2	1	2	0	0	1	0	0	0
IEEQ2	9	8	1	2	1	2	0	0	0	0
IEEQ3	4	6	0	0	0	1	1	0	1	0
IEEQ4	3	(note 3)	0	(note 3)	0	(note 3)	0	(note 3)	0	(note 3)
All cohorts	16	16	2	4	1	3	2	0	1	0

Notes:
Participants were also asked if their current activity was their preferred activity. At nine-months and 24 months post-IEEQ, a total of 18 and 19 respondents respectively indicated that they were engaged in their preferred activity.
1 At nine-months and 24 months post-IEEQ, a total of 16 and 14 respondents respectively indicated that their employment was related to connections made during the IEEQ co-op term.
2 Options included: Other employment; University / college studies in a field other than engineering; Other (e.g. care-giving duties, volunteering, etc.).
3 Timing of data collection event fell beyond the end of the study period.

Table 4.4
Salary Outcomes of Employed Respondents

Cohort	Equivalent annual salary, $/yr (range, $/yr) [standard deviation, $/yr]		
	IEEQ Program co-op term	**Nine months post-IEEQ**	**24 months post-IEEQ**
IEEQ1	36,000 (32,000 – 40,000)	33,150 (33,150)	55,250 (34,000 – 66,000) [14,400]
IEEQ2	36,000 (32,000 – 48,000)	43,180 (36,000 – 53,700) [6,100]	54,375 (44,000 – 68,000) [10,400]
IEEQ3	40,000 (32,000 – 48,000)	51,250 (40,000 – 64,000) [10,500]	56,192 (36,650 – 72,500) [16,500]
IEEQ4	42,000 (40,000 – 48,000)	55,000 (50,000 – 64,000) [7,800]	(Note 1)
All cohorts	38,000 (32,000 – 48,000)	46,787 (33,150 – 64,000) [9,200]	55,175 (34,000 – 72,500) [12,700]

Notes
1 Timing of data collection event fell beyond the end of the study period.

The data show a progression in annual salaries for all cohorts post-IEEQ between the nine-month and 24-month follow-up periods. The data also show a progression in the earnings of former IEEQ participants across cohorts during the co-op period and at the nine-month follow-up, meaning that annual salaries during co-op work terms and at nine months post-IEEQ respectively, consistently increased year over year. This is likely reflective of general economic trends in Manitoba over the years of the study period, in which the average industrial wage in Manitoba increased 11% between 2004 and 2007.

Table 4.5
Self-assessed Employment Classification of Respondents

Cohort	Duties[1], mean score (range)		Recommendations, decisions, and commitments[1], mean score (range)		Supervision received[1], mean score (range)		Leadership authority & supervision exercised[1], mean score (range)	
	9 mths post-IEEQ	24 mths post-IEEQ	9 mths post-IEEQ	24 mths post-IEEQ	9 mths post-IEEQ	24 mths post-IEEQ	9 mths post-IEEQ	24 mths post-IEEQ
IEEQ1	1 (1)	3.4 (2-5)	5 (5)	4 (3-5)	5 (5)	4 (3-5)	3 (3)	4 (3-5)
IEEQ2	2.6 (2-5)	2.9 (2-4.5)	3.4 (2-7)	3.8 (2-5)	3.8 (2-6)	3.7 (2-5.5)	2.4 (1-4)	2.5 (1-4)
IEEQ3	2.3 (2-3)	2.8 (1.5-4)	2.3 (2-3)	3.3 (1.5-4)	3.0 (2-4)	3.5 (3-4)	2.0 (1-3)	3.5 (1-5)
IEEQ4	2.5 (2-3)	(Note 2)	3.7 (2-5)	(Note 2)	3.0 (2-4)	(Note 2)	2.8 (2-3.5)	(Note 2)
All cohorts	2.4 (1-5)	3.0 (1.5-5)	3.3 (2-7)	3.6 (1.5-5)	3.5 (2-6)	3.7 (2-5.5)	2.4 (1-4)	3.2 (1-5)

Notes:
1 As per Appendix F.3: APEGM Professional Engineering Employment Classification Rating Guide, excerpted from the APEGM annual salary survey tools.
2 Timing of data collection event fell beyond the end of the study period.

The data generally show moderate to significant increases in the professional characteristics of employment of former IEEQ participants between the nine-month and 24-month follow-up periods.

Table 4.6
Licensing Status and Progress of Respondents

Cohort	Registered as EIT		Registered as P.Eng.		For EITs, average expected time until registration as P.Eng., yrs	
	9 mths post-IEEQ	24 mths post-IEEQ	9 mths post-IEEQ	24 mths post-IEEQ	9 mths post-IEEQ	24 mths post-IEEQ
IEEQ1	2	1	0	3	1.5	1.0
IEEQ2	10	5	0	5	1.6	1.4
IEEQ3	6	3	0	3	1.4	1.3
IEEQ4	3	(Note 1)	0	(Note 1)	1.3	(Note 1)
All cohorts	21	9	0	11	1.5	1.3

Notes: 1 Timing of data collection event fell beyond the end of the study period.

Table 4.6 reflects the self-reported licensing status of IEEQ graduates that responded to the follow-up questionnaires. Licensing status is also searchable through the APEGM database (publicly available at www.apegm.mb.ca). At regular intervals, the researcher searched for the licensing status of all IEEQ graduates. Upon graduation from the IEEQ Program, 100% of graduates from all cohorts were accepted for registration as EITs by APEGM, generally within two months of completion of the IEEQ Program. At time of writing, the licensing status of IEEQ graduates as per the APEGM database was as follows: of the 31 successful graduates from cohorts IEEQ1 through IEEQ4, 14 were registered as an EIT, 15 were registered as a P.Eng., and two were no longer listed in the APEGM database (licensing had lapsed).

Table 4.7
Respondents' Loyalty to Manitoba

Cohort	Nine months post-IEEQ, mean score[1]	24 months post-IEEQ, mean score[1]
IEEQ1	1.0	0.3
IEEQ2	0.6	0.4
IEEQ3	0.7	0.7
IEEQ4	1.0	(Note 2)
All cohorts	0.7 (standard deviation = 0.5)	0.5 (standard deviation = 0.7)

Notes:
1 In response to the question, "Are you more likely to stay in Manitoba as a result of the IEEQ Program?" participants' responses were recorded as +1.0 for 'yes', -1.0 for 'no', and 0 for 'neutral / undecided'
2 Timing of data collection event fell beyond the end of the study period.

The data show a degree of loyalty to the province of Manitoba at both nine months and 24 months post-IEEQ. The data further imply that the degree of loyalty to Manitoba as a result of the IEEQ Program attenuates over time.

Within the program evaluation objective of the research, the data were compared to other comparable data for the engineering profession. The following tables provide these comparisons. Because of the low participant numbers in IEEQ and the lack of exactly parallel data for comparison, only basic statistics have been calculated. The comparison is intended to begin to explore how the outcomes for IEEQ graduates compare to similar metrics for the profession overall and, in particular, to those IEGs who pursued licensing through a Confirmatory Exam program.

At time of writing, APEGM acknowledged limitations in the information contained in their database, one of which was a limited ability to accurately track how many IEGs who initially applied for an *Assessment of Academic Credentials* eventually completed the FCR process. The main limitation rested with the uncertainty in definitively identifying whether IEGs with inactive files had dropped out of the process, or were still considering themselves to be 'in progress' and intending to achieve academic qualification at some point in the future. Thus, the data on completion rates of the various pathways toward academic qualification only allow coarse figures and general trends to be inferred.

It is known that the number of IEG applicants that apply for an *Assessment of Academic Credentials* in any given year rose rapidly between 2000 and 2005. This corresponded to an increase in immigration to Manitoba. These figures, along with the number of IEGs that achieved academic qualification in the same time period, are presented in Table 4.8.

Table 4.8
IEGs Entering and Leaving the Academic Qualification (Licensing) Process

Year	IEG applicants to APEGM[1]	IEGs achieving academic qualification (all pathways)[2]
2002	57	20
2003	62	10
2004	101	29[3]
2005	100	38[4]
2006	89	41[5]

Notes
1 IEG applicants who applied to APEGM in a given year, regardless of the year they achieved academic qualification. Source: APEGM, 2007.
2 IEG applicants who achieved academic qualification in a given year, regardless of the year they applied to APEGM. Source: APEGM, 2007.
3 Includes five IEEQ graduates
4 Includes 10 IEEQ graduates
5 Includes 8 IEEQ graduates

If the numbers of applicants to APEGM were static over the long-term (year over year), one would ideally prefer to see approximately the same number of people applying to APEGM (entering the process) and achieving academic qualification (leaving the process) in a given year. Although a 100% completion (success) rate is likely not realistic, one could identify a target level (for example, 80% of those entering the process) to successfully achieve academic qualification. The data in Table 4.8 would imply a much lower success rate for achieving academic qualification. However, the increasing number of applicants to APEGM year over year distorts the apparent trends in Table 4.8, and makes this kind of straight inference inappropriate.

Given data on the time-to-completion of a licensing pathway (presented in Table 4.9), one can roughly infer a three-year offset between entering and leaving the process. For example, the 57 applicants to APEGM in 2002 would likely achieve academic qualification in 2005. Likewise, the 62 applicants to APEGM in 2003 would likely achieve academic qualification in 2006. Taking this offset into account, the completion

rates appear more favorable (38 of 57 in 2005, or 66%; 41 of 62 in 2006, or 66%) (note that these rates *include* the IEEQ Program graduates). These rates are still lower than the completion rates observed in the first four cohorts of the IEEQ Program alone (79% for cohorts IEEQ1 through IEEQ4 overall), supporting the inference that participants in the IEEQ Program had higher completion rates than IEGs pursuing the Confirmatory Exam pathway for licensing.

The data did allow a crude tracking of those applicants that applied to APEGM in 2002 and 2003, as these numbers were expected to be fairly static by the time of writing. (The data on applicants in 2004, 2005, and 2006 was still considered to be changing at time of writing). In 2002, 57 IEGs applied to APEGM. At time of writing, 22 of 57 (39%) had achieved academic qualification and four of 57 (7%) were known to be in progress. An additional 27 of 57 (47%) were considered to have withdrawn from the process. The status of the remaining four IEGs (7%) was unknown.

Similarly in 2003, 62 IEGs applied to APEGM. At time of writing 28 of 62 (45%) had achieved academic qualification and 19 of 62 (31%) were considered to be in progress. An additional 15 of 62 (24%) were considered to have withdrawn from the process. These data from all IEG applicants to APEGM in 2002 and 2003 further support the inference that the IEEQ Program had a higher completion rate than other licensing pathways available to IEGs in Manitoba, which was an objective when establishing the IEEQ Program.

Data related to time-to-completion from the IEEQ Program in comparison to other licensing pathways is presented in Table 4.9.

Table 4.9
Time-to-completion Comparisons between IEEQ Graduates and Other Licensing Pathways

Cohort	Average time-to-complete, mths	Comparison time-to-complete, mths	Notes and source of comparison[1,2,3]
IEEQ1	12	18	Applicants assigned 1-2 C.E.
		41	Applicants assigned 3-5 C.E.
IEEQ2	14	15	Applicants assigned 1-2 C.E.
		36	Applicants assigned 3-5 C.E.
		67	Applicants assigned P.E.
IEEQ3	13	13	Applicants assigned 1-2 C.E.
		32	Applicants assigned 3-5 C.E.
		34	Applicants assigned 6-7 C.E.
		29	Applicants assigned P.E.

Notes
1 Source of comparison is (APEGM, 2007), for IEGs who achieved academic qualification through another pathway (Confirmatory Exams or oral interview) in the same year as the IEEQ cohort.
2 C.E. = Confirmatory Exams; P.E. = Proficiency Exams
3 Comparison data extended to 2006 only; therefore, comparisons for IEEQ4 (achieved academic qualification in 2007) are not presented.

In cohorts IEEQ1 through IEEQ3, only two participants were initially assigned one to two Confirmatory Exams in the *Assessment of Academic Credentials* by APEGM. The remaining 28 participants in cohorts IEEQ1 through IEEQ3 were initially assigned between three and five Confirmatory Exams by APEGM. In comparison to other IEG applicants assigned between three and five Confirmatory Exams and who achieved academic qualification by other pathways, the time-to-completion comparisons indicate that the IEEQ Program was a more time-effective option, which was a further objective in establishing the IEEQ Program. For those applicants originally assigned between three and five Confirmatory Exams, those that achieved academic qualification by pathways other than the IEEQ Program used approximately 2.5 to 3.5 times longer than participants in the IEEQ Program. For those applicants originally assigned one or two Confirmatory Exams, the time to achieve academic qualification was approximately equal between the IEEQ Program and other pathways.

Table 4.10 summarizes the self-reported salaries of IEEQ participants, and compares them to self-reported salaries of APEGM members (both EITs and P.Engs.). Due to regional differences in general economic factors (demand for engineers, cost of living, etc.) across Canada, salary comparisons were limited to APEGM data only, of which the majority of members reside in Manitoba. This is considered the most valid data set for comparison.

As expected, the salaries of IEEQ participants during their co-op terms were generally significantly lower than the mean EIT salary reported by APEGM for the same time period. At both nine months and 24 months post-IEEQ, former participants' salaries were compared to the salaries of EIT graduate engineers, reported to APEGM by year of graduation. Considering the year of successful completion from IEEQ as the IEGs' graduating year from an equivalent Canadian program, former IEEQ participants were reported to be earning similar annual salaries to EIT graduate engineers, anywhere from zero to three years removed in favour of the former IEEQ participants. However, given that former IEEQ participants generally had years of engineering experience in another country prior to their immigration to Canada, the comparative nature of their income to that of EITs generally (those typically in the first four years of their engineering career) supports the well-documented notion of a 'transition penalty' for immigrant professionals seeking to regain professional status in Canada, in the area of financial earnings.

Table 4.10
Salary Comparisons between Respondents and APEGM Members

Cohort	Equivalent annual salary, $/yr	Comparison salary, $/yr	Notes and source of comparison salary[1,2]
IEEQ1	Co-op: 36,000	38,569	Mean EIT salary [2005:6]
	9-mth post-IEEQ: 33,150	45,050	Mean EIT salary [2006:6]
		40,279	Mean salary of 2005 and 2006 grads [2006:11]
	24-mth post-IEEQ: 55,250	49,904	Mean EIT salary [2007:6]
		48,663	Mean salary of 2004 grads [2007:11] (peer cohort)
		56,044	Mean salary of 2003 grads [2007:9] (closest $ match)
IEEQ2	Co-op: 36,000	45,050	Mean EIT salary [2006:6]
	9-mth post-IEEQ: 43,180	49,904	Mean EIT salary [2007:6]
		43,884	Mean salary of 2005 grads [2007:11] (peer cohort and closest $ match)
		45,960	Mean salary of 2006 grads [2007:11]
	24-mth post-IEEQ: 54,375	52,680	Mean EIT salary [2008:6]
		52,017	Mean salary of 2005 grads [2008:11] (peer cohort)
		54,803	Mean salary of 2002 grads [2008:11] (closest $ match)
IEEQ3	Co-op: 40,000	49,904	Mean EIT salary [2007:6]
	9-mth post-IEEQ: 51,250	52,680	Mean EIT salary [2008:6]
		47,551	Mean salary of 2006 grads [2008:11] (peer cohort)
		52,017	Mean salary of 2005 grads [2008:11] (closest $ match)
	24-mth post-IEEQ: 56,192	Comparison data not available at time of writing	
IEEQ4	Co-op: 42,000	52,680	Mean EIT salary [2008:6]
	9-mth post-IEEQ: 55,000	Comparison data not available at time of writing	

Notes

1 Source of comparison is the APEGM Annual Salary Survey reports for the years 2005 through 2008, available on-line at http://www.apegm.mb.ca/practice/infomem/index.html.

2 Source notation: [x:y] where x = year of publication of salary survey and y = table number referenced in the survey. The 2005 salary survey, for example, reports salary data collected in 2004.

Table 4.11 summarizes the self-reported employment classifications of IEEQ participants, and compares them to self-reported employment classifications of APEGM members (both EITs and P.Engs.).

Table 4.11
Employment Classification Comparisons between Respondents and APEGM Members

Classification	IEEQ cohorts' average points rating[1] at 9 mths post-IEEQ	IEEQ cohorts' average points rating[1] at 24 mths post-IEEQ	Comparison points rating	Notes and source of comparison[2]
Duties	34	55	37 112	EITs Engineers
Recommendations, Decisions, and Commitments	63	70	67 107	EITs Engineers
Supervision Received	48	51	53 75	EITs Engineers
Leadership Authority and/or Supervision Exercised	8	12	13 39	EITs Engineers

Notes
1 Average ratings (all cohorts) reported on Table 4.5 as correlated to points in the APEGM Classification Rating Guide (available on-line at www.apegm.mb.ca/practice/infomem/salarydocs/class-rat.pdf)
2 Average of APEGM Salary Survey reports 2005 through 2008, Table 15.

At nine months post-IEEQ, the self-reported employment classifications of IEEQ graduates were generally comparable to those of EITs in the categories of: Duties; Recommendations, Decisions, and Commitments; and Supervision Received, and significantly below the classifications of professional engineers in the same categories. The classification rating for IEEQ graduates was notably lower than the rating for professional engineers as well as the rating for EITs in the category of Leadership Authority and/or Supervision Exercised, indicating that IEEQ graduates were generally providing only occasional work direction to others and none had continuing supervisory responsibility.

At 24 months post-IEEQ, IEEQ graduates had overtaken EITs in the self-reported classification of Duties in employment, but remained comparable to EITs in the classifications in the categories of: Recommendations, Decisions, and Commitments; Supervision Received; and Leadership Authority and/or Supervision Exercised. At 24 months post-IEEQ, IEEQ graduates' employment classifications remained significantly below the classifications of professional engineers in the same categories.

Despite having varying years of engineering experience in their home countries prior to immigration to Canada, including at times senior supervisory roles, the nature of IEEQ graduates' employment is generally comparable to that of EITs or early-career engineers in Manitoba. However, the data do not indicate whether these classification ratings indicate the full capacity of the IEEQ graduates' professional contributions at the given point in time, or whether IEEQ graduates are being underutilized in the workplace. The data also do not indicate what, if anything, is the limiting factor in the IEEQ graduates' employment classifications (e.g., technical knowledge, language skills, cultural knowledge, etc.). The discussion in Chapter 5 proposes the context of social and cultural capital as a means of interpreting these outcomes.

The Qualitative Narrative

Participants' Perceptions and Experiences

In support of the research objective of carrying out an exploratory, participant-oriented study, the qualitative data illuminate a narrative of participants' perceptions and experiences of their involvement in the IEEQ Program, and their subsequent adaptation

to and integration into the Canadian engineering profession over time. The narrative emerges out of data collected longitudinally over multiple cohorts and via multiple instruments. It is outlined below, and representative quotes provide a glimpse of the richness of the data set.

In reflecting back to their participation in the IEEQ Program, participants were able to acknowledge entering the IEEQ Program with deeply private feelings of fear and anxiety. The anxieties varied between individuals, but spanned feelings of potential inadequacies in a variety of areas, including technical abilities, language and communication abilities, the transferability of their non-Canadian education and prior experience in the new environment, and their ability to fulfill the expectations of an employer. These fears and anxieties, held at the time of participation in IEEQ, were only disclosed in retrospect, several years post-IEEQ, with the benefit of elapsed time and having reached personal success milestones in the interim years. One participant expressed these anxieties as follows: *"At the beginning I was really afraid about the challenges and the language, also I was worried that my technical level would not be enough,"* while another commented, *"To be given that opportunity in the workplace was exciting, challenging, and a little bit scary."*

Both in the university courses, but more so in the co-op work experience terms, IEEQ participants experienced technical challenges that they felt to be commensurate with their qualifications, received support, and were treated as a peer professional by their other engineering colleagues. At times, participants described these experiences with a hint of surprise: *"I wasn't expecting to be assigned complex tasks to do on my own unsupervised and to be treated as a full-fledged engineer."* This comment came

from a civil engineer working for a small, private-sector consulting firm. An electrical engineer working in a large, public sector organization similarly remarked,

> *The people in my workplace were friendly and gave me a lot of help for my adaptation to the new working atmosphere. My colleagues always gave me much valuable advice in my job, and as well encouraged me to share my past experience. Canadian technical people value the experience and skill from all over the world.*

Through the courses and co-op experiences, participants reflected on the growth that they identified in themselves. This growth was self-identified both in technical skill areas, and in learning the broader scope of the professional engineering identity in Canada. While there was a strong realization that previous technical knowledge was appropriate and applicable to Canadian professional engineering, technical skill development was also identified, both as expanded knowledge in one's field, as well as learning new applications of existing knowledge to Canadian engineering contexts. For example, one participant commented, *"Technically, there are not too many differences between the industrial environments I come from. The difference is here we can afford the latest technology, which is extremely motivating to keep my engineering abilities technologically updated,"* while another echoed the sentiment, *"Most tests were similar to tests previously used, however the compaction testing equipment using Proctor values was something new."* Others identified that their work experiences within the IEEQ Program had given them exposure to new topics entirely, and these insights came primarily from the early-career participants in the group. An electrical engineer described,

> *I was given firsthand experience in many emerging topics in testing power transformers such as frequency response analysis. On the practical end, I have learned much about designing transmission lines using PLS-CADD and*

> *PLS-POLE software. Overall, the experience was enriching and very instructional.*

The second growth area which participants identified in themselves through their participation in the IEEQ Program was learning, understanding, and beginning to adopt the broader scope of the professional engineering identity in Canada. One participant commented, *"The idea, conception I had before of what being an engineer means … it is different than I knew it before: responsibility to clients, environment, and society, in a positive way,"* while another expressed a similar view: *"I really learned the meaning of being an engineer, the role in society, responsibilities, ethical and moral obligations. There is a social responsibility in the profession here that is not present in my home country."*

In describing the experiences over the course of the program, participants also expressed a sense of redemption in their self-confidence and of the views they held of their own competence. These views related to their self-perception of the adequacy and transferability of their engineering qualifications, their abilities to carry out technical tasks, and their abilities to conduct themselves according to Canadian professional norms in the engineering workplace. One participant in a manufacturing environment commented, *"Discussions about the design process facilitated the realization that the design parameters and processes are similar to previous work experience,"* while another participant, in describing his work as a site engineer for a large civil engineering project, remarked, "*The most enlightening conclusion was the lesson that engineering and logic transcend borders."*

In reflecting on the period of their participation in the IEEQ Program and the subsequent elapsed time since they had completed IEEQ, participants identified various

areas of changes, outcomes, and milestones they had achieved. Participants identified that their participation in IEEQ had direct and indirect effects on their professional mobility. In many cases, they were able to directly translate their co-op work terms into long-term employment within the same organization and, subsequently, use that experience to add to their competitiveness in later moving on to different jobs. In describing their career development post-IEEQ, all participants enthusiastically identified increased proficiency in their scopes of work, and approximately half of participants were able to identify minor to significant transitions in their scopes of work, moving from early experiences of almost exclusively technical roles, to roles that were beginning to include managing projects and personnel. One participant, highly motivated to seek mobility as a means of expanding experience and professional opportunities, had worked for two employers, registered as a P.Eng., and recently started his own consulting firm. This participant commented, *"I came to Canada almost five years ago, and I can't believe where I am. I learned a lot in the companies where I was, had people that I could follow."*

Employers also recognized the enhanced proficiencies over time in the former IEEQ participants in their employ, and further expressed many positive attributes of their post-IEEQ employees, including highly developed and transferable technical skills and experiences. One group of employers echoed one another's sentiments that *"IEGs generally bring vast experience on projects undertaken prior to their arrival in Canada and the ability to build on those experiences in their work in Canada. There is no problem with their understanding of the projects."* Employers also recognized IEGs' competencies in teamwork, strong work ethic, open-mindedness, and sense of

responsibility. Another employer commented, *"There seem to be two trains of thought [in employees]: what can I do for you, vs. what can you do for me? It's a different perspective, and it's very loud. [The former IEEQ students] seem to fall into the former perspective."*

Further, employers' reflections on the career progression of former IEEQ participants in their employ were heavily contextualized within the organizational approach to the Engineer-in-Training (EIT) role. Despite varying years of professional experience in the home country, former IEEQ participants appeared to be most often integrated into the organization under an umbrella of senior technical supervision and professional mentoring reflective of an early-career engineer. This finding was also supported by the self-reported employment classifications of participants, reported earlier (see Table 4.11). One employer stated, *"As long as they are EITs, they are treated as in-training, with more interface and supervision. I am not just assessing their technical capability but their interpersonal capability as well. Relationships, client services is very important to our company."* Another employer reflected on his own development as an effective supervisor to several IEGs over time, which he attributed as follows: *"The key part was that I considered him a graduate engineer, regardless of where he was from."* Overall, employers' views of the former IEEQ participants' career development carried a more muted sense than the comments of the former IEEQ participants themselves. This could simply reflect that the short term gains experienced by the participants appear attenuated when discussed within the employers' larger view of the organization, the career paths available, and the long term career development opportunities yet to be experienced over the course of an entire career.

Participants also identified professional adaptation to the Canadian professional engineering culture as an outcome over time. Often this was articulated in concrete terms that were contextualized in one's specific working context: *"…technical language, shop language, identifying good and bad, understanding the need for procedures, the meaning of documenting my work, people's safety, how to work with minimum feedback, the importance of following the rules."* Furthermore, participants identified personal satisfaction and enrichment as an outcome: *"Working with [my colleagues] has raised my personal expectations and objectives for my career as a professional engineer."* These experiences were closely related to outcomes that participants identified in their personal measures of success, in areas such as job title, job role, income, and other changes they were able to identify over time. One participant reflected on his career development by saying, *"When we came to Canada, we expected that we would be the sacrifice generation. After five years, I now think I* myself *will be able to take advantage of opportunities,"* while another participant commented, *"I'm happy with the point where I am. I love to be an engineer, I love to design. Here I have the opportunity for variety in my job."*

These outcomes, in particular related to adaptation to the Canadian professional engineering culture and the follow-on positive outcomes in personal satisfaction and career development was a pervasive theme in the data. Because it was such a strong finding, this theme is further developed in the following section of this chapter.

Critical Value of the IEEQ Program

With each data collection event (end-of-program focus group, two follow-up questionnaires, and alumni focus groups), participants were asked to reflect on the most important aspect or the critical value of the IEEQ Program, as they experienced it. This data allowed these perceptions to be tracked over time, to discern how one's participation in the program was assessed with increasing retrospect, from the time of participating in the program to a time of up to four years' post-IEEQ. The data from employer focus groups supported the findings, and data were consistent with the literature (Chapter 2).

The perceptions and experiences of the key value or critical contribution of the IEEQ Program to themselves, as expressed during IEEQ and in the first year post-IEEQ were extremely diverse and varied. Participants' responses included:

- expanded technical knowledge: *"a great educational opportunity to learn new information and new technologies in engineering;"*
- access to Canadian engineering employment: *"It opened to the door to the profession [via] the co-op term;"*
- networking opportunities: *"contact with professors and exposure to the Winnipeg network through visits to companies;"*
- support derived from other participants and program staff: *"The group support, we met together, studied together"* and *"excellent support from the IEEQ staff;"*
- development of cross-cultural awareness: *"gained understanding and tolerance of expectations"* and *"A key benefit was the gradual transition into*

the Canadian engineering perspectives through the course Practicing Professional Engineering in Manitoba;" and,

- obtaining a professional licensing credential: *"It is a provision for professional re-entry, better than the Confirmatory Exam system for immigrant engineers."*

Data from the participants furthest removed from their IEEQ experiences (alumni focus groups) revealed that, over time, the notions of the program's critical value and take-away outcomes were primarily identified along three themes: building cultural knowledge; understanding of the engineering regulatory framework; and, deriving personal value from the cohort support. While some of the benefits and value of the program articulated in the early data (nearest in time to their participation in IEEQ) became less consequential in retrospect, the themes identified in the later data (further post-IEEQ) were, in many ways, an aggregation of earlier specific articulations. These three themes arising from the data from participants were well matched by employers' views of the critical success factors for IEGs' professional adaptation and career progression.

First, participants identified the building of cultural knowledge, both of the general Canadian culture and of the professional engineering culture as a significant aspect of IEEQ's critical value. One participant commented that the most important knowledge to help transition into the engineering profession "*is the cultural knowledge, awareness of how big the differences are,"* while another commented, *"I learned the concept of multiculturalism and tolerance. My home country is very homogeneous and certain foreigners are treated very poorly,"* and *"It was a place to learn about Canadian society. [IEEQ] gave a place to try things and see how they turn out."* Employers likewise

identified the understanding of cultural differences as critical knowledge for IEGs to acquire for successful professional integration, commenting that *"We can easily underestimate the scope of differences that they encounter when they immigrate to Canada."* Employers naturally tied cultural differences to an adaptation to organizational cultures, acknowledging that *"We* do *have specific ways that we like things done,"* citing general examples such as one's approaches to authority, as well as specific examples such as a company's preferred ways of interviewing prospective employees. One employer commented,

> *In consulting, technical competency is very important and valued, on the floor too. Interpersonal skills are important, but you can always put someone else in front of the client. Other organizations are very different. What you are measured on is very different, for example the ability to influence others, negotiating, organizational politics, versus technical skills.*

While employers identified various cultural norms that IEGs needed to adapt in order to integrate into the Canadian engineering profession, employers could also readily identify characteristics of IEGs in their employ, including cultural characteristics, that were assets to the company. One employer commented, *"Having advanced degrees and more education seems to facilitate adjustment."* Another echoed, *"[IEGs] seem well-suited to out-of-the-box thinking and not work too fast to get to an answer. This is very positive. Is it due to being more resourceful? Having more life experience? Due to having* had *to adapt, both personally and professionally?"* Yet, all employers were quick to caution that it often came down to the individual person and they hesitated to assign inference across an entire group.

Second, participants identified an understanding and appreciation of the regulatory framework for professional engineering in Canada as a critical outcome, and a key factor

in their professional adaptation: *"In Canada, the standards are much higher, not technical standards, but regulatory standards, for example the right to call yourself an engineer,"* and another participant reflected on his

> *understanding of what makes an engineer – the university degree versus the licensing process. APEGM regulation is hard to understand because for many, there is no similar context in the home country. Even though there was contact with APEGM many times before entering IEEQ, it wasn't fully clear until we got it explained in IEEQ.*

Employers from various industry sectors concurred that *"Licensing is critical, especially in consulting,"* and *"Registration is so very important."* Employers further acknowledged that understanding the regulatory system and navigating the licensing process is known to be a challenge for IEGs, and one that has been known to shake IEGs' self-confidence. Employers expressed empathy for IEGs who have perceived the licensing process as communicating the message *"'Here's where you're* not *as good as a Canadian, here's where you're* lacking*'. It puts you back a bit,"* while affirming the IEEQ Program's 'difference' vs. 'deficit' model toward professional integration: *"IEEQ offers a reasonable pathway to a P.Eng. license."* At the same time, employers were quick to acknowledge changes in the regulatory process, particularly since 2008, that have improved the process and the experience for IEGs.

While the increased cultural knowledge consistently emerged as a prominent theme in all the data from participants from the time of their participation in IEEQ to the latest data collection events post-IEEQ, the appreciation and understanding of the regulatory framework only became more prominent for participants in retrospect. Participants also identified the perspective and support gained from being part of an IEEQ cohort as a critical value of the program, and this outcome was particularly evident with increased

time post-IEEQ. One participant said, *"What I found so striking were so many different perspectives on the same issue, all within our class,"* while another commented, *"You feel like you are not alone, there are more people in the same situation. Let's do it together, it is much easier than doing it on your own."*

Participants' responses on these themes reflected personal self-directed processes spanning awareness, understanding, and active adaptation. Furthermore, these ideas were encompassed within a broader discussion in which the most memorable and lasting impact of the IEEQ Program, as perceived by the participants, was the broad notion of gaining understanding of the nature of professional engineering and the identity of a professional engineer in Canada, and taking successful steps toward adaptation. This perception was expressed both generally and specifically.

Generally, participants spoke along key themes of professional responsibility and ethics, in that being an engineer in Canada "*is a big responsibility"* and "*is a complete package. You not only have to have technical skills, you have to think broader."* Participants spoke of "*learning the importance of engineering in society, the values, what it means to be an engineer,"* and coming to see that the definition of professional engineering *"is different than I knew it before. The idea, conception I had of what being an engineer means, I felt I really learned in the program, the values."* Another participant agreed:

> *When working on the shop floor with non-engineers, they apply different standards, high standards to you, and you notice right away. Not standards on your behaviour or how you dress, but standards on how you communicate, how you make decisions.*

Participants were able to identify these responsibilities and obligations, for example, in the priority of the public welfare in an engineers' work as codified engineering ethics,

and in the self-regulatory nature of the profession both at the individual level of the peer, as well as the organizational level and the reputation of the profession as a whole.

Participants were also able to identify this understanding of and adaptation to a new professional identity in context-specific ways. One participant, in particular, reflected at length about his insights as a mechanical designer in a manufacturing environment:

> *The work experience has been extremely educational in terms of fitting into the Canadian social environment at the workplace: from coming five to ten minutes early, to saying just 'morning' instead of 'good morning', or simply being a member of the employees' 'social club'.*
>
> *Regarding the technical experience itself, I would say that what I believe is the Canadian way of life: discipline and respect are the most exerted actions, therefore a procedure, a 'frame', legislation (rules and punishments) have to be made first, then everybody knows what to respond to. My background is from a country where things change at an incredible pace, where we are ready for immediate changes, while here, I started to understand the importance and benefits of having a procedure: methodologically repeating steps that proved to be successful.*
>
> *Advantages? Because everything is documented, there are easier ways to investigate past design documents or past research, and it creates a common language within the company that everyone understands. The procedure is 'safe'. Disadvantages? The process is not elastic; things that are different become difficult to be categorized and put into the process, changes are really slow.*
>
> *To understand how I see the influence of this idea in the engineering profession itself, 'the procedure' becomes the whole frame in which an engineer in Canada does his / her engineering work: the way he/she approaches a solution, the way the design is initiated, the way the drawings are done, and the way the ideas are exchanged. There is not too much creativity or out-of-the-box thoughts, but things are made 'in the language' and it is absolutely useful for the company's goal and society's safety.*
>
> *If I have to balance my work experience, I would say that I learned many things that are not in any book yet they impact my performance and position within the company, and finally understanding that the immigration adjustment process takes a long time.*

Employers also demonstrated a proactive understanding of the role and the degree of influence that they carry in an IEG's professional integration. Employers were able to thoughtfully articulate a vision of IEGs' integration as a collective responsibility of the employer and the IEG. One employer spoke extensively about this responsibility:

> *Employers need to work with that too. It can't just be a one-way street. We need to be a welcoming community, it needs to be the whole group. It is not just necessary to get the supervisor on board, but the whole work environment has to be welcoming. I was lucky that our unit saw the value of IEGs. It was [the department's] acceptance that helped the IEGs integrate. It is very important.*

Employers were further able to speak to specific employer actions that support the integration of IEGs, including a modified training program to suit the specific background and needs of IEG employees, acknowledgement and encouragement of IEGs' successes, and the need for advocacy on behalf of IEG employees. One employer recalled asking an engineering colleague to apologize to an IEEQ participant in their collective workgroup, for a comment that the IEEQ participant had perceived as a slight, while another employer recalled facing opposition for his decision to hire the IEEQ participant into a permanent position upon completion of the co-op work term. While both employers acknowledged that the experiences were challenging, both felt that it was the ethical thing to do, and neither felt that their advocacy of their IEG employee had constituted a professional risk.

The data from participants illuminates that a critical outcome of the IEEQ Program is supporting and facilitating the processes of awareness, understanding, and gradual active adaptation to a new engineering identity and knowledge of the nature and culture of the engineering profession in Canada. While this adaptation is to a great extent derived internally (within the IEG), the support and facilitation are also derived from the

IEEQ Program's content, delivery, program staff, and industry partners (employers). Language facility holds a significant key in IEGs' active and self-directed process of professional adaptation, and participants were increasingly aware of the limits and opportunities of their language as their adaptive processes unfolded over time. This significant finding is discussed in the following section.

The Role of Language

As one component of one's personal assets, the data reveal the participants' deep insights and understandings of the role that language plays in their own professional adaptation and career development. Early data (nearest in time to their participation in IEEQ) reflect a very concrete understanding of the opportunities, or conversely, the limits that language capacity imposes on one's opportunities and readiness to practice professional engineering. Participants expressed an understanding that the IEEQ Program provides an immersion into an English-speaking environment *"which is difficult, but necessary,"* with the opportunity to expand vocabulary and improve skills in reading, writing, listening, and speaking. In developing a professional identity in Canada, participants unanimously expressed that language remains the greatest barrier, even at three to four years post-IEEQ: *"It took me a good two years [in the workplace] to feel comfortable communicating. Speaking in small groups, being able to lead a conversation are skills that are appreciated in the company,"* and *"My frustration is still the language issues. For example, when I write a business letter, I can't guarantee that it doesn't have a mistake, and I hate that."* When probed, a participant expressed the view that

> *In Canada, you have to prove yourself, it is not a given. It took some time before colleagues took what I said as being valid…especially at the beginning when it is difficult to express yourself, make your points with good language and strength, so that others don't think, 'ah, whatever…'*

Employers likewise identified language as a critical success factor for IEGs' professional adaptation and career development: *"The biggest thing is English."* Beyond fluency, employers spoke of the need for IEGs to integrate communication norms, which includes such things as *"reading body language, how to approach clients, how to communicate sensitive issues."*

Later data (further post-IEEQ) reflected a much richer and more nuanced understanding of the opportunities and limits of language. Here, participants are describing links between language and underlying mental constructs and, thus, between language and identity. Specifically, participants discuss the ability to describe a construct in a way that one finds relevant and useful to one's work as a professional engineer. Participants stated, "*Language influences the thinking process, the decision process, the structure of the language , what you can say, the methods to express yourself, the perspectives you express."*

The underlying mental constructs inferred in the data included heuristics of decision-making, improvisation, risk tolerance, and notions of responsibility, reward, and professional identity. One participant commented, "*In Canada, the perceptive responsibilities are different,"* and when probed, explained "*Perceptive responsibilities to me would signify how different countries perceive their responsibility for their work different, although essentially the work [is] the same."* Other participants added specific examples to the discussion: *"We come from countries with less regulation and control,*

so we tend to be able to take more risks [in the home country] than a professional engineer can in Canada," while another observed,

> *Some things in Canada got my attention. I applied for a mortgage and I was approved for $400,000. That was unbelievable to me! When I asked 'why would you give me so much money', he said 'because you are an engineer. The rate of repayment is over 99%'. Also, I saw that the signature on passport applications has to be someone you can trust, someone you can believe, and professional engineers are part of the list.*

Another participant agreed with this comment, and added,

> *I come from a place where you don't plan your career. To me, that is a very North American approach to career. The culture, the reality of [my home country] doesn't allow you to plan long term. For example, being paid on-time by your employer is a benefit, not an obligation.*

The association between these concrete observations, the underlying constructs, and one's language is expressed in the comment of one participant: *"It could be that even having the words, [that since the practice] of the profession in our home country does not have a social role, it makes the role of an engineer in Canada difficult to describe in our home countries."*

Summary

The data begin to clarify the critical value of the IEEQ Program for the participants in terms of those factors that build awareness and understanding around, and facilitate adaptation to, the nature of professional engineering and the identity of a professional engineer in Canada. These data also support the program development spirals described in the first section of this chapter, framed in terms of action research and the engineering design process, in which increasing attention was focussed on developing and enhancing a holistic approach within IEEQ, in which program components included cultural

orientation, language development, and support structures. The findings also support the program philosophy of adopting a 'difference' vs. a 'deficit' model toward its mandate.

While it seems intuitive that the successful adaptation of IEGs extends beyond technical confirmation and technical gap-filling when required, the findings of this study challenge us to look beyond institutional recognition of foreign credentials, and to afford deeper significance to social, cultural, and linguistic elements in the professional adaptation process – that is, toward a more holistic means of conceptualizing IEGs' professional adaptation. These findings can be contextualized within a framework of personal assets or non-economic forms of capital. The findings also infer links between language and identity, which can likewise be contextualized within a framework of linguistic capital, but with further implications for an underlying engineering epistemology as well. It is these inferences that are explored in the next chapter.

Chapter 5

Discussion

This chapter begins by stating the two key contributions of this study to our collective body of knowledge with respect to the integration of IEGs into the Canadian engineering profession. These contributions are derived from the findings articulated in the previous chapter, and they are then developed further in the remainder of this chapter.

Contribution #1

The acquisition of social and cultural capital is critical to the successful adaptation of IEGs to the Canadian engineering profession. To date, FCR processes have focussed on the recognition and translation of human and/or institutional capital. In programs and processes intended to facilitate the formal professional integration of IEGs, access to and the acquisition of social and cultural capital needs to receive at least equal attention. Currently, the engineering profession has little experience with *systematically* categorizing the meaning of social and cultural capital in professional engineering, and how one successfully achieves it.

Contribution #2

It is intuitively justifiable that language fluency is a prerequisite for successful professional integration. At the surficial level, immigrants are reasonably expected to and expect to learn English vocabulary and grammar, writing - speaking - reading - listening skills, and Canadian communication formats (email, letters, reports, etc.). At a fundamental level, there is a link between language and cognition, well documented in disciplines of linguistics, philosophy, and psychology. When integrating into the engineering profession, language limits what an IEG and what a member of the dominant

community can hear and understand from one another. One cannot understand nor assimilate information for which one does not possess useful language or the underlying mental constructs. In practice, one's best efforts at giving advice and instruction to newcomers may appear to fall on deaf ears if the underlying mental constructs are absent. Conversely, IEGs actions and attitudes may appear inappropriate to the dominant community if the dominant community does not possess the mental constructs within which to interpret them.

Conversely, IEGs possess a language and vocabulary by which to express their individual and collective competencies and contributions which often find no natural audience in the new Canadian environment. It is an individual and collective excellence that remains hidden to the dominant community, but undoubtedly includes a breadth of knowledge and mental constructs that would expand the dominant community's understanding of the nature of professional engineering practice.

This link between language and cognition is also an epistemological issue that offers a unique viewpoint from which to further explore our collective understanding of the engineering body of knowledge.

Forms of Capital

Sociologists have theorized extensively that capital exists in forms other than economic. Although evident in the works of early classical sociological theorists (e.g. Marx, Wittgenstein, Weber, Durkheim), the idea of multiple forms of capital is primarily attributed to Pierre Bourdieu (1985), where capital is defined as "the goods material and symbolic, without distinction, that present themselves as rare and worthy of being sought

after, in a particular social formation" (p. 248). The ideas of multiple forms of capital benefited from subsequent development by many other theorists, key among them (in the English-speaking world) including Coleman (1988) and Putnam (2000). Some scholars suggest that social and cultural capital are as, or more, important than human capital (e.g. educational credentials) for achieving career success and mobility, especially for women and minorities (Metz & Tharenou, 2001; Ingram & Parker, 2002). This section explores forms of capital in light of the findings of the study.

Human, Social, and Cultural Capital

Human capital is most often characterized as formal education, skills, and experience: relatively tangible entities that have strong and immediate ties to the labour market. Human capital also encompasses less-quantifiable factors like one's relative literacy, psychological dexterity, physical health, and even personal connections that enhance one's productivity in the labour market. In this latter aspect of personal connections, human capital begins to overlap with characteristics of social and cultural capital. However, more than those other two forms of capital, there is a more direct correlation between investments made (education, training, etc.) and the return on investment. The value of human capital is derived both from its acquisition (e.g. holding educational credentials) as well as the prestige that the object holds (Becker, 1993).

If human capital reflects ability, *social capital* reflects opportunity. Many definitions exist in the literature, all centered on the core idea that social networks have value, and that the social network as a *contextual* factor has an impact on *individual* economic participation. Bourdieu (1985) defines social capital as actual and potential

resources based on group membership, relationships, and networks of influence and support. Social capital is a deliberately-constructed sociability, so constructed for the resources it creates. Like human capital, the value of social capital is derived from two elements: the social relationship itself (and access thereto); and the amount and quality of resources made available by the social relationship (Portes, 1998).

Within social capital, Portes & Sensenbrenner (1993) articulate four specific types of expectations. The first of these is value introjections, defined as socialization into consensually established beliefs. Value introjections are reminiscent of Green's (1985, 1999) discussion of the formation of a moral conscience, and more specifically of conscience as membership, or the strong norm acquisition that characterizes moral practitioners. Second, the expectation of reciprocity transactions within social capital refers to the norm of reciprocity in interactions, focused on social intangibles such as favours, information, and approval. Third, bounded solidarity within social capital refers to situational and reactive sentiments of the group, or situational circumstances that can lead to principled, group-oriented behavior, often arising out of circumstances of common adversities. Finally, enforceable trust is an expectation within social capital in which individual members subordinate their present desires to collective expectations, in anticipation of advantages by virtue of group membership. The first and third expectations – value introjections and bounded solidarity – are expectations within social capital that come out of a *principled* focus. The second and fourth expectations – reciprocity transactions and enforceable trust – are expectations within social capital that have a clear *instrumental* orientation. The third and fourth expectations – bounded

solidarity and enforceable trust – are theorized to be particularly clearly manifested in a sociological analysis of immigrant communities (Portes & Sensenbrenner, 1993).

Beyond individual benefits and opportunities, social capital – here understood as access to, mobility within, and membership within social networks – is often held up for its collective benefits, including civic engagement, consensus building, and collective action (Putnam, 2000). Portes (1998) also discusses negative potential functions of social capital, including social control and restrictive gate-keeping, constraints on individual actions and freedoms, and intra-group leveling pressures to keep members of downtrodden groups in the same situation as their peers.

Finally, *cultural capital* is defined as social relations within a system of exchange that includes the accumulated cultural knowledge, along with the power and status that such cultural knowledge confers. Cultural capital can be thought of as forms of knowledge, skills, education, and advantages that a person has which gives them a higher status in society (Bourdieu, 1985). Bourdieu articulates three sub-types of cultural capital – all of which share the critical perspectives that cultural capital is a mechanism of power and is a major factor in social and economic mobility.

First, cultural capital can exist in an embodied state within an individual, consisting of inherited and acquired properties of one's self. This is strongly linked to the concept of *habitus*, discussed later. Linguistic capital is a specific form of embodied cultural capital, referring to mastery of and relation to language, and encompassing subtleties of accent, grammar, spelling, and style. Second, cultural capital can exist in an objectified state, or as cultural goods transmitted physically. Objectified cultural capital derives value both from the artifact itself but, crucially, on the individual's ability to understand

its cultural meaning (e.g. artwork). Finally, cultural capital can exist in an institutionalized state, as in the institutional recognition of cultural capital held by an individual, most often understood as academic credentials or qualifications.

Human, social, and cultural capital are intertwined and often transition into one another. For example, Portes (1998) describes how people with desired types of cultural capital (for example, linguistic capital) transform this into social capital with agents who can transmit valuable resources. Conversely, through social capital – contact with experts or affiliations with institutions that confer valued credentials – people can increase their cultural capital.

The concept of habitus, also developed to its current state by Bourdieu, is closely related to cultural capital. Habitus has been variably defined as an acquired system of durable dispositions, perceptions, and schemes of thought and action common to all members of the same group, and which become the basis of structured and objectively unified action and practice within the group. Habitus is said to engage the most fundamental principles of an individual's construction and evaluation of the social world. Habitus is derived from the internalization of culture and social structures through experience; it provides the practical skills and dispositions necessary to navigate within different fields. Habitus guides the choices of an individual at an intuitive or heuristic level, without being reducible to formal rules (Bourdieu 1977, 1984). Habitus can be seen as lying between deterministic social structures (context-specific capitals) and personal agency and autonomy.

These definitions and descriptions of human, social, and cultural capital and of habitus provide the basis from which to draw applications to the study on the IEEQ Program.

Applications to this Study

While much has been written about the role of education in building social capital and, conversely, the role of social capital in gaining access to educational circles, there is also a literature on the roles of capital in the experiences of minority groups. Metz and Tharenou (2001) investigated the relative roles of human and social capital in women's advancement in the male-dominated banking industry in Australia, as an example of how the field of gender studies has demonstrated that men and women's income and position are related to both forms of capital. Within immigration literature, there are attempts to illuminate the social and institutional forces that – in addition to human capital – influence the immigrant integration experience (Girard & Bauder, 2007).

In an exploration of the immigrant experience in the engineering profession in Ontario, Canada, Girard and Bauder (2007) view the P.Eng. license (validated credentials) as institutionalized cultural capital. They focus their argument on a view that Professional Engineers Ontario (PEO) regulates the engineering profession in that jurisdiction, in part, on the basis of habitus, and thereby presents a systemic barrier blocking IEG access to the engineering profession. In the article, habitus is defined as knowledge of the professional culture: professional codes of conduct; professional ethics; professional workplace behaviours; and, business practices in the Canadian context. In part, the authors argue that habitus is impossible to acquire prior to arrival in Canada and that, for IEGs, the unfamiliar habitus of the engineering profession in Canada

is a greater obstacle to gain access to the profession than writing technical exams. The authors take an overtly negative slant to the licensing process within PEO, and an explicit view that an acquisition of the specific habitus of the engineering profession in Canada is not a legitimate expectation to hold of newcomers. In their focus on institutionalized cultural capital (recognition of foreign credentials) and habitus, the authors also neglect to consider the impact of other forms of cultural capital, in particular, linguistic capital.

Taken together, however, the literature on forms of capital illuminates several potential applications to participants' experiences in the IEEQ Program, and in participants' processes of overall adaptation to the engineering profession in Manitoba.

Federal and provincial immigration processes are oriented toward the quantification of human capital (formal education), and the subsequent selection of successful applicants for immigration on those metrics. The initial process of FCR with the engineering regulatory body represents a translation of human capital into institutionalized cultural capital, by seeking a demonstration of academic qualification as a means of conferring institutional recognition (often through a set of technical exams labeled as 'confirmatory'). While the FCR process is intended to create institutionalized cultural capital, the literature review (Chapter 2) indicates that institutionalized cultural capital does not necessarily facilitate the acquisition of social capital and other forms of cultural capital in the engineering profession, and that true opportunities at re-entry into the Canadian engineering profession remain limited.

Like other FCR processes, IEEQ was also initially conceived with a focus of translating human capital into institutionalized cultural capital: a validation of non-Canadian university credentials through an alternative process, with a secondary value-

added component of Canadian engineering work experience. Through the study data, the IEEQ participants and employers have indicated that the critical value of IEEQ has been in the awareness and facilitation of both social and cultural capital for IEGs, and in the acquisition of the habitus of professional engineering in Canada. In addition, employers have recognized their influence as gatekeepers to social and cultural capital within the engineering profession, in the power they carry to either perpetuate structural constraints or create access for IEGs.

Metz and Tharenou (2001) identified concrete examples of social capital as social networks, mentoring relationships, career encouragement, and personal tactics. The ongoing development of IEEQ has centered on these and other aspects that fall under the umbrella of social and cultural capital: primarily, the building of cultural knowledge (the habitus of the profession), deliberately-created sociability among IEGs and between IEGs and the dominant engineering community (planned interaction and networking opportunities), and language and communication skill development.

Language and communication skill development has proven to be an increasingly critical focus in the IEEQ Program year over year. At times, this has been viewed grudgingly, with the university's and the profession's perspective that language is a separate, stand-alone skill area that should be addressed apart from (and preferably prior to) the FCR process that IEEQ represents, and that any focus on language development within the program is remedial in nature. Cultural capital provides another way to understand this issue by elevating linguistic capital to the same level as other forms of cultural and social capital as critical facilitators of professional engineering identity and

integration. It is a significant insight of this study, with epistemological overtones which are discussed in the next section.

Language and Identity

The role of language in meaning-making is an extensive and developed area of intellectual thought and inquiry. It is not possible to do justice to its breadth and depth in this section, and these comments are limited to contextualizing the role of language development of IEGs beyond grammar and vocabulary, and language's role in facilitating other forms of capital and the professional engineering habitus.

From the fields of science philosophy and psychology, a perspective has emerged that – aligned with critical theory – language *shapes* one's reality, rather than merely *describing* one's reality. Thomas Kuhn (1990, 2000) eloquently develops the notion that words, the meanings we give them, and the world we describe by them are all circular, in that language terms create and define conceptual groups (mental constructs), which in turn give structure to how we define reality and see the world. As example, Kuhn asserts that in the development of Newton's Second Law F = ma, the definitions of F (force) and m (mass) are circular, in that "one cannot learn how to use either one without simultaneously learning how to use the other" (1983, p. 566). He speaks of the world as being mind-dependent: "Conceptually, the world is *our* representation of *our* niche" (1990, p. 11), further arguing that niches both create and are created by the conceptual and instrumental tools of their practitioners (in which Kuhn often refers back to the context of individual natural science disciplines). Niches are as solid, real, and resistant

to arbitrary change as the external world was once said to be, and are not independent of mind and culture.

Kuhn is not alone in these perspectives. Einstein's philosophy evolved over various phases of his working life in relation to the question of how far mental constructs are correlated to sensory evidence but, in later years, Einstein held firmly to the view that a formal theory is freely invented by the mind, rather than objectively describing the facts of experience. In Einstein's view, theories determine what one can observe, by which he meant that mental constructs restrict the freedom of the scientists, so that only certain kinds of information can be obtained and counted as valuable and real (Campbell, 1982).

These ideas stand in contrast to a view of the world as being mind-independent, or an objective reality. In relation to language and communication, Kuhn argues that communication across niches can be difficult, and direct translation is often not possible. When underlying mental constructs are too different from one another to facilitate direct and meaningful translation, the niches are said to be incommensurable (1990, 2000). Kuhn further states that niches have lexicons associated with them, and "the lexicon supplies preconditions of possible experiences" (1990, p. 12). In other words, things which cannot readily be said in a language are things that the speakers do not expect to have the need or occasion to say. Campbell (1982) likewise asserts that language "does not wear meaning on its sleeve" (p. 162), but that beneath the spoken word lie abstract structures, or a set of rules by which humans give form and sense to their universe. Wittgenstein echoes this concept when he states, "Die Grenzen meiner Sprache bedeuten die Grenzen meiner Welt [The borders of my language define the borders of my world]" (Wittgenstein, 1921).

Applications to this Study

Reflecting on the concepts of capital, and in particular on linguistic capital as a subset of cultural capital, the current study provides insights into the role of linguistic capital in the acquisition of an engineering habitus. It is intuitively rational that one needs to have an advanced level of language competency in order to be able to practice effectively in a profession. Generally, though, one considers this at a surficial (yet indispensable) level: offering IEGs classes to develop vocabulary, learn grammar rules, and practice oral and written communication in various media and formats, and with a focus on occupation-specific language. This study extends these insights through the data from IEG participants that link language, identity, and cognition, or the mental constructs by which one defines one's world – in this case, one's professional world. When asked to reflect on the critical value of the IEEQ Program, the responses comprise the Canadian engineering habitus, and the IEEQ Program's role in facilitating this habitus. It is also this habitus that participants find most difficult to describe and compare to the engineering habitus in their home countries. This is demonstrated, for example, in their insights that for many participants, since the profession in their home countries does not have a social role (e.g. protecting the public welfare), it makes the role of an engineer in Canada difficult to describe to family and friends that remain in their home countries.

These ideas hold potential applications to the engineering body of knowledge as part of an engineering epistemology. This study supports the notion that when educators and employers speak of needing to develop 'soft skills' or 'professional skills' in students and early-career engineers alongside their technical skills, they are referring to the

acquisition of an engineering habitus, which is often more subtle and less quantifiable than a defined curriculum in (for example) professional ethics, team skills, communication skills, project management skills, etc. By associating our typical notions of 'soft skills' or 'professional skills' with an engineering habitus, one can legitimately draw the engineering habitus into the engineering body of knowledge.

While Girard and Bauder (2007) explicitly see the requirement to acquire the engineering habitus as a systemic barrier faced by IEGs, it could also be argued that the ability to function effectively as a professional engineer depends on this context-specific, heuristic knowledge, skills, affective approaches, and patterns of thought. This view then challenges the typical notion of the 'transition penalty' often referenced in the literature on the integration of immigrant professionals. From a perspective of human capital alone, there is indeed a penalty associated with immigration with respect to regaining pre-immigration status according to metrics of income, job title, and the like. However, if one encompasses the acquisition of habitus, and more broadly the acquisition of social and cultural capital as critical professional resources and knowledge, and acknowledging that these forms of capital take significant periods of time to acquire, then the concept of a 'transition penalty' is challenged or mitigated.

An additional extension is that by locating habitus within the concepts of capital, one can associate social and cultural capital with an engineering epistemology as well. This supports our existing tacit understanding that certain aspects of engineering knowledge, identity, and practice competence are heuristic, context-specific, and culturally-dependent. Social and cultural capital provide one possible framework by which to understand what we take to be true and real knowledge in the engineering

profession, and these capitals further represent the knowledge assets that IEGs must acquire in order to fully understand, be understood by others, and operate effectively within the Canadian engineering profession. Kuhn asserts that "What is at issue […] is the shaping of cognition by language, a point by no means epistemologically innocuous" (1982, p. 713).

In summary, the idea of various forms of capital and habitus provide a mechanism by which to understand the holistic goals, delivery, and outcomes of the IEEQ Program. This appears to be validated by its participants, which may contribute to an explanation for the success that has been anecdotally and formally extended to the IEEQ Program. Further, the specific concept of linguistic capital provides a framework to understand the role of language development beyond grammar and vocabulary and, in particular, its role in facilitating other forms of capital and the professional engineering habitus.

Further Thought and Research

The study raises numerous interesting directions for further thought and research, of which four are highlighted below. First, Portes and Sensenbrenner (1993) name several negative potential effects of a strong social capital within the minority community living within a larger dominant community. These negative effects included social control, constraints on individual actions and freedoms, and intra-group leveling pressures to keep members of downtrodden groups in the same situation as their peers. Extended to the engineering profession, one may hypothesize the extent to which a group

that has collectively faced higher barriers to licensing than other immigrant groups[1] may exert these leveling pressures on those within the minority community that do manage to be successful in the dominant community.

More importantly, though, social capital theory raises the question as to what extent social capital within the minority community limits or discourages social capital building in the dominant community. Portes (1998) implies a reciprocity between the investment in social capital in the community of origin (minority community) and an individual's ability and resources (physical, mental, emotional) to invest in the social capital of the dominant community. This raises the possibility that within immigrant communities with strong internal social capital, sanctions are levied on those who extricate themselves from that social capital. In effect, it leads to the reality of an exchange of social capital in one community for another, of which the personal costs have not been investigated within the context of the professional integration of IEGs.

Second, this study was framed within an interpretivist theoretical approach (refer to Table 3.1), out of which emerged a qualitative methodology. However, the discussion on forms of capital, and linguistic capital in particular, have highlighted the contributions of critical theorists such as Bourdieu, Kuhn, and Wittgenstein in interpreting the findings of this study. Critical theory, emerging out of the Frankfurt School of philosophical thought, has evolved to encompass a broad range of social science theories that share a radical focus, a critique of domination, and an emancipatory goal. Common examples include feminist theory, disability studies, and liberation theology. In addition to the traditional demand of social science theories to be explanatory (explaining what is wrong

[1] For example, due to characteristics of a country's educational system, IEGs from certain countries may consistently be assigned additional requirements for licensing eligibility in Canada than IEGs from most other countries.

with current social reality), critical theories are also practical (identifying actors to change current reality) and normative (providing clear norms for criticism and achievable practical goals for social transformation). Critical theories are said to be verified through increasingly democratic practice. Critical theory offers a little-used theoretical perspective when exploring issues of engineering education and professional practice, which in the future can complement existing theoretical perspectives and their concomitant methodologies and insights. For example, critical theory is concerned with the rejection of binaries. Research questions such as, 'what differentiates successful IEGs from unsuccessful IEGs' can be reframed to ask 'how do IEGs define success?' or 'how does the dominant community define a successful IEG?'

Third, within critical theory there is an emphasis on critical knowledge, defined as knowledge oriented toward self-reflection and emancipation. This implies that the emancipatory focus is internally-derived (originating from within an individual or a community). This leads to the question of the extent to which a third party (for example, a regulatory body) can exercise critical theory for another individual or group. Within the engineering context, this implies that IEGs need to be actively involved in the design of any processes that are intended to have ultimate emancipatory outcomes. Such processes may include the revision of the regulatory body's assessment policies and practices, and the delivery of processes, programs, and other opportunities for professional integration.

Finally, economics-minded individuals may be interested in exploring how the findings of this study relate to economic mobility theory. As North Americans, we claim to live within a meritocracy, wherein *individual* ability and the willingness to work to

develop that ability will be rewarded. In doing so, we assume that success is related to individual characteristics. However, economic mobility studies come to some common conclusions: trends in income persist across generations; trends in wealth persist across generations; economic mobility trends are not independent of ethnicity; and, education is not as great an equalizer as one may like to think (Isaacs, 2008; d'Addio, 2007; Corak, 2006).

Economic mobility theorists also acknowledge that economic mobility rests on subtle, intangible, and indirect influences, as well as on social institutions. Gladwell (2002, 2008) reinforces the notion that because we so profoundly *personalize* success, we miss the *systemic* factors – of which we are all a part – that create opportunity and advantage for individuals. These systemic factors include everything from the values of the world we inhabit, the rules we choose to write as a society, and the people that are most likely to cross our paths through subtle processes of selection and streaming.

Therein, economic mobility is reasonably linked to various forms of personal capital assets, with varying degrees of personal control. One often has the greatest degree of personal control over the acquisition of human capital, whereas access to social and cultural capital often depends on a third party and serendipitous opportunity. Only upon this intervention (i.e. opportunity and facilitated access) can an individual exercise self-directed and active acquisition of the capital. A question arises as to whether meaningful and persistent economic mobility is possible without this facilitated access to capital acquisition. Economic mobility studies do indeed focus on long-standing minority communities (e.g. African Americans and Hispanics in the U.S.) as well as the general immigrant experience. However, the immigrant professional, of which the IEG is one

example, is a fairly new type of immigrant in North America, and perhaps deserving of more attention in this regard.

One could develop an argument that one's economic position and mobility, to the extent that it is related to individual characteristics, including those within and those beyond one's personal control, is overall a deterministic process. In this context, the role and success of IEEQ may be tied to its interventionist function, in introducing an element of non-determinism or opportunity into the otherwise normative process of professional mobility for IEGs. Thereby, IEEQ may increase the chances of meaningful professional adaptation and career development (i.e. economic mobility) for participants, as compared to IEGs involved in less interventionist processes. Overall, however, we do well to heed Gladwell's caution against becoming too confident in our perceptions of understanding how and why success occurs. Whether it is for a program such as IEEQ, or for an individual such as an IEG, the systemic influences are more subtle and the serendipitous timing of opportunities more random than our empirical way of seeing the world cares to acknowledge.

Chapter 6

Conclusion

This study has outlined an exploratory, participant-oriented evaluation of the University of Manitoba's IEEQ Program, for both formative and summative purposes. Built on an interpretivist theoretical approach that supported a primarily qualitative methodology (with selected quantitative elements), the research questions were developed to discover IEEQ participants' perceptions and experiences in the IEEQ Program, and IEEQ participants' outcomes in the IEEQ Program relative to IEGs in the traditional Confirmatory Exam pathway for licensing. An additional focus was to explore employers' experiences with former IEEQ participants within their organizations. The study was grounded in focus group interviews, follow-up questionnaires, participants' reports, and program records for data collection, with inductive data analysis for qualitative data and descriptive statistics for quantitative data.

The findings yielded rich understandings of participants' experiences in the IEEQ Program, their outcomes relative to IEGs pursuing other licensing pathways, and their perceptions of their own adaptation to the Canadian engineering profession. The findings demonstrated many areas of common perceptions between IEEQ participants and employers, as well as congruence with the literature. These findings were framed in discussions of human, social, and cultural capital and habitus, as well as discussions of the relationship between language, identity, and epistemology.

Specifically, the study suggested that many FCR processes have tended to focus on the recognition and translation of human and/or institutional capital, yet access to and acquisition of social and cultural capital needs to receive equal attention, with the inference that the engineering habitus is part of the professional body of knowledge. Further, the study suggested that while it is reasonable that language fluency is a pre-

requisite for successful professional integration, there is also a fundamental link between language and cognition that is not insignificant in the professional adaptation process. IEGs and other professionals cannot understand nor assimilate information for which they do not possess useful language or the underlying mental constructs. At the same time, IEGs possess a language and vocabulary by which they can express their individual and collective excellence, which often find no natural audience in the new Canadian environment and, thus, remains hidden to the dominant community.

At time of writing, the IEEQ Program at the University of Manitoba continues to be a unique model for foreign credentials recognition of IEGs in the Canadian engineering profession. While there are other potential IEEQ-style programs in development or under consideration in other jurisdictions, the only direct parallel program exists at Ryerson University in Ontario, Canada. As such, the IEEQ Program is an initiative for which the university as an institution has no prior mandate, and for which the institution and the engineering profession have limited experiential history to serve as a guide. The delivery of a regulatory function within an academic institution for a profession that itself combines a depth of theory and breadth of practice is resonant with the emerging perspective that

> *Engineering education is both intellectual and practical, both creative and ethical. This very complexity makes the education of engineers a particularly strategic site for applying the new sciences of learning, […] and in turn contributing new understanding to those very fields* (Shulman, 2005, p. 11).

Postscript

Sometimes it seems as if a thesis will never end. At times, this is a discouraging feeling, reflective of the scope of the task and the work left to be done. At times, it is an optimistic feeling, reflective of the interesting roads that could be explored further and new roads waiting to be discovered. Like any complex challenge or life circumstance, the opportunity is in the journey, rather than the end. During the process of this thesis, I often thought of these reassuring words:

It's two steps forward, three steps back.
Then you turn around, and it's three steps forward, two steps back.
In the end, somehow you get there.
-G.S.

Thanks for reading this far.

Best wishes in all your own journeys of the heart & mind.

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Appendix A

Framework for a Manitoba Strategy on Qualifications Recognition
(Province of Manitoba, 2007a)

The entire document is available from: Manitoba Labour & Immigration, Immigration and Multiculturalism division, 500 – 213 Notre Dame Avenue, Winnipeg, Manitoba, Canada, R3B 1N3.

Summary of Principles

Guiding Principle of the Framework: the Government of Manitoba should take the leadership role to ensure the development of a Manitoba Strategy to address the issue of qualifications recognition and entry to practice of highly skilled immigrants.

Principle 1 – Manitoba should ensure highly skilled immigrants have access to the information and resources necessary to prepare for qualifications recognition and entry to practice in a timely manner.

Principle 2 – Manitoba should ensure that assessing bodies are accountable for their practices and that they observe the principles of substantive equality in their assessment and recognition of highly skilled immigrants. Determination of both eligibility for assessment and recognition of qualifications should be fair and equitable while maintaining appropriate occupational standards.

Principle 3 – Manitoba should ensure that there is co-ordinated capacity for highly skilled immigrants to enter their occupations in an efficient and equitable manner.

Principle 4 – Manitoba should encourage partnerships / co-operation for further action including models of best practice.

Principle 5 – Manitoba should enter into joint initiatives with other levels of government where appropriate and advantageous.

Principle 6 – Manitoba should make certain this initiative can be sustained as a priority among stakeholders, and that attitudes and approaches that are significant barriers to the initiative can be overcome.

Principle 7 – Manitoba should encourage support and involvement from the public and the assessing institutions.

Manitoba Qualifications Recognition (QR) Action Strategy.

1. the Government of Manitoba's intention is to ensure the development and the realization of a Manitoba Strategy to address the issue of QR and entry to practice of highly skilled immigrants. To expect buy-in and support from regulating

bodies, post-secondary institutions, employers, other levels of government and the public, it is critical that the Government of Manitoba lead by example.

2. In order to be successful in making significant and necessary systems changes, we must continually encourage support and involvement from all relevant stakeholders, including the public, employers, post-secondary institutions and regulatory authorities.
3. Responsibility for address the issue of QR of highly skilled immigrants rests with these key stakeholders. In order to ensure much needed changes take place outside of government, involvement and action is needed by these groups.
4. It is important that Manitoba ensure that assessing institutions are accountable for their assessment practices and that they observe the principles outlined in the *Framework for a Manitoba Strategy on Qualifications Recognition.*
5. Assistance to skilled immigrants with information, advice, and guidance as they navigate their entry into their occupations in Canada is required and in the majority of these cases, one-on-one support to ensure their successful integration.
6. a means to address gaps that stand as barriers to qualifications recognition and entry to practice are important. They should be co-ordinated and accessible in a timely manner.
7. Manitoba should enter into joint initiatives with other levels of government where appropriate and advantageous.
8. In order to support licensing and successful workplace entry and integration, it is necessary that immigrants have access to financial resources.
9. Demonstration projects originated by and/or involving regulators, post-secondary institutions, government, and employers – the key players in QR – are required to allow stakeholders to test ideas and potential solutions to address the barriers to QR following the principles outlined in the *Framework.*

Appendix B

From Consideration To Integration – A project of Engineers Canada (www.engineerscanada.ca/fc2i)

Final Recommendations from Phase II

Research

The profession acknowledges the need to better understand IEGs and the employment market into which they are immigrating. To that end, there are three recommendations focussing on research:

i. **Track all applicants, including IEGs, throughout the licensing system.** Understanding how effectively the licensing system is being navigated will permit the profession to determine where candidates are having difficulty, and where problems seem to be specific to IEGs.

ii. **Conduct research to determine the factors leading to low licensure uptake.** In most regions of Canada, very few IEGs apply for licensure, relative to the number who immigrate. Understanding the rationale behind not applying for licensure could have implications for the profession and help explain the perceived and real value of the P.Eng./ing. It is important to study both IEGs and CEAB graduates so that issues common to both groups can be identified, as well as those unique to IEGs.

iii. **Undertake an engineering labour market study that also develops models to provide current and ongoing labour market information, including maintenance and dissemination.** Human Resources and Skills Development Canada (HRSDC, the former HRDC) has financed labour market studies for other sectors, and defines them as "forward-looking analyses of current and future human resources development needs, issues and challenges facing a particular industry or occupation, such as the supply and demand of skilled labour, the impact of changing technology, the need for skills upgrading and the adequacy of existing training." It is this type of study that the Steering Committee is recommending. The Steering Committee also sees that the labour market study will involve developing the tools that will allow the profession to have accurate, up-to-date Labour Market Information over time after the study is completed.

Information, Culture and Language

Having access to clear, accurate information, understanding cultural issues and being able to communicate effectively are all key issues for IEGs. This set of recommendations addresses these issues:

iv. **Provide accurate and consistent information about the engineering profession, licensing process, employment situation and IEG support agencies, prior to and after arrival in Canada.** Such information could be on the web or in print where practical and necessary. It is also important that the content for any information piece is supplied by the agency most appropriate to do so. Licensing information, for example,

should come from the regulatory bodies while information on employment or language would come from other agencies. Providing accurate information would also entail being upfront with candidates who are clearly not going to be able to practice as engineers in Canada, and referring them to the associations representing, for example, technicians, technologists or architects. Finally, information – both its content and delivery – must be culturally sensitive, respecting the backgrounds of the IEGs coming to Canada.

v. **Provide a single source of engineering information on the Internet for IEGs; do this through the Going to Canada portal which would link to regulatory bodies' sites.** Many IEGs turn to the Internet for information about the licensing process. Being able to direct them to a single, credible portal would make the information search process much easier and help demystify the licensing process.

vi. **Determine and implement effective relationships between settlement agencies and regulatory bodies to enhance communication and information exchange.** In some regions, the relationship between settlement agencies and the regulatory bodies is well-established and effective, while in others there is simply no relationship at all. Given the influential role that these agencies play in the lives of IEGs, it is crucial that IEGs be able to rely on the information provided to them by the agencies. That information is much more likely to be accurate if the agency obtains it from the regulatory body. It would be up to each regulatory body in conjunction with the agency, to determine the nature of the relationship.

vii. **Make information available at the regulatory body to IEGs in a simple, timely, personal, easy-to-access manner.** Throughout the Phase II process, IEGs referred to the difficulty they had in understanding the role of the regulatory bodies, and in their inability to "just talk" to someone. While the original recommendation had been for the regulatory bodies to provide a single point of contact for IEGs to help them navigate the licensing process, it is recognized that this may not be practical in all jurisdictions. This revised recommendation places an emphasis on taking a customer service approach, so that IEGs feel well-served by the regulatory body, rather than seeing the body as an impediment to their being able to find work or achieve licensure in Canada.

Licensing

The licensing process is seen as unnecessarily difficult and lengthy by many IEGs. This set of recommendations addresses those concerns, while maintaining rigorous standards so as to protect public safety:

viii. **Develop and set a language standard to ensure IEGs have the appropriate level of English or French proficiency to navigate through the licensing process.** This recommendation recognizes that the regulatory bodies are not responsible for language testing. Instead, a Phase III project would involve determining what the language requirement should be to work one's way through the licensing process. Once this has been determined – and it may differ for oral, written, and reading skills – it should be clearly communicated to IEGs so that
they can then present the regulatory bodies with proof of their having met the standard.

ix. **Permit IEGs to prepare for and write the PPE at any time during the licensing process.** Allowing IEGs to write the PPE at any time inserts more flexibility into the licensing process, and by preparing for the PPE before immigration, IEGs may become more aware of the Canadian manner of conducting business and working on teams.

x. **Establish an accurate, current database of recognized non-CEAB degrees and institutions that will be used in a consistent manner in the licensing system.** The form that this database will take is a key Phase III project. Working with the regulatory bodies, criteria for inclusion on the list would be determined, and various levels of degrees would also likely be determined (so as to differentiate CEAB and Washington Accord degrees from others). It is also key that the database, once established, remain current and be used consistently by all regulatory bodies.

xi. **Study the feasibility of alternative systems of evaluating an applicant's professional competency for licensure in comparison with the current Canadian system.** While there has been discussion about moving towards a competency-based system, there may also be other systems to which the profession should look to determine if the current licensing process can be streamlined without putting public safety at risk.

xii. **Determine and implement the elements of the licensing process that can be done pre-immigration.** While some regulatory bodies already provide this flexibility, it is not consistently offered. Being able to work through much of the licensing process pre-immigration will certainly streamline the system, permit IEGs to recognize what is involved in the process before they immigrate and save time for IEGs once they arrive in Canada.

xiii. **Implement an interim approval mechanism at the regulatory bodies that will indicate to employers that the applicant has met all requirements for licensure except the one year of Canadian experience (e.g. provisional licensure).** IEGs have consistently said that obtaining an engineering job is the most challenging aspect of being a new immigrant. Given that many employers view the P.Eng./ing. as a stamp of approval, this recommendation proposes an interim step, that would allow IEGs to demonstrate their readiness for employment while still adhering to the licensing process.

Employment

Obtaining a job once in Canada is the number one challenge for IEGs and their area of greatest concern. These recommendations address that concern.

xiv. **Create a "Working in Canada" seminar for IEGs.** Many IEGs who have successfully found engineering work or obtained their P.Eng./ing. Have noted that among their key challenges was learning to negotiate the Canadian workplace – its culture and norms. A "Working in Canada" seminar, developed in partnership with settlement agencies and likely delivered by them, could help bridge that cultural gap.

xv. **Promote the concept that cross-cultural training be taken by licensing body volunteers and staff, CCPE, IEGs, and employers.** It is important to note that cross-cultural understanding is not a one-way street. It is likely that regulatory body staff and volunteers – and others who work with IEGs – would benefit from cross-cultural training so that they can better appreciate the IEG's perspective. The issue of who would develop and deliver this training, and the level of regulatory body involvement, would be determined in Phase III.

xvi. **Undertake a study to determine best practices in the employment area for integrating IEGs into the workplace (e.g. internship, job matching, job fairs, job boards).** While regulatory bodies are not in a position to create jobs for IEGs, they can facilitate a meeting of IEGs and employers. What form that facilitation should take would be the topic of a study, to be undertaken in Phase III.

xvii. **Develop a mentoring program for IEGs.** Mentoring often came up during Phase II as a valuable tool for IEGs – someone to help them understand the Canadian engineering licensing process and the employment culture.

Appendix C

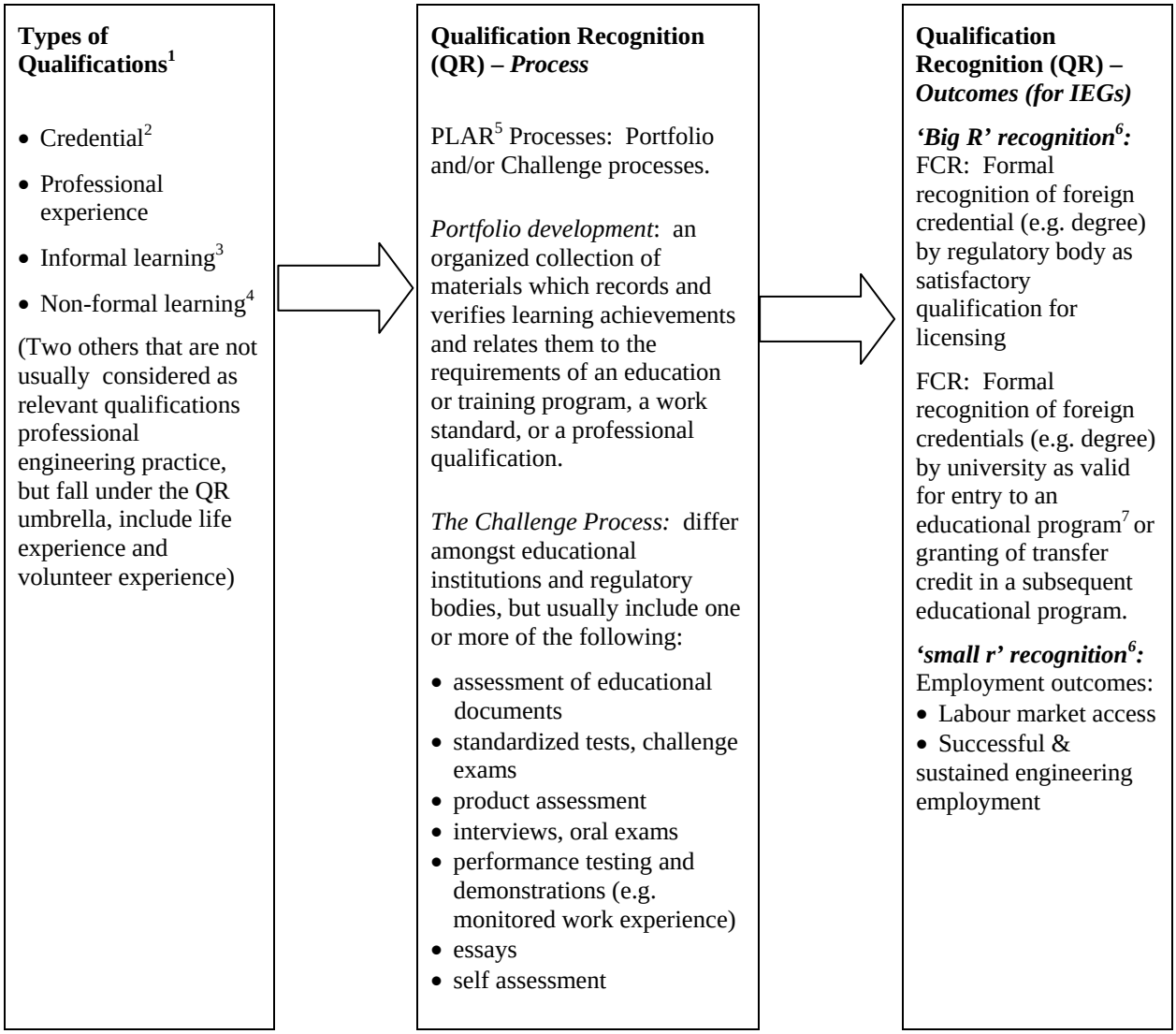
Other Bridging Programs for International Engineering Graduates

Initiatives are often carried out with time-limited project funding, and new initiatives are constantly under development. Therefore, this list is not intended to be comprehensive, and programs are listed in alphabetical order.

- *Bridging Program for Engineering Graduates,* Edmonton Mennonite Centre for Newcomers, www.emcn.ab.ca
- *Bridging Program for Immigrants,* Toronto Region Immigrant Employment Council, www.triec.ca
- *Career Bridge Internships for Internationally Qualified Professionals,* www.careeredge.ca
- *Communication for Engineering and Technology,* Vancouver Community College, www.vcc.ca, and Camosun College, www.camosun.bc.ca
- *Engineering and Technology Upgrading Program,* Calgary Catholic Immigration Society, www.ccis-calgary.ab.ca/engineering_program.html
- *Engineers' and Technologists' Integration Program,* Edmonton Mennonite Centre for Newcomers, www.emcn.ab.ca
- *Engineering Degree Completion Program* and *Bachelor of Technology Degree*, McMaster University, www.mcmaster.ca
- *English for Engineering Professionals,* Canadian English for Professionals, www.cefp.ca
- *International Engineer Bridging Program,* Bredin Institute – Centre for Learning, www.bredin.ab.ca
- *Internationally Educated Engineers (IEE) Program,* Educational Program Innovations Center, www.epic-edu.com/IEE/index.html
- *Programmes de Perfectionnement en Ingénierie des Diplômés en Génie de L'Etranger*, and *Certificat en intégration professionnelle des ingénieurs immigrants*, Ecole Polytechnique, www.polymtl.ca/etudes/cfc/cheminement/integration.php
- *Skills Connect,* Multicultural helping House Society, www.helpinghouse.org
- *Transitions to Technical and Engineering Careers,* Norquest College, www.norquest.ca
- *Work Experience for Immigrants Program* and *Directions for Immigrants in Trades and Professional Careers,* Bow Valley College, www.bowvalleycollege.ca

Appendix D

The relationship between Qualifications Recognition (QR) and Foreign Credentials Recognition (FCR)



Definitions & Notes

1. QUALIFICATION: Knowledge, skills, and experience for entry to an educational program or practice in an occupation.
2. CREDENTIAL: Documented evidence of learning based on completion of a recognized program of study or training. Degrees, diplomas, certificates, and licenses are examples.
3. INFORMAL LEARNING: Learning acquired through work experience, using unstructured methods and settings (i.e. knowledge, skills, and attitudes developed through years of professional practice)

4. NON-FORMAL LEARNING: Learning acquired in structured programs outside formal educational institutions and/or outside of formal certificate / diploma / degree programs. For example, knowledge, skills, and attitudes developed through professional development seminars, short courses, etc.
5. PLAR - PRIOR LEARNING ASSESSMENT AND RECOGNITION: PLAR is often promoted as a way to grant academic credit or determine eligibility to practice a trade or profession. PLAR is used to assess an individual's knowledge and skills in relation to specific criteria. The establishment of clear, measurable criteria is the key to a high-quality PLAR process. There are two main processes to help learners assess and gain recognition for their learning: portfolio development, and the challenge process.
6. Manitoba Labour & Immigration conceptualize QR as both 'Big R' recognition and 'small r' recognition. Big R recognition is the formal recognition of formal learning (e.g. via a regulatory body granting EIT or P.Eng. status, or via an educational institution granting entry to an educational program). Small r recognition is, for example, an employer's recognition of (acceptance of, confidence in) an individual's credential, skills, and competence. This 'small r' could be demonstrated through documented Canadian engineering work experience and/or a letter of reference from a Canadian employer. Studies find that Big R recognition (e.g. a P.Eng. license) helps with small r recognition (e.g. getting hired), but does not guarantee it. Small r recognition is always a hurdle, but the magnitude of the hurdle is larger without Big R recognition, and decreases if also accompanied by Big R recognition.
7. For example, undergraduate engineering degree from home country as adequate credential for entry to Canadian M.Sc. in Engineering with no pre-Masters year required.

Sources:

- Canadian Information Centre for International Credentials (www.cicic.ca)
- www.recognitionforlearning.ca - "The PLAR Community in Canada", linked directly from the Canadian Association of Prior Learning Assessment (www.capla.ca)
- Ongoing conversations with program staff, Manitoba Labour & Immigration, 2005 – present.

Appendix E

Interview Guides for Data Collection

E.1 Assurance of Confidentiality to Focus Group Participants

This standard text will be used for all focus group interviews. The moderator will read or paraphrase the following:

Thank you for agreeing to participate in this study. The purpose of this focus group session is to evaluate the IEEQ Program by understanding your experiences in/with *[specific text for each of focus group interview / group of participants*]. The questions have been designed to explore these areas. The goal is to see our time together as a relaxed conversation and not a structured question-and-answer period. You are free to withdraw any of your comments or withdraw completely from this study at any time, and you are under no obligation to answer any of the questions. When I summarize the audiotape and report the results of the study, I will use a code (letter or number) only to identify you, and will not use any quotations that would identify you specifically. Everything you say will be held in confidence. After I have summarized the audiotape, the summary will be returned to you for your review, and the audiotape will be destroyed at the end of the study. Marcia will not hear the audiotape and will only have access to the written summary notes I provide, with no names attached. Although she will know how many people participated in the session, they will not know who did or did not participate. Do you have any questions about these procedures?

E.2 Interview Guide for Focus Group with IEEQ Participants at Program Completion

The following questions and probes will guide the interview:

- Tell me about your experience in the university courses you took as part of the IEEQ Program. For example,
    - This year, people had varying course loads, taking anywhere from four to six courses over the year. Most people were taking six courses. How did the course load feel?
    - How did you feel about the course list that was developed for you?
    - How did you feel about the transition back to university studies after a number of years?
    - How did you feel about your relationships to fellow students?
    - How did you feel about your relationships to the instructors?

- Tell me about the strengths of the IEEQ Program in terms of the university-based portion (Sept –April). For example,
    - What aspects of the program did you enjoy?
    - What aspects of the program met your expectations?
    - What aspects of the program seemed to function well, from your perspective?
    - What aspects of the program are the most valuable, from your perspective?
    - How did the program help you in your long-term goals?

- Tell me about the weaknesses of the IEEQ Program in terms of the university-based portion (Sept-April). For example,
    - What aspects of the program did you find difficult or frustrating?
    - What aspects of the program did not meet your expectations?
    - What aspects of the program did not function well, from your perspective?
    - What aspects of the program are least valuable or useful, from your perspective?
    - What aspects of the program seemed irrelevant to your long-term goals?

- What changes would you recommend for the IEEQ Program in future years in terms of the university-based portion. For example,
    - What changes would you recommend to the university-based portion of the program (number of courses, type of courses)?
    - What could the IEEQ Program have done to make the transition back to university studies easier for you?

E.3 Interview Guide for Focus Group with former IEEQ Participants (12-48 Months after Program Completion)

The following questions and probes will guide the focus group interview:

- When you think back to your time as a student in the IEEQ Program, what stands out in your memory?
    - Looking back, what do you consider to have been the most valuable parts of the program? How or why were they valuable to you?
    - Which knowledge / skills / experiences gained through the program ended up being important to you, when you reflect back now? In what way were they important?
- Tell me about your career development since you finished the IEEQ Program.
    - Describe your career path since you finished IEEQ: where have you worked, what kinds of roles have you had?
    - How do you feel about your career path since you finished IEEQ?
    - What career expectations have you been able to meet in the time since you finished IEEQ? Which career expectations have not yet been met?
- Tell me about your personal view of the knowledge and skill set that one needs to practice professional engineering in Canada.
    - How would you describe the role of a professional engineer in Canada?
    - How would you describe the expectations – technical, professional, personal – of a professional engineer in Canada?
    - As a newcomer to Canada, where did you need to adjust your expectations or understanding of your role as a professional engineer (if you needed to adjust your expectations / understanding at all), relative to your experience as an engineer in your home country?
    - As a newcomer to Canada, what were the gaps in knowledge, skills, or attitudes that you needed to bridge (if you feel there were any gaps at all).

E.4 Interview Guide for Focus Group with Employers / Supervisors

The following two questions will be the focal point of the discussion. Several 'probes' are suggested underneath each question, as possible ways to consider the question and response.

- Tell me about your experiences in supervising international engineering graduates (IEGs) that came to you through the IEEQ Program.

  Probes:
  - Describe your IEG employee's career progression with your firm, during the period they were employed with you.
  - What did these IEGs do well? Where did they shine?
  - What knowledge and skill assets did they bring to your firm?
  - How did your IEG employee fit into your organizational culture?
  - What, if any, gaps in technical knowledge or skill did you identify in your IEG employee? To what extent would you consider these gaps to be related to being foreign-trained?

- Tell me about your perceptions and experiences of the challenges facing IEGs in their integration into the Canadian professional engineering workplace.

  Probes:
  - In your experience, what are common challenges facing IEGs in terms of effectively fulfilling the role of a professional engineer in Canada?
  - What expectations – professional and personal – did you observe in your IEG employee? To what extent did you perceive these to be appropriate expectations?
  - In which area(s) – knowledge, skill, attitudes – did your IEG employee experience difficulties, if any? To what would you attribute those difficulties?
  - How did the supervision, mentorship, or coaching that you provide to employees differ between your IEG employee(s) and your non-IEG employees at the same professional level?

Appendix F

Follow-up Questionnaires for Data Collection

F.1 Nine-month Follow-up Questionnaire with IEEQ Cohorts

Questionnaire to Follow-up 9 Months after completion of the IEEQ Program

June 20xx

This questionnaire is part of our evaluation of the IEEQ Program.

You may remember that about a year ago you were invited to take part in a focus group with *(name of facilitator)* to discuss your experiences in the IEEQ Program to that time. That focus group concentrated primarily on your experiences in the university courses that were a part of your IEEQ Program.

This questionnaire is being sent to you nine months after your completion of the IEEQ Program. It is to help us understand your experiences in the co-op work portion of your IEEQ Program and to follow-up with your subsequent career development to this point. Your responses will be useful to understand whether the program is meeting its intended goals. Please take note of the following:

- Your responses to this questionnaire are confidential. ***PLEASE DO NOT PUT YOUR NAME, ADDRESS, SIGNATURE, OR ANY OTHER IDENTIFYING INFORMATION ANYWHERE ON THIS FORM***. The IEEQ Office Assistant has assigned a tracking number to this questionnaire: ___*(20xx:x)*_____. This tracking number is to help us identify changes in your career over time, as we intend to send you a similar questionnaire again in September, 20xx). Only the IEEQ Office Assistant who prepared the mailing is aware of the tracking number assigned to each individual, and she is obliged by the Research Ethics Board to keep this information confidential.

- Your participation in this questionnaire is entirely voluntary. If you do choose to participate, please read and sign the Letter of Informed Consent (attached) and mail it back in the enclosed envelope, together with this questionnaire.

- If you prefer not to complete this questionnaire, please return the blank questionnaire in the enclosed envelope anyway.

If your address changes before we send out the second questionnaire in September 20xx, kindly let us know by writing: IEEQ Program, E2-262 EITC, University of Manitoba, R3T 5V6
or e-mailing ieeq@Umanitoba.ca

Part 1: In answering the following questions, please think back to your activities in your **IEEQ Program co-op work term from May through August 20xx only**.

These questions are to help us understand your experiences in the IEEQ Program co-op work term. The questions are intended to be general, in order that you are not identified by your engineering discipline or specific employment duties.

1. To what extent did you feel that you were engaged in engineering work during the co-op work term (legally defined in the *Engineering Act* as the application of theory (analysis, design, testing, implementation); practical experience (field engineering, site visits); engineering management (planning, scheduling, budgeting, project control); communication skills; exposure to ethical responsibilities; and, exposure to the societal implications of engineering).

2. To what extent did you feel that the co-op job was suited to your technical engineering *background* and *interests*?

3. To what extent did you feel that the co-op job was suited to your technical engineering *capabilities* and the *level of challenge* you were looking for?

4. Please indicate what training, if any, you were provided in the co-op job.

5. Please describe the supervision, guidance, and feedback, if any, you received from a supervisor and/or colleagues.

6. Please comment on how you experienced your work environment (facilities and equipment).

7. Please comment on how you experienced relationships with your co-workers.

8. Please comment on what role, if any, the four-month co-op work term had in helping you develop your professional engineering network in Manitoba (contacts and connections to other engineers and organizations).

9. Please indicate the equivalent hourly wage you were earning during your four-month co-op work term (please circle one)

$14-$18 $18.01-$22.00 $22.01-$26.00 above $26.01

Please comment on how you felt about your wage or salary.

10. Please indicate the most significant challenge(s) or issue(s) you encountered in the co-op work term?

11. Please indicate in which ways (if any) your previous coursework in the IEEQ program helped prepare you for the co-op work term.

12. Please indicate in which ways the IEEQ Program could have better prepared you for the co-op work term.

13. Please indicate the general strengths and benefits you perceived in taking the IEEQ Program.

14. Please indicate how the IEEQ Program could better serve the needs of its participants.

Part 2: In answering the following questions, please think of your experiences **since completing the IEEQ Program in September 20xx.**

The questions in this part are to provide information on how the careers of former IEEQ participants have developed after the IEEQ Program.

1. Please indicate your current primary activity:

   - ☐ Employment
     - ☐ in engineering work
     - ☐ in engineering-related work
     - ☐ in other work
   - ☐ Attending a university, college, or other training program
     - ☐ in an engineering or engineering-related area
     - ☐ in another area – please describe
       _____
   - ☐ Unemployed and actively searching for work
   - ☐ Other: For example, care-giving duties to children or others, working as a volunteer, etc. Please describe

   _____

2. Are these activities (#1 above) what you want to be doing at this time?

   - ☐ Yes
   - ☐ No. If no, what would you prefer to be doing at this time?

   _____

3. If you are currently employed in engineering work, please indicate the following:

   3a. Is your employment related in any way to your employment or the connections you made during the four-month co-op term in the IEEQ Program? ☐ Yes ☐ No

   3b. Referring to the attached pages, which level(s) of "Duties" best describe your current employment? _____

   3c. Referring to the attached pages, which level(s) of "Recommendations, Decisions, and Commitments" best describe your current employment? _____

   3d. Referring to the attached pages, which level(s) of "Supervision Received" best describe your current employment? _____

   3e. Referring to the attached pages, which level(s) of "Leadership Authority and/or Supervision Exercised" best describe your current employment? _____

   3f. Please indicate the equivalent hourly wage or annual salary you are <u>currently</u> earning: _____

4. Regarding the process of registration as a Professional Engineer with APEGM:

4a. Have you been formally registered as an Engineer-in-Training with APEGM?
☐ Yes ☐ No

4b. Have you submitted any reports of past work experience to the Experience Review Committee of APEGM? ☐ Yes ☐ No

If you answered "yes", please indicate:

How many years of credit did you receive for work experience obtained **outside of Canada**?

____ out of ____ yrs of experience submitted for review to APEGM.
(e.g. 2 out of 2.5 yrs of experience submitted for review to APEGM)
or
☐ assessment result is not yet available

How many years of credit did you receive for work experience obtained **in Canada but prior to** the IEEQ Program?

____ out of ____ yrs of experience submitted for review to APEGM
or
☐ assessment result is not yet available

How many years of credit did you receive for work experience **in Canada during and after** the IEEQ Program?

____ out of ____ yrs of experience submitted for review to APEGM
or
☐ assessment result is not yet available

4c Have you written and passed the National Professional Practice Examination with APEGM?
☐ Yes
☐ No. When do you intend to write this examination?
_____

4d. When do you hope to or expect to have completed all requirements for P.Eng. registration with APEGM?
_____

5. Are you more likely to stay in Manitoba as a result of the IEEQ Program?
☐ Yes ☐ No ☐ Neutral / Undecided

Thank you for taking the time to complete this questionnaire!

Please return the following in the enclosed envelope:
☐ The completed questionnaire
☐ The signed Letter of Informed Consent
☐ The sheet indicating whether you wish to receive the summary of the responses to this questionnaire

F.2 24-month Follow-up Questionnaire with IEEQ Cohorts

Questionnaire to Follow-up <u>24 Months</u> after completion of the IEEQ Program

September 20xx

This questionnaire is part of our evaluation of the IEEQ Program.

This questionnaire is being sent to you approximately 24 months after your completion of the IEEQ Program. It is intended to follow-up with your subsequent career development to this point. Your responses will be useful to understand whether the program is meeting its intended goals. Please take note of the following:

- Your responses to this questionnaire are confidential. ***PLEASE DO NOT PUT YOUR NAME, ADDRESS, SIGNATURE, OR ANY OTHER IDENTIFYING INFORMATION ANYWHERE ON THIS FORM***. The IEEQ Office Assistant has assigned a tracking number to this questionnaire: ___*(20xx:x)*_____. This tracking number matches the tracking number you were assigned when a similar questionnaire was sent to you approximately nine months after your completion of the IEEQ Program. Only the IEEQ Office Assistant who prepared the mailing is aware of the tracking number assigned to each individual, and she is obliged by the Research Ethics Board to keep this information confidential.

- Your participation in this questionnaire is entirely voluntary. If you do choose to participate, please read and sign the Letter of Informed Consent (attached) and mail it back in the enclosed envelope, together with this questionnaire.

- If you prefer not to complete this questionnaire, please return the blank questionnaire in the enclosed envelope anyway.

Part 1: In answering the following questions, please think of your experiences **since completing the IEEQ Program in September 20xx.**

The questions in this part are to provide information on how the careers of former IEEQ participants have developed after the IEEQ Program.

1. Please indicate your current primary activity:

   - ☐ Employment
     - ☐ in engineering work
     - ☐ in engineering-related work
     - ☐ in other work
   - ☐ Attending a university, college, or other training program
     - ☐ in an engineering or engineering-related area
     - ☐ in another area – please describe
       _____
   - ☐ Unemployed and actively searching for work
   - ☐ Other: For example, care-giving duties to children or others, working as a volunteer, etc. Please describe

   _____

2. Are these activities (#1 above) what you want to be doing at this time?

   - ☐ Yes
   - ☐ No. If no, what would you prefer to be doing at this time?

   _____

3. If you are currently employed in engineering work, please indicate the following:

   3a. Is your employment related in any way to your employment or the connections you made during the four-month co-op term in the IEEQ Program? ☐ Yes ☐ No

   3b. Referring to the attached pages, which level(s) of "Duties" best describe your current employment? _____

   3c. Referring to the attached pages, which level(s) of "Recommendations, Decisions, and Commitments" best describe your current employment? _____

   3d. Referring to the attached pages, which level(s) of "Supervision Received" best describe your current employment? _____

   3e. Referring to the attached pages, which level(s) of "Leadership Authority and/or Supervision Exercised" best describe your current employment? _____

   3f. Please indicate the equivalent hourly wage or annual salary you are currently earning: _____

4. Regarding the process of registration as a Professional Engineer with APEGM:

4a. Have you been formally registered as an Engineer-in-Training with APEGM?
☐ Yes ☐ No

4b. Have you submitted any reports of past work experience to the Experience Review Committee of APEGM? ☐ Yes ☐ No

If you answered "yes", please indicate:

How many years of credit did you receive for work experience obtained **outside of Canada**?

____ out of ____ yrs of experience submitted for review to APEGM.
(e.g. 2 out of 2.5 yrs of experience submitted for review to APEGM)
or
☐ assessment result is not yet available

How many years of credit did you receive for work experience obtained **in Canada but prior to** the IEEQ Program?

____ out of ____ yrs of experience submitted for review to APEGM
or
☐ assessment result is not yet available

How many years of credit did you receive for work experience **in Canada during and after** the IEEQ Program?

____ out of ____ yrs of experience submitted for review to APEGM
or
☐ assessment result is not yet available

4c. Have you written and passed the National Professional Practice Examination with APEGM?
☐ Yes
☐ No. When do you intend to write this examination?
_____

4d. When do you hope to or expect to have completed all requirements for P.Eng. registration with APEGM?
_____

5. Do you think or feel that you would be in a similar position in your engineering career at this time in Canada without having attended the IEEQ Program?

6. Do you see value or merit in the current licensing requirements set by APEGM?

7. Are you more likely to stay in Manitoba because of the IEEQ Program?

☐ Yes ☐ No ☐ Neutral / Undecided

Thank you for taking the time to complete this questionnaire!

Please return the following in the enclosed envelope:

- ☐ The completed questionnaire
- ☐ The signed Letter of Informed Consent
- ☐ The sheet indicating whether you wish to receive the summary of the responses to this questionnaire

F.3 Attachment for Question #3 for 9-Month and 24-Month Follow-Up Questionnaires

Professional Engineering Employment Classification Rating Guide (excerpted from the APEGM annual salary survey tools)

A. DUTIES

This factor is concerned with the general nature of tasks assigned. The range is from duties performed in entrance-level jobs to those carried out at an advanced level.

Level 1: Receives training in various phases of office, plant, field, or laboratory engineering/geoscience work as classroom instruction or “on-the-job” assignments. May prepare plans, make calculations, and develop costs and bills of material in accordance with established codes, standards, drawings, or other specifications. May carry out routine technical surveys or inspections and prepare reports.

Level 2: This level is normally regarded as a continuing portion as professionals training and development. Receives assignments of limited scope and complexity, usually minor phases of broader assignments. Uses a variety of standard engineering/geoscience methods and techniques in solving problems. Assists more senior professionals in carrying out technical tasks requiring adherence to prescribed testing, analysis, design, or other methods.

Level 3: This is typically regarded as a fully qualified professional level. Carries out varied assignments requiring general familiarity with a broad field of engineering and knowledge of reciprocal effects of the work upon other fields. Solves problems by use of combinations of standard procedures, modifications of established techniques, or methods developed in previous assignments. Participates in planning to achieve prescribed objectives.

Level 4: This is the first level of direct and sustained supervision of other professionals. It is also the first level of full specialization. Requires application of mature professional knowledge in planning and conducting generally difficult or involved projects having scope for independent accomplishment. In solving problems, modifies established guides, devises new approaches, applies existing criteria in new ways, and draws conclusions from comparative situations.

Level 5: Participates in short-range and sometimes long-term planning. Makes independent decisions on work methods and procedures within an over-all program. Devises practical and economical solutions to problems. May supervise large groups containing both professional and non-professional staff. Or may exercise authority over a small group of highly qualified professional personnel engaged in complex technical applications. Or, as a specialist, may engage in research or other advanced technical studies calling for approaches that are ingenious, creative, and novel. Applies knowledge usually of more than one general field of engineering/geoscience or the specialized knowledge of a limited field or phase of engineering/geoscience.

Level 6: Normally directs an engineering/geoscience function involving several professional and other groups engaged in interrelated responsibilities. Or, as a specialist, has achieved recognition as an authority in an engineering/geoscience field of major importance to the organization. Conceives programs and problems to be investigated. Participates in discussions to determine basic operating policies, devises ways of reaching program objectives in the most economical manner, and meets unusual conditions affecting work progress.

Level 7: Directs the technical and administrative activities of a major division in a very large organization or all activities of a smaller organization. Determines policies, sees that projects and programs are carried to a conclusion, approves major expenditures of money, handles major contacts, and effects co-ordination on a broad scale. Or, as a senior specialist and widely

recognized engineering/geoscience authority, conceives and carries out programs of great significance to the organization.

Level 8: Is accountable, as the chief executive of a very large organization, to a board of directors for the management of all technical and administrative activities to realize the objectives of the enterprise.

B. RECOMMENDATIONS, DECISIONS, AND COMMITMENTS

Select the level(s) that fits your job most appropriately.

Level 1: Makes technical decisions of a routine nature with ample precedent or clearly defined procedures as guides.

Level 2: Makes recommendations that are limited to problem solutions rather than end results. Makes decision that usually fall within established guidelines.

Level 3: Makes independent studies, analyses, and interpretations where technical subject matter, usually of limited scope, is involved. Normally refers difficult, complex, or unusual matters or decisions to more senior authority.

Level 4: Makes recommendations arising from work assignments that are reviewed for soundness of judgment but are usually accepted as technically accurate and feasible. Makes decisions on assignments in hand other than those having a major bearing on the course or cost of the work.

Level 5: Makes responsible decisions, not usually subject to technical review, on all matters assigned, subject to established operating policies and financial controls. Takes action to expedite the successful accomplishment of projects or programs assigned.

Level 6: Makes responsible technical and/or administrative decisions pertaining to functions assigned, including the expending of money and the implementation of major programs, subject only to over-all policies, budgets, and other financial controls. May participate in the formulation of corporate policies and long-term plans for the organization as a whole.

Level 7: Deals with major problems and makes the final technical and administrative policy decisions for a small or medium-sized organization. In a very large organization, makes the principal technical and administrative decisions bearing upon the activities of a major decision. Work carries responsibility for actions taken, though these may be guided by policy of a board of directors or other superior authority.

Level 8: Isolates and analyzes major over-all problems and makes the associated final decisions for a very large organization. Requires sound, mature judgment to conceive and apply broad policies which may affect other companies in the area of operation or field of industry.

C. SUPERVISION RECEIVED

This factor is concerned with the degree to which independent action is required or permitted. This will be limited by the amount of direction received from superiors or provided through standard-practice instructions, policies, precedents, or practice. Select the level that fits your job most appropriately.

Level 1: Works under close supervision or completely detailed instructions. Work is reviewed for accuracy, adequacy, and conformance with prescribed procedures.

Level 2: Receives oral or written instructions as to methods and procedures to be followed in work assignments. Results are usually reviewed in detail and technical guidance is normally present to deal with problems and difficulties.

Level 3: Works under general supervision although amount of supervision received may vary with the assignment. Technical guidance is normally available to review work programs and advise on unusual features.

Level 4: Works in terms of specific objectives, relative priorities, and defined critical areas relating to work of other units. Makes decisions when general instructions, established methods, and clearly defined precedents indicate action to be taken, but refers unusual problems to supervisor.

Level 5: Works on programs or towards objectives to be accomplished. Results are reviewed for soundness of approach and general effectiveness. Makes decisions and takes action in the application of operating policies and of standards widely accepted within the profession.

Level 6: Works independently on broad, general assignments, with responsibility for the planning, direction, and conduct of all associated activities, limited only by policy and established financial controls. Takes action without reference to superiors, except where problems of policy change are involved.

Level 7: Operates as an executive at divisional level in a very large organization or as the chief executive in a smaller organization. Makes most technical and administrative decisions on his own rather than by reference to superiors.

Level 8: Determine the policies, plans, and programs through which the technical and administrative operations of a very large organization are directed and controlled, subject only to the approval of a board of directors.

D. LEADERSHIP AUTHORITY AND/OR SUPERVISION EXERCISED

This factor is concerned with the character of the supervisory responsibility. This may be direct (line) or indirect (staff). Select the level that fits your job most appropriately.

Level 1: Has no supervisory role.

Level 2: May assign and check work of one or two non-professional persons. Responsibility is limited to provision of occasional work direction.

Level 3: May give work direction to one or more technologists or helpers assigned to work on a short-term project, with no continuing supervisory responsibility.

Level 4: Usually responsible for the work of one or more full-time non-professional assistants. May give work direction to professionals of less standing assigned to work on a common project. Supervision of professionals is not usually a regular or continuing responsibility. May has a liaison responsibility with field crews on the interpretation of plans and specifications.

Level 5: Usually responsible for supervising the work of one or more junior professionals as well as other categories of staff. Assigns and outlines work; advises on technical problems; reviews work for accuracy and adequacy. Supervision may call for recommendations concerning

selection, training, rating, and discipline of staff. May give technical direction to contractors employed on small projects and approve their finished work.

Level 6: Co-ordinates work programs and directs use of materials, equipment, and personnel, both professional and nonprofessional. Plans assignments, outlines methods of approach, and deals with difficult features. Normally makes recommendations on the selection, training, discipline, termination, and remuneration of staff. May give technical direction to contractors on major projects and approve their finished work. For staff positions, acts as advisor and assistant to the chief executive or in a very large organization, to an executive at divisional level.

Level 7: Supervises and directs the work of two or more major functions in an organization. Sets up standards of performance, co-ordinates operations, counsels assistants on unusual problems, evaluates performance, and sees that policies and programs are carried out. For staff positions, acts as advisor or consultant to the chief executive of a very large organization.

Level 8: Co-ordinates activities of the personnel in a major division in a very large organization or all personnel in a smaller organization. Develops long-term programs and objectives, shapes and interprets policy, and effects co-ordination on a broad scale.

Level 9: Functions as the chief executive officer of a very large organization, having final responsibility for direction of all personnel subject only to approvals of a board of directors. Effects co-ordination through contacts with senior executive officers who operate with a good measure of independence, through use of control devices of complex sorts, and through activities of personal staff assistants.

Appendix G

Approval Certificates for Human Subjects Research

G.1 Protocol E2004:001 for Focus Group Interviews: Original approval and renewals.
G.2 Protocol E2005:005 for Follow-up Questionnaires: Original approval and renewals
G.3 Protocol E2008:064 for Focus Group Interviews with former IEEQ Participants and with Employers / Supervisors: Original approval

G.1 Protocol E2004:001 for Focus Group Interviews: Original approval and renewals

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www.umanitoba.ca/research

UNIVERSITY OF MANITOBA | OFFICE OF RESEARCH SERVICES
Office of the Vice-President (Research)

RENEWAL APPROVAL

11 December 2006

TO: **Marcia R. Friesen**
Principal Investigator

FROM: **Stan Straw, Chair**
Education/Nursing Research Ethics Board (ENREB)

Re: **Protocol #E2004:001**
"Evaluation of the Internationally-Education Engineers Qualification (IEEQ) Pilot Program 2003 - 2004, University of Manitoba"

Please be advised that your above-referenced protocol has received approval for renewal by the **Education/Nursing Research Ethics Board.** This approval is valid for one year only.

Any significant changes of the protocol and/or informed consent form should be reported to the Human Ethics Secretariat in advance of implementation of such changes.

Please be advised that this is the final renewal allowed. Subsequently a full application must be submitted.

UNIVERSITY OF MANITOBA

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Fax: (204) 261-0325
www.umanitoba.ca/research

RENEWAL APPROVAL

06 December 2005

TO: **Marcia R. Friesen**
Principal Investigator

FROM: **Stan Straw, Chair**
Education/Nursing Research Ethics Board (ENREB)

Re: **Protocol #E2004:001**
"Evaluation of the Internationally-Educated Engineers Qualification (IEEQ) Pilot Program 2003 - 2004, University of Manitoba"

Please be advised that your above-referenced protocol has received approval for renewal by the **Education/Nursing Research Ethics Board.** This approval is valid for one year only.

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AMENDMENT APPROVAL

06 December 2005

TO: **Marcia R. Friesen**
Principal Investigator

FROM: **Stan Straw, Chair**
Education/Nursing Research Ethics Board (ENREB)

Re: **Protocol #E2004:001**
"Evaluation of the Internationally-Educated Engineers Qualification (IEEQ) Pilot Program 2003-2004, University of Manitoba"

This will acknowledge your fax dated December 2, 2005 requesting amendment to the above-noted protocol.

Approval is given for this amendment. Any further changes to the protocol must be reported to the Human Ethics Secretariat in advance of implementation.

UNIVERSITY OF MANITOBA

RESEARCH SERVICES & PROGRAMS
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RENEWAL APPROVAL

06 December 2004

TO: **Marcia R. Friesen**
Principal Investigator

FROM: **Stan Straw, Chair**
Education/Nursing Research Ethics Board (ENREB)

Re: **Protocol #E2004:001**
"Evaluation of the Internationally-Educated Engineers Qualification (IEEQ) Pilot Program 2003 - 2004, University of Manitoba"

Please be advised that your above-referenced protocol has received approval for renewal by the **Education/Nursing Research Ethics Board.** This approval is valid for one year only.

Any significant changes of the protocol and/or informed consent form should be reported to the Human Ethics Secretariat in advance of implementation of such changes.

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AMENDMENT APPROVAL

06 December 2004

TO: **Marcia R. Friesen**
Principal Investigator

FROM: **Stan Straw, Chair**
Education/Nursing Research Ethics Board (ENREB)

Re: **Protocol #E2004:001**
"Evaluation of the Internationally-Educated Engineers Qualification (IEEQ) Pilot Program 2003 - 2004, University of Manitoba"

This will acknowledge your memo dated December 2, 2004 requesting amendment to the above-noted protocol.

Approval is given for this amendment. Any further changes to the protocol must be reported to the Human Ethics Secretariat in advance of implementation.

UNIVERSITY OF MANITOBA

RESEARCH SERVICES & PROGRAMS
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www.umanitoba.ca/research

APPROVAL CERTIFICATE

22 January 2004

TO: **Marcia R. Friesen**
Principal Investigator

FROM: **Stan Straw, Chair**
Education/Nursing Research Ethics Board (ENREB)

Re: **Protocol #E2004:001**
"Evaluation of the Internationally-Educated Engineers Qualification (IEEQ) Pilot Program 2003 - 2004, University of Manitoba"

Please be advised that your above-referenced protocol has received human ethics approval by the **Education/Nursing Research Ethics Board**, which is organized and operates according to the Tri-Council Policy Statement. This approval is valid for one year only.

Any significant changes of the protocol and/or informed consent form should be reported to the Human Ethics Secretariat in advance of implementation of such changes.

Please note that, if you have received multi-year funding for this research, responsibility lies with you to apply for and obtain Renewal Approval at the expiry of the initial one-year approval; otherwise the account will be locked.

G.2 Protocol E2005:005 for Follow-up Questionnaires: Original approval and renewals

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Winnipeg, MB R3T 2N2
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www.umanitoba.ca/research

RENEWAL APPROVAL

10 December 2007

TO: **Marcia R. Friesen**
Principal Investigator

FROM: **Stan Straw, Chair**
Education/Nursing Research Ethics Board (ENREB)

Re: **Protocol #E2005:005**
"Follow-up with IEEQ Pilot Program Cohorts"

Please be advised that your above-referenced protocol has received approval for renewal by the **Education/Nursing Research Ethics Board.** This approval is valid for one year only.

Any significant changes of the protocol and/or informed consent form should be reported to the Human Ethics Secretariat in advance of implementation of such changes.

Please be advised that this is the final renewal allowed. Subsequently a full application must be submitted.

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UNIVERSITY OF MANITOBA | OFFICE OF RESEARCH SERVICES
Office of the Vice-President (Research)

RENEWAL APPROVAL

11 December 2006

TO: **Marcia R. Friesen**
Principal Investigator

FROM: **Stan Straw, Chair**
Education/Nursing Research Ethics Board (ENREB)

Re: **Protocol #E2005:005**
"Follow-up with IEEQ Pilot Program Cohorts"

Please be advised that your above-referenced protocol has received approval for renewal by the **Education/Nursing Research Ethics Board.** This approval is valid for one year only.

Any significant changes of the protocol and/or informed consent form should be reported to the Human Ethics Secretariat in advance of implementation of such changes.

UNIVERSITY OF MANITOBA

OFFICE OF RESEARCH SERVICES
Office of the Vice-President (Research)

244 Engineering Building
Winnipeg, MB R3T 5V6
Telephone: (204) 474-8418
Fax: (204) 261-0325
www.umanitoba.ca/research

RENEWAL APPROVAL

06 December 2005

TO: **Marcia R. Friesen**
Principal Investigator

FROM: **Stan Straw, Chair**
Education/Nursing Research Ethics Board (ENREB)

Re: **Protocol #E2005:005**
"Follow-up with IEEQ Pilot Program Cohorts"

Please be advised that your above-referenced protocol has received approval for renewal by the **Education/Nursing Research Ethics Board.** This approval is valid for one year only.

Any significant changes of the protocol and/or informed consent form should be reported to the Human Ethics Secretariat in advance of implementation of such changes.

UNIVERSITY OF MANITOBA

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Winnipeg, MB R3T 5V6
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Fax: (204) 261-0325
www.umanitoba.ca/research

APPROVAL CERTIFICATE

28 January 2005

TO: **Marcia R. Friesen**
Principal Investigator

FROM: **Stan Straw, Chair**
Education/Nursing Research Ethics Board (ENREB)

Re: **Protocol #E2005:005**
"Follow-up with IEEQ Pilot Program Cohorts"

Please be advised that your above-referenced protocol has received human ethics approval by the **Education/Nursing Research Ethics Board**, which is organized and operates according to the Tri-Council Policy Statement. This approval is valid for one year only.

Any significant changes of the protocol and/or informed consent form should be reported to the Human Ethics Secretariat in advance of implementation of such changes.

Please note that, if you have received multi-year funding for this research, responsibility lies with you to apply for and obtain Renewal Approval at the expiry of the initial one-year approval; otherwise the account will be locked.

G.3 Protocol E2008:064 for Focus Group Interviews with former IEEQ Participants and with Employers / Supervisors: Original approval

CTC Building
208 - 194 Dafoe Road
Winnipeg, MB R3T 2N2
Fax (204) 269-7173
www.umanitoba.ca/research

UNIVERSITY OF MANITOBA | OFFICE OF RESEARCH SERVICES
Office of the Vice-President (Research)

APPROVAL CERTIFICATE

30 July 2008

TO: **Marcia R. Friesen**
Principal Investigator

FROM: **Stan Straw, Chair**
Education/Nursing Research Ethics Board (ENREB)

Re: **Protocol #E2008:064**
"Follow-Up with IEEQ Program Cohorts: Phase III"

Please be advised that your above-referenced protocol has received human ethics approval by the **Education/Nursing Research Ethics Board**, which is organized and operates according to the Tri-Council Policy Statement. This approval is valid for one year only.

Any significant changes of the protocol and/or informed consent form should be reported to the Human Ethics Secretariat in advance of implementation of such changes.

Please note:

- **if you have funds pending human ethics approval, the auditor requires that you submit a copy of this Approval Certificate to Kathryn Bartmanovich, Research Grants & Contract Services (fax 261-0325), including the Sponsor name, before your account can be opened.**

- **if you have received multi-year funding for this research, responsibility lies with you to apply for and obtain Renewal Approval at the expiry of the initial one-year approval; otherwise the account will be locked.**

The Research Ethics Board requests a final report for your study (available at: http://umanitoba.ca/research/ors/ethics/ors_ethics_human_REB_forms_guidelines.html) **in order to be in compliance with Tri-Council Guidelines.**

Appendix H

Letters of Informed Consent

H.1 Letter of Informed Consent for Focus Group Interviews with IEEQ Participants

[date]

Dear IEEQ Program participant:

This letter is provided to you to outline the purpose and nature of a focus group session to be used to evaluate the IEEQ Program, to formally request your participation in the study, and to obtain your written informed consent as a participant.

This consent form, a copy of which will be left with you for your records and reference, is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

The purpose of this research is to be an evaluation tool for the IEEQ program by understanding your experiences in the university-based part of the program (September 20xx – April 20xx), the strengths and challenges in the program, and your suggestions for changes to the program for future years.

Should you agree to participate, you will participate in one focus group interview of 90-minute duration. The interview will be scheduled for *(date, time, location)*

Focus groups are a carefully planned, informal group discussion. They are designed to obtain perceptions on a defined area of interest in a permissive, non-threatening environment. The discussion is relaxed, comfortable, and often enjoyable to the participants as they share ideas and experiences. The purpose of a focus group is to gather data on the opinions, attitudes, and perceptions of the group.

The focus group session will be held at a time and location on campus suitable to the group, and will be carried out by a focus group moderator, [name]. The interview strategy will follow qualitative focus group interviewing norms. As opposed to a structured question and answer session, the format will be conversational and relaxed. The focus group moderator will use a prepared interview guide with open-ended questions to guide the conversation. The moderator's role will be to provide an atmosphere in which you feel comfortable disclosing your experiences, perceptions, and opinions relative to the IEEQ Program. The discussion during the focus group session will be audiotaped, and after the session, the moderator will summarize the main points of the session in a written document. The written summary of the session will also be provided to you for your review and comment. The identity of focus group participants will be kept confidential by the moderator. In the written summary notes of the session, the moderator will identify the participants only by a letter or number.

Before providing written consent, you should be aware that you have the right to withdraw any of your comments or withdraw completely from this study at any time, and that any disclosures or data you provide are held in complete confidence. To preserve confidentiality, you will only be

identified by a letter or number in all notes and reports associated with the study. An explicit assurance of confidentiality will be given prior to the focus group interview session. The focus group moderator will not reveal the identity of any of the focus group participants. In any reports based on the session, all quotations, citations, or paraphrases will be made generic with respect to unique personal features or identifiers, including but not limited to your gender, age, ethnicity, and speech habits. The focus group moderator will keep the audiotape of the session at her home, and will destroy the audiotape at the end of the study. I will not hear the audiotape. The written summary notes of the session will be kept at my home, and the notes will only be seen by the focus group moderator, yourselves, IEEQ staff, and the Associate Dean (Design Education) (Ron Britton).

I should also let you know that no compensation is being offered for your participation, although I will likely provide refreshments during the focus group interview. You should also be aware that your participation in this study is completely independent of (unrelated to) your grade any course in which you were or are registered. You will not be rewarded nor penalized in the IEEQ Program for your decision to participate or not to participate in the focus group session.

Your signature on this form indicates that you have understood to your satisfaction the information regarding participation in the research project and agree to participate as a subject. In no way does this waive your legal rights nor release the researcher, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw from the study at any time, and/or refrain from answering any questions you prefer to omit, without prejudice or consequence. Your continued participation should be as informed as your initial consent, so you should feel free to ask for clarification or new information throughout your participation. I can be contacted as follows:

Marcia Friesen, P.Eng.
Tel 474 7873
Marcia_Friesen@Umanitoba.ca

This research has been approved by the Education/Nursing Research Ethics Board. If you have any concerns or complaints about this project, you may contact the above-named persons or the Human Ethics Secretariat at 474-7122, or e-mail margaret_bowman@umanitoba.ca. A copy of this consent form has been given to you to keep for your records.

Please sign below to indicate your informed written consent to participate in this study:

Participant's signature Date

Researcher's Signature Date

H.2 Letter of Informed Consent for Follow-up Questionnaires with IEEQ Participants

[Date]

Dear IEEQ Program Participant:

Research Project Title: Follow-up with IEEQ Program Cohorts

Researcher(s): Marcia Friesen, P.Eng., M.Ed.

Sponsor (if applicable): none

This letter is provided to you to outline the purpose and nature of the attached questionnaire to be used as part of our evaluation of the IEEQ Program, to formally request your participation in the study by completing the enclosed questionnaire, and to obtain your written informed consent as a participant.

This consent form (an additional copy of which is included for your records and reference) is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

The purpose of the attached questionnaire is to *[specific text for 9- and 24-month follow-up questionnaires]*. Should you agree to participate, I request that you complete and return the attached questionnaire in the enclosed envelope within four weeks.

Before providing written consent, you should be aware that you have the right to withdraw any of your comments or withdraw completely from this study at any time, and that any disclosures or data you provide are held in complete confidence. To preserve confidentiality, you have been assigned a tracking number on the questionnaire. This tracking number has been assigned by the IEEQ Office Assistant, and only she/he has a log of names and corresponding tracking numbers. She/he is obliged by the Research Ethics Board to keep this information confidential. If you choose to complete and return the questionnaire, the IEEQ Office Assistant will word-process your responses into a blank questionnaire form. I will only see this word-processed form and I will not see your original responses. From the word-processed forms, I will create a summary document of all of the responses. If you wish to receive a copy of this summary document, please indicate so on the last page of this letter.

In all notes and reports associated with the study, you will only be identified by a letter or a pseudonym. All quotations, citations, or paraphrases will be made generic with respect to unique personal features or identifiers, including but not limited to your gender, age, ethnicity, and speech habits.

No compensation is being offered for your participation.

Your signature on this form indicates that you have understood to your satisfaction the information regarding participation in the research project and agree to participate as a subject. In no way does this waive your legal rights nor release the researchers, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw from the study at any time, and/or refrain from answering any questions you prefer to omit, without prejudice or consequence. Your continued participation should be as informed as your initial consent, so you should feel free to ask for clarification or new information throughout your participation.

Marcia Friesen, P.Eng.
Telephone 474-7873
Email Marcia_Friesen@Umanitoba.ca

This research has been approved by the Education/Nursing Research Ethics Board. If you have any concerns or complaints about this project you may contact any of the above-named persons or the Human Ethics Secretariat at 474-7122, or e-mail margaret_bowman@umanitoba.ca. A second copy of this consent form has been included for you to keep for your records and reference.

Please sign below to indicate your informed written consent to participate in this study. If you choose to participate in this study, please return this signed letter with the completed questionnaire in the enclosed envelope.

_____

Participant's Signature Date

_____

Researcher and/or Delegate's Signature Date

To receive a summary of the results of this study, please fill out this page and return it together with the Questionnaire and Letter of Consent in the enclosed envelope.

Name _____

I prefer to receive the summary as an (check one)

☐ E-mail attachment to this e-mail address:
_____

☐ Hard copy to this mailing address:
_____

H.3 Letter of Informed Consent for Focus Group Interviews with former IEEQ Participants

[Date]

Dear Former IEEQ Program Student:

This letter is provided to you to outline the purpose and nature of a study to be used to evaluate the IEEQ Program which includes a focus group session and a review of co-op work term reports. This letter formally requests your participation in the study and your written informed consent as a participant.

This consent form, a copy of which will be left with you for your records and reference, is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

The purpose of this research is to be an evaluation tool for the IEEQ program by understanding your (the former IEEQ students') retrospective perceptions and experiences of the program, and your career development post-IEEQ. This research is the *final* phase of an overall study that began in 2004 and has included focus group interviews that you (IEEQ students) were invited to participate in at the end of the academic component of IEEQ, and two follow-up questionnaires after you were invited to complete one and two years after you finished the program.

Should you agree to participate at this time, your participation will involve the following:

1. **One focus group interview of 60-to-90 minute duration, with other former IEEQ students. The interview will be scheduled for fall 2008 with details on date/time/location to follow.** The conversation during the focus group session will focus on your perceptions of the IEEQ program, now that several years have passed since you completed the program. The conversation will also focus your career development since the time that you completed the program.

2. **Granting permission to the IEEQ Program to access your co-op work term report (completed at the end of your IEEQ Program) from the IEEQ archives, and use the co-op work term report as a source of data for this study.** The co-op work term reports will be used to understand your perspectives on employment and career development during the work term (several years ago), for comparison to the responses you provide at this time in the focus group session.

You may also consent to participating in the focus group interview (#1), but not consent to the IEEQ Program using your co-op work term report (#2).

As you have experienced previously, focus groups are a carefully planned, informal group discussion. They are designed to obtain perceptions on a defined area of interest in a permissive, non-threatening environment. The discussion is relaxed, comfortable, and often enjoyable to the participants as they share ideas and experiences. The purpose of a focus group is to gather data on the opinions, attitudes, and perceptions of the group.

The focus group session will be held at a time and location on the University of Manitoba campus suitable to the group, and I will be moderating the session. The interview strategy will follow qualitative focus group interviewing norms. As opposed to a structured question and answer session, the format will be conversational and relaxed. I will use a prepared interview guide with open-ended questions to guide the conversation, and I will work to ensure the atmosphere is one in which you feel comfortable disclosing your feelings, perceptions, and opinions relative to the IEEQ Program. The discussion during the focus group session will be audiotaped, and after the

session, I will summarize the main points of the session in a written document. You will be invited to review the written summary and send any comments of clarification, correction, or additional thoughts and ideas to me. I will make any corrections identified by participants and will add any additional information provided after the focus group session. The revised written summary will again be provided to all participants for review and comment. Your identity as a focus group participant will be kept confidential. In the written summary notes of the session, I will identify participants only by a letter or number.

Before providing written consent, you should be aware that you have the right to withdraw any of your comments or withdraw completely from this study at any time, and that any disclosures or data you provide are held in complete confidence. To preserve confidentiality, you will only be identified by a letter or number in all notes and reports associated with the study. An explicit assurance of confidentiality will be given prior to the focus group interview session. As the focus group moderator, I will not reveal the identity of any of the focus group participants. In any reports based on the session, all quotations, citations, or paraphrases will be made generic with respect to unique personal features or identifiers, including but not limited to your gender, age, employer, ethnicity, and speech habits.

The IEEQ Program Assistant will make a photocopy of your co-op work term report, and will black-out all personal identifying features in the report, including but not limited to your name, your employer's name, location, job role, gender, age, ethnicity, speech habits, etc. I will use the black-out copy for further data analysis.

I will keep all the data, including the focus group summary notes, the audiotape of the focus group, and the co-op work term reports in my home, and the data will be destroyed at the end of the study.

I should also let you know that no compensation is being offered for your participation, although refreshments will be provided during the focus group interview.

Your signature on this form indicates that you have understood to your satisfaction the information regarding participation in the research project and agree to participate as a subject. In no way does this waive your legal rights nor release the researcher, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw from the study at any time, and/or refrain from answering any questions you prefer to omit, without prejudice or consequence. Your continued participation should be as informed as your initial consent, so you should feel free to ask for clarification or new information throughout your participation. My contact information is as follows:

Marcia Friesen
Mailing address: E2-262 EITC Office location: E3-571 EITC
University of Manitoba, Winnipeg, Manitoba, Canada R3T 5V6
Tel 474 7873 Fax 474 7676 E-mail Marcia_Friesen@Umanitoba.ca

This research has been approved by the Education/Nursing Research Ethics Board. If you have any concerns or complaints about this project, you may contact the above-named persons or the Human Ethics Secretariat at 474-7122, or e-mail margaret_bowman@umanitoba.ca. A copy of this consent form has been given to you to keep for your records and reference.

Sincerely,

Marcia Friesen, P.Eng.
Director, IEEQ Program

Please sign below to indicate your informed written consent to participate in this study.
Please choose either Option #1 or Option #2.

Option #1: I consent to participate in the focus group interview, and I allow the IEEQ Program to access my co-op work term report, written during the time I was a student in the IEEQ Program.

Participant's signature	Date
Researcher's signature	Date

Option #2: I consent to participate in the focus group interview only.

Participant's signature	Date
Researcher's signature	Date

To receive a summary of the results of this study, please fill out this page and return it to the IEEQ Program, or bring it to the focus group session:

Return to: Marcia Friesen
E2-262 EITC
University of Manitoba
Winnipeg, Manitoba R3T 5V6
Or by fax: 474-7676

Name _____

I prefer to receive the summary as an (check one)

☐ E-mail attachment to the following e-mail address:
_____

☐ Hard copy to the following mailing address:
_____

H.4 Letter of Informed Consent for Focus Group Interviews with Employers / Supervisors

[Date]

Dear participant:

This letter is provided to you to outline the purpose and nature of a focus group session to be used to evaluate the IEEQ Program, to formally request your participation in the study, and to obtain your written informed consent as a participant.

This consent form, a copy of which will be left with you for your records and reference, is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

The purpose of this research is to be an evaluation tool for the IEEQ program by exploring engineering employers' experiences in employing former IEEQ Program students. This research is the final phase of an overall study that began in 2004 and has included a series of focus group interviews and follow-up questionnaires with four consecutive cohorts of IEEQ Program students, during and after their participation in the IEEQ Program.

Should you agree to participate at this time, you will participate in one focus group interview of 60-to-90 minute duration, with other engineering employers who have employed former IEEQ students. The interview will be scheduled for [date and location].

Focus groups are a carefully planned, informal group discussion. They are designed to obtain perceptions on a defined area of interest in a permissive, non-threatening environment. The discussion is relaxed, comfortable, and often enjoyable to the participants as they share ideas and experiences. The purpose of a focus group is to gather data on the opinions, attitudes, and perceptions of the group.

The interview strategy will follow qualitative focus group interviewing norms. As opposed to a structured question and answer session, the format will be conversational and relaxed. I will use a prepared interview guide with open-ended questions to guide the conversation, and I will work to ensure the atmosphere is one in which you feel comfortable disclosing your feelings, perceptions, and opinions relative to your experiences with the IEEQ Program. The discussion during the focus group session will be audiotaped, and after the session, I will summarize the main points of the session in a written document. You will be invited to review the written summary and send any comments of clarification, correction, or additional thoughts and ideas to me. I will make any corrections identified by focus group participants and will add any additional information provided after the session. The revised written summary will again be provided to all participants for review and comment. Your identity as a focus group participant will be kept confidential. In the written summary notes of the session, I will identify participants only by a letter or number.

Before providing written consent, you should be aware that you have the right to withdraw any of your comments or withdraw completely from this study at any time, and that any disclosures or data you provide are held in complete confidence. To preserve confidentiality, you will only be identified by a letter or number in all notes and reports associated with the study. An explicit assurance of confidentiality will be given prior to the focus group interview session. As the focus group moderator, I will not reveal the identity of any of the focus group participants. In any reports based on the session, all quotations, citations, or paraphrases will be made generic with respect to unique personal features or identifiers, including but not limited to your gender, age, ethnicity, and speech habits. I will keep all the data, including the summary notes and the audiotape of the focus group, in my home, and the data will be destroyed at the end of the study.

I should also let you know that no compensation is being offered for your participation.

Your signature on this form indicates that you have understood to your satisfaction the information regarding participation in the research project and agree to participate as a subject. In no way does this waive your legal rights nor release the researcher, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw from the study at any time, and/or refrain from answering any questions you prefer to omit, without prejudice or consequence. Your continued participation should be as informed as your initial consent, so you should feel free to ask for clarification or new information throughout your participation. My contact information is as follows:

Marcia Friesen
Mailing address: E2-262 EITC
Office location: E3-571 EITC
University of Manitoba, Winnipeg, Manitoba, Canada R3T 5V6
Tel 474 7873
Fax 474 7676
E-mail Marcia_Friesen@Umanitoba.ca

This research has been approved by the Education/Nursing Research Ethics Board. If you have any concerns or complaints about this project, you may contact the above-named persons or the Human Ethics Secretariat at 474-7122, or e-mail margaret_bowman@umanitoba.ca. A copy of this consent form has been given to you to keep for your records and reference.

Sincerely,

Marcia Friesen, P.Eng.
Director, IEEQ Program

Please sign below to indicate your informed written consent to participate in this study:

Participant's signature Date

Researcher's Signature Date

Appendix I

A Holistic Definition of Engineering Design
(Friesen, 2003)