Skills Research Initiative
Initiative de recherche sur les compétences

Canadian Professional Networks:
A Survey of Highly Skilled Canadian Workers

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A. Labour Market and Skills Implications of Population Aging;
B. Employer-Supported Training;
C. Adjustments in Markets for Skilled Workers;
D. International Mobility of Skilled Workers.

Dans le cadre de la stratégie d'innovation du gouvernement fédéral, Ressources humaines et Développement social Canada (RHDSC), Industrie Canada (IC) et l'Initiative de la nouvelle économie du Conseil de recherches en sciences humaines (INE-CRSH) se sont associés pour concevoir et financer un programme pluriannuel de recherches sur les compétences, appelé Initiative de recherche sur les compétences de RHDSC-IC-CRSH. Ce programme comprend quatre grands thèmes :

A. les incidences du vieillissement de la population sur le marché du travail et la main-d'oeuvre spécialisée;
B. la formation en entreprise;
C. l'adaptation du marché du travail aux travailleurs spécialisés;
D. la mobilité des travailleurs spécialisés dans le monde.

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Abstract

The international mobility of skilled labour, and the possible benefits and costs to its sending and receiving countries, which is conceptualized in two models, the traditional *brain drain* model, and the more contemporary *brain circulation model,* is considered to have significant affect on the innovativeness of national economies. In addition, knowledge, one of the key inputs to the innovative process, is regarded as the most important single factor in determining competitiveness and success in the global knowledge-based economy. The study of knowledge flows and spillovers, which to a certain extent take place through the mobility of highly-skilled labour, are therefore becoming increasingly important concerns on the agendas of public policy initiatives, with the purpose of developing sustainable economic strategies. Most current national policy measures only focus on the simple attraction of highly-skilled individuals, with the understanding that an increased stock of knowledge will lead to innovation and successive economic growth. However, innovation is not a random phenomenon that takes place by chance, but is rather a collective process relying on the skills, and embedded in the social and professional networks, of individuals. Our comprehension of such networks is limited mainly because of the lack of relevant data and empirical research on this subject. Questions concerning the role of social and professional networks in facilitating international mobility of the highly skilled workers, and the intensity and activity of professional networks in Canada compared to other advanced countries, remain largely unanswered. This study attempts to respond to these questions by offering empirical evidence that was gathered through the "Survey of Canadian Professional Networks", which analyses highly-skilled Canadian individuals who obtained at least part of their graduate education abroad, and now either reside in Canada or abroad. Canadians living abroad do constitute, in part, a brain drain. By being embedded in a foreign network, their contribution to the Canadian knowledge network is almost by definition reduced. But there are also elements of brain circulation: Canadians abroad do seem to become involved in the Canadian knowledge economy when opportunities arise. But the survey results indicate significant differences between Canadians at home and Canadians abroad, and imply that there may be an opportunity to improve Canada's innovation system with public policies that enhance social and professional networks of highly-skilled Canadians.

Résumé

La mobilité internationale de la main-d'œuvre qualifiée, et les coûts et avantages possibles pour les pays d'origine et d'accueil, conceptualisée dans deux modèles, le modèle traditionnel de l'*exode des cerveaux*, et le modèle plus contemporain de la *circulation des cerveaux*, aurait un effet significatif sur la capacité d'innover des économies nationales. De plus, le savoir, l'un des éléments clés du processus d'innovation, serait le facteur le plus déterminant de la compétitivité et de la réussite dans l'économie mondiale du savoir. Les mouvements et les retombées du savoir qui, dans une certaine mesure, se produisent avec la mobilité de la main-d'œuvre qualifiée, sont des préoccupations de plus en plus importantes dont doivent tenir compte les décideurs dans l'élaboration de politiques publiques portant sur des stratégies économiques durables. La plupart des politiques nationales actuelles se concentrent uniquement sur la capacité d'attirer des personnes hautement qualifiées en supposant qu'un plus grand bassin de connaissances mène à l'innovation et à la croissance économique. Cependant, l'innovation n'est pas un processus

aléatoire qui se produit par hasard, mais plutôt un processus collectif reposant sur les compétences des personnes et intégré aux réseaux sociaux et professionnels. Nous ne comprenons pas très bien ces réseaux à cause surtout du manque de données pertinentes et d'études empiriques sur le sujet. Des questions restent en grande partie sans réponse, notamment en ce qui touche le rôle des réseaux sociaux et professionnels pour faciliter la mobilité internationale des travailleurs hautement qualifiés ainsi que l'intensité et l'activité des réseaux professionnels au Canada comparativement à ceux d'autres pays avancés. Nous tentons de répondre à ces questions en présentant des données empiriques tirées de l'enquête intitulée « Survey of Canadian Professional Networks », laquelle comprend une analyse portant sur des Canadiens hautement qualifiés qui ont effectué au moins une partie de leurs études à l'étranger et qui résident aujourd'hui au Canada ou à l'étranger. Les Canadiens qui vivent à l'étranger représentent, en partie, un exode des cerveaux. Comme ils font partie d'un réseau étranger, leur contribution au réseau du savoir canadien est, par définition, presque réduite. Toutefois, il existe des éléments liés à la circulation des cerveaux : il semble bien que les Canadiens à l'étranger participent à l'économie du savoir canadienne lorsque l'occasion se présente. Cependant, les résultats de l'enquête montrent de grandes différences entre les Canadiens qui vivent au pays et ceux qui vivent à l'étranger, et ils laissent supposer qu'il y a peut-être lieu d'améliorer le système d'innovation du Canada grâce à des politiques publiques destinées à perfectionner les réseaux sociaux et professionnels des Canadiens hautement qualifiés.

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INTRODUCTION

The project team is pleased to submit this final report presenting the results and findings of the undertaken research to Industry Canada (IC). The original request for proposal set out by the Skills Research Initiative (SRI), a multi-year initiative undertaken by IC and Human Resources and Social Development Canada (HRSDC), in partnership with the Social Sciences and Humanities Research Council (SSHRC), asked for a policy-relevant study to be undertaken that addresses the fourth skill policy-research theme on the SRI agenda: **International Mobility of Highly Skilled Workers**. Of particular interest are issues regarding the role of *social and professional* networks in facilitating international mobility of highly skilled workers, as well as their intensity in different localities.

The first phase of the SRI created a substantial body of literature concerning the mobility of highly skilled labour (HSL) and related topics in a Canadian context (Gera *et al.*, 2004 and Harris, 2004). The roundtable that followed set out research priorities, which served as a foundation and provided valuable insight for the successful undertaking of the study presented here (Benjamin *et al.*, 2004). Some of the conclusions drawn at this roundtable discussion were especially significant for the development of a sound methodology for carrying out the current research, such as the finding that data on HSL migration are scarce, or the importance of quality of social infrastructure in location decisions, and differences that apply across various types of high-skilled labour. In particular the scarcity of HSL migration data, and the lack of empirical studies concerning social and professional networks of individuals in this group, caused the project team to focus on gathering data that would allow for a detailed analysis to develop public policies that would support the SRI strategy. One method the project team explored to collect data in order to assess the extent and patterns of HSL mobility in detail, was the use of on-line surveys. This approach was subsequently pursued in the current study, and an on-line survey under the label "Survey of Canadian Professional Networks" was successfully carried out.

Furthermore, the project team also made an effort to consider other research findings and directions made in the previous phase of the SRI. The social infrastructure issue was not only incorporated into the on-line questionnaire, but this subject was even extended by incorporating questions with regards to the professional infrastructure. Finally, it was recognized that in the context of the proposed research, different types of high-skilled labour might belong to social and professional networks that vary significantly in their composition and structure. In order to assure consistency in the results derived from the survey, and to develop relevant public-policy recommendations that target a specific segment of the HSL population, the project team centered its investigation around professionals with at least a doctorate degree, in specific disciplines.

This approach was not only to include previous findings, but also to extend our understanding of the international mobility of high-skilled individuals in a Canadian context, in particular by adding empirical results concerning their professional networks. However, over the course of an empirical study it is sometimes necessary to adjust the initial proposed methodology in response to insights

gained while carrying out the research. In particular the identification and successive collection of contact information for potential survey recipients has been a challenging, and for the most part a work intensive task. Nevertheless, the project team was able to overcome various obstacles in the process of obtaining high quality data concerning the networking capabilities of highly skilled Canadians. Subsequently the derived findings and policy recommendations presented here should be a significant addition to the research carried out under the SRI, which will lead to wide-ranging public policies that secure Canada's future success in the competitive and innovative global economy that exist today.

This report is organized as follows: Section two consists of a concise review of the research objectives and methodology set out in the beginning of the study. Section three provides an overview of the project outline, in particular the selection process of survey recipients and the actual development of the on-line survey. Section four discusses some of the relevant literature concerned with the role of professional and social networks in the migration of highly skilled individuals. Section five summarizes the results and findings of the undertaken survey. Location motivation, graduate school experience and international networking are the main topics which have been analysed in detail. Section six provides policy recommendations based on the findings of the present study. The final section of this report will suggest further research directions in order to gain a better understanding of the differences between Canadians working at home, those working abroad, and their networking abilities in general.

RESEARCH OBJECTIVES

In an ongoing effort to support the Innovation Strategy, launched by the Federal Government of Canada in 2001, the SRI has set out specific research priorities with the purpose of developing progressive socio-economic Canadian policies that will secure and expand the nation's role as an innovative and highly successful economy. The present study addresses the area of social and professional network. In particular, the study addresses the following questions:

- What is the role of social and professional networks in facilitating international mobility of the highly skilled workers?
- What is the recent evidence in terms of intensity and activity of professional networks in Canada
- How do highly skilled Canadians develop and use international networks?
- Are expatriate Canadians a *potential* source of knowledge inflows to Canada?

The existence of strong professional networks, and a related increase in international mobility of highly skilled labour are, potentially, a source of complementary knowledge flows that could improve innovation and competitiveness. We should emphasize that in this study we do not address knowledge flows directly, but rather look in detail at some of the channels that underpin these flows,

such as conference participation and co-authorship. Given the importance of knowledge and information to support an innovative economy, these issues have a strong policy relevance and so deserve detailed study.

The main policy-relevant objective that guides the present study is

- To improve the ability of Canadians to network internationally without changing locations.

METHODOLOGY

The project methodology was to develop hypotheses and to design an on-line survey to collect relevant empirical data. The analysis of the survey responses combined with the insights gained through the review of similar empirical studies and the related theoretical literature should provide a foundation to deal with the research questions outlined above and further should lead to the development of policy recommendations which will assist the SRI in its task to develop progressive public policies.

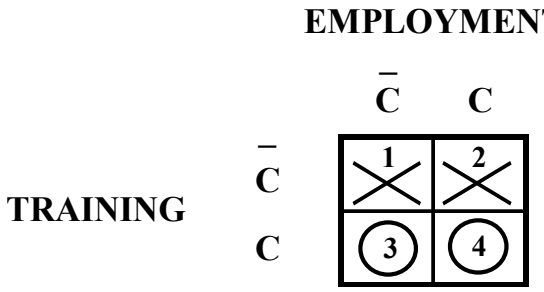
Highly skilled labour refers to skilled individuals in knowledge-intensive professions. In the current research, special attention was given to features of the professional networks used by researchers and scientists to understand their role in migration and career development processes. Consequently individuals with an advanced degree (e.g. Masters and Doctorate) have been of particular interest.

For highly skilled labour, there are two important elements that are significant in understanding such networks:

- Place of training – the actual location where skills were acquired; and
- Place of employment – the location were the acquired skills are utilized and therefore are a 'real' input into the economy.

The project team has stratified HSL on two dimensions: the place where they received training and the place where they are currently employed. Based on these factors a training/employment matrix was developed. This matrix, see **figure 1**, is useful in differentiating between the more significant and less significant policy-relevant population groups that should be analysed in detail.

Figure 1 – TRAINING/EMPLOYMENT MATRIX



Columns refer to place of employment and rows refer to place of training – C is in Canada, whereas C indicates outside Canada. X represents people who were trained outside Canada and O symbolizes individuals who were trained in Canada.

Thus, each cell represents a different category of skilled labour.

1) Canadian citizens who received part of their training and currently work outside Canada.

2) Canadian citizens and people residing in Canada who were trained outside Canada but have their place of work in Canada.

3) Canadian citizens and people of other nationalities who were trained in Canada but have their place of work outside Canada.

4) Canadian citizens and people residing in Canada who were trained and work in Canada.

Individuals who were trained in Canada benefit from an investment in their human capital by the Canadian government. If they do not engage in productive work in Canada then this is a net loss for the country. Similarly, individuals who are trained elsewhere and subsequently migrate to Canada to work are a relative bargain since the country has not or only partly subsidized their education. The goal of the current study was to undertake a quantitative analysis in order to understand what motivates these migration patterns and what role professional networks play in this decision making process.

The international mobility of highly skilled workers, which is conceptualised in category two and three of the training/employment matrix, indicates that we are dealing with a bidirectional process. The first and last category constitutes a relatively static population that is currently not mobile. However, despite this apparently immobility it is important to formulate an understanding of these

two categories, as they could potentially provide an insight into the factors that make highly skilled individuals remain at a certain place of residence.

PROJECT OUTLINE

Building on the findings of the HRSDC-IC-SSHRC Skills Research Initiative working paper series, in particular Gera *et al*. (2004) and Harris (2004), the project team has identified additional literature that is relevant for the study of social and professional networks for the mobility of HSL.

Recent studies conducted by researchers for the Organization for Economic Co-operation and Development (OECD) and the European Commission (EC) provide important practical insights, the same also applies to Statistics Canada's working papers series. The project team has identified several scholarly articles, which analyze the international mobility of skilled labour that have been valuable in the development and practical undertaking of the on-line survey. In addition, a detailed literature review was undertaken which was enormously helpful in carrying out the analysis of the data acquired through the on-line survey.

SIMILAR IDENTIFIED SURVEYS

The project team has reviewed several surveys that were initiated by international and national organizations with the goal of analyzing the mobility of highly skilled individuals and its impact on the economies. In particular two examples, although they were not conducted in Canada, have offered some significant insight into this field of research and served as a foundation for the development of the current on-line survey.

Blume (1995) has undertaken a comparative study for the European Commission on the mobility of doctoral students in the member countries of the European Union. This study, which involved 200 European teachers and doctoral students, outlines their motivation and criteria in selecting host institutions. One of the essential findings of the study is that the institutionalization, which is to a certain extent equal to the provision of social and professional networks, of student mobility for doctorates in science, translates into higher financial benefits than an individual could obtain through his own personal efforts. In addition, the survey also confirms that student perceptions of the prestige of institutions, or the general reputation of certain countries as a centre of excellence in a particular discipline, are determining factors in the motivation to relocate internationally. In the case of Canada, one approach to the institutionalization of student mobility is facilitated through extensive funding opportunities by organizations like the Social Science and Humanities Research Council (SSHRC), the Natural Sciences and Engineering Research Council of Canada (NSERC), and the Canadian Institutes of Health Research (CIHR) in form of postgraduate scholarship and postdoctoral fellowship programs. These programs partially provide financial assistance to

Canadians who pursue professional training abroad. This group also constitutes the key target population in the present study.

Another relevant project that offered suggestions for the current research task is a recent OECD study by Hansen (2004) carried out at the Maastricht Economic Research Institute on Innovation and Technology (MERIT). Hansen (2004) has conducted an on-line survey with the purpose of understanding the importance of social and professional networks in the context of international mobility of highly skilled labour. The findings, which were presented at the Productivity, Innovation and Value Creation Conference in Amsterdam, June 2004, found the following key reasons why HSL individuals migrate to work abroad:

- Access to R&D funding;
- Access to leading edge technology; and
- Reputation of institutions.

Although this study targeted highly skilled EU immigrants to the U.S., the project team believes that these findings are also significant in the Canadian context, considering that the United States are one of the major destinations of highly skilled Canadians.

In addition to empirical studies, the project team also evaluated several academic articles that focus on the development of HSL mobility surveys. In a theoretical account Recotillet (2003) summarizes the availability and characteristics of surveys on the destination of doctorate recipients in OECD countries. This article not only represents a compendium of various surveys but also provides the actual survey methodology and general questionnaire outline. The insights gained from the two policy-relevant studies described above, combined with the literature concerning the international mobility of HSL, allowed for the development of a well-designed on-line survey.[1]

First it was necessary to clearly specify the recipients of the specific survey. The task was to identify and obtain contact details of professionals belonging to the target population who have gone through extensive training, in the form of graduate school, and hold a professional position in the job market.

SELECTION PROCESS OF SURVEY RECIPIENTS

The training/employment matrix (Figure 1), described in the methodology sections above, stratifies highly skilled labour on two dimensions: the place where they received training, and the place where they are currently employed. Canadians who were trained abroad and subsequently return to Canada to work represent a relative bargain, as the country did not have to subsidize their education in the

1 The Appendix following this report contains detailed information regarding the format of the current on-line survey.

same way it is required to do for individuals who remained in the country and attended a Canadian institution of higher education and therefore are an essential target population that is highly relevant in carrying out the study of professional networks. However, even students who are funded by Canada to attend graduate school abroad, e.g. through SSHRC, NSERC or CIHR scholarships or fellowships, can represent an efficient way of importing knowledge and know-how developed abroad into the Canadian innovation system if these individuals return to Canada after their studies and actively network internationally. Although Canadians who were funded to be trained abroad and do not return to Canada following their graduation constitute a net loss for the country in terms of human capital and networking opportunities, they potentially also contribute to the national innovation system, especially if they engage in an intensive knowledge exchange with Canadians working at home.

The SSHRC, NSERC and CIHR every year provide extensive funding opportunities for Canadian students who study abroad through their postgraduate scholarship and postdoctoral fellowship programs. The project team consulted with these organizations, who in turn provided separate lists containing the names of funding recipients who have studied outside Canada in the past. These lists provided an excellent starting point however, most of them only contain the name, the year that the award was received, the institution awarded and the main discipline of the recipient. None of the lists enclose email addresses of the individuals who received funding for their studies abroad. In the months following the commencement of the study the project team put in a considerable effort to find email addresses of the identified individuals through an extensive web search process.

The Social Sciences and Humanities Research Council List of Funding Recipients

The list of doctoral and postdoctoral fellowships held outside of Canada in the time period from 1992/93 to 2005/06 provided by SSHRC contains 2,195 names. Doctoral fellowships accounted for 1,653 individuals while the remaining 542 were postdoctoral fellowships. The study team decided to search for email addresses of doctoral fellowships award holders in the time period from 1992/93 to 2000/01, which amounted to a total of 1,094 individuals. The reasons for focusing particularly on awarded doctoral fellowships in these specific years are twofold. First, the SSHRC list of doctoral fellowship award holders is considerably longer than the one for postdoctoral fellowships, allowing for the isolation of more individuals in one specific discipline, which is important considering the issue of consistency in the overall sample. Second, doctoral fellowship holders who received funding after the 2000/01 time period are expected to still be in graduate school, which does not make them potential candidates for the international job market as of yet.

Table 1 shows a breakdown by main discipline of doctoral fellowships awarded, and the country of the host institution in which the award was received in the time frame 1992/93 to 2000/01. The columns and rows following the detailed breakdown of awards by discipline and by the country in which the host institution is located, illustrate how many individuals in each of the respective groups have been identified through the web-based search that utilized the individual's name and the name

of the proposed organization. Searching for email addresses on the internet with only these two criteria is very time consuming. Considering this and the limited budget available to undertake the current research, disciplines where the email addresses found field is empty, which is indicated by a dash, have not been searched.

Almost 200 email addresses of individual who received a doctoral fellowship from the SSHRC in ten different disciplines have been found. The sample of addresses found in some disciplines is substantial. For example, the web-based search found 68% and 77% of all award holders in political sciences and economics respectively. In terms of the location breakdown of the organization awarded, the fast majority of funding is awarded to universities in the United States or the United Kingdom. Nevertheless, the search of email addresses conducted in the ten specified disciplines had a success rate of more than 50% in each country awards were utilized.

Not all email addresses that were found through the web-based search were still valid at the time the survey was electronically submitted to the recipients. The result is that it reduced the overall sample size in the respective disciplines and various locations of host institutions.
Subsequent to the columns and rows that indicate the breakdown of found email addresses, table 1 also presents the actual distribution of valid email addresses, which is actually the number of actual received on-line surveys, by discipline, and countries of host institutions. Once the survey was successfully conducted and officially closed, table 1 was supplemented with the final distribution of responses in each of the categories of funded individuals who received a SSHRC fellowship to pursue training opportunities abroad. The result is 67 complete responses in ten different disciplines.

Table 1. SSHRC Doctoral Fellowship Recipients in the Time Period of 1990/91 to 2000/01 who Studied Outside Canada.

Location of Awarded Organization / Main Discipline	AU	BE	FR	GE	IR	IL	IT	NL	RA	SE	UK	US	TOTAL	EMAIL ADD. FOUND	EMAIL ADD. % OF TOTAL	EMAIL ADD. VALID	EMAIL ADD. % OF FOUND	RESPONSES RE-CEIVED	RESPONSES PRTICI-PATION RATE
Anthropology	4	0	4	0	0	0	0	1	1	0	17	37	**64**	-	-	-	-	-	-
Archaeology	0	0	0	0	0	0	0	0	0	0	14	21	**35**	-	-	-	-	-	-
Classics, Classical & Dead Lang.	0	1	6	0	0	0	0	1	0	0	9	12	**29**	-	-	-	-	-	-
Communications and Media St.	0	0	1	0	0	0	0	0	0	0	3	9	**13**	4	*31%*	2	*50%*	1	*50%*
Criminology	0	0	0	0	0	0	0	0	0	0	2	1	**3**	-	-	-	-	-	-
Demography	0	0	0	0	0	0	0	0	0	0	0	1	**1**	1	*100%*	1	*100%*	1	*100%*
Economics	0	0	0	0	0	0	0	2	0	0	6	45	**53**	41	*77%*	32	*78%*	15	*47%*
Education	1	0	1	0	0	0	0	0	0	0	3	10	**15**	-	-	-	-	-	-
Fine Arts	0	0	8	2	1	0	0	3	0	0	28	64	**106**	-	-	-	-	-	-
Geography	0	0	0	0	0	0	0	0	0	0	3	6	**9**	6	*67%*	6	*100%*	3	*50%*
History	0	0	4	2	0	1	0	1	0	0	48	90	**146**	-	-	-	-	-	-
Industrial Relations	0	0	1	0	0	0	0	0	0	0	2	4	**7**	5	*71%*	5	*100%*	1	*20%*
Interdisciplinary Studies	1	0	0	0	0	0	0	1	0	0	5	10	**17**	7	*41%*	7	*100%*	1	*14%*
Law	1	1	3	0	0	0	0	0	0	0	18	50	**73**	-	-	-	-	-	-
Linguistics	0	0	3	3	0	0	1	0	0	0	2	21	**30**	-	-	-	-	-	-
Literature	0	0	14	0	1	0	0	0	0	0	40	69	**124**	-	-	-	-	-	-
Management, Business, Admin. St.	0	0	0	0	0	0	0	0	0	0	5	22	**27**	20	*74%*	16	*80%*	6	*38%*
Mediaeval Studies	0	0	2	0	0	0	0	0	0	0	9	11	**22**	-	-	-	-	-	-
Medical Sciences	0	0	0	0	0	0	0	0	0	0	0	1	**1**	-	-	-	-	-	-
Philosophy	1	3	13	2	0	0	0	2	0	0	24	47	**92**	-	-	-	-	-	-
Political Science	1	0	8	0	0	0	0	0	0	0	41	72	**122**	83	*68%*	62	*75%*	28	*45%*
Psychology	0	0	0	0	0	0	0	0	0	0	6	28	**34**	21	*62%*	13	*62%*	8	*62%*
Religious Studies	0	0	0	0	0	0	0	1	0	0	6	16	**23**	-	-	-	-	-	-
Social Work	0	0	0	0	0	0	0	0	0	0	1	0	**1**	-	-	-	-	-	-
Sociology	0	1	1	0	0	0	0	1	0	0	18	17	**38**	-	-	-	-	-	-
Urban, Reg. and Environmental St.	1	0	0	0	0	0	0	0	0	1	4	3	**9**	8	*89%*	5	*63%*	3	*60%*
TOTAL	**10**	**6**	**69**	**9**	**2**	**1**	**1**	**13**	**1**	**1**	**314**	**667**	**1,094**	**196**	***18%***	**149**	***76%***	**67**	***45%***
FOUND EMAIL ADDRESSES	2	-	6	-	-	-	-	3	-	1	40	144	**196**						
SHARE OF TOTAL	*20%*	-	*9%*	-	-	-	-	*23%*	-	*100%*	*13%*	*22%*	***18%***						
VALID EMAIL ADDRESSES	1	-	5	-	-	-	-	2	-	1	26	114	**149**						
SHARE OF TOTAL FOUND	*50%*	-	*83%*	-	-	-	-	*67%*	-	*100%*	*65%*	*79%*	***76%***						
RECEIVED RESPONSES	0	-	0	-	-	-	-	1	-	0	15	51	**67**						
PARTICIPATION RATE	*0%*	-	*0%*	-	-	-	-	*50%*	-	*0%*	*58%*	*45%*	***45%***						

Source:

SSHRC list of doctoral fellowships held outside of Canada in the time period from 1992-93 to 2005-06 provided by SSHRC specifically for the purpose of the current study.

The Natural Sciences and Engineering Research Council of Canada List of Funding Recipients

The detailed list of postgraduate scholarships and postgraduate fellowships recipients for the fiscal year from 1991/92 to 2004/05 provided by NSERC contains almost 16,000 names. However, this includes funding provided to both individuals who studied in as well as outside Canada. Furthermore, the list also includes a variety of different available funding programs. The relevant programs for the purpose of the current study are:

- 1967 Science and Engineering Scholarships
- Postdoctoral Fellowships
- Postgraduate Scholarships

The initial task of preparing a master list for the purpose of the current research was to filter out funding recipients who have attended an educational institution outside Canada. The next step was to only consider scholarships and fellowships that were awarded in the 1992/93 to 2000/01 time period, for the same reasons as described in the previous section, which resulted in a list of about 1,340 contacts who received awards in more than fifty disciplines. It was not feasible under the current contract with IC to undertake a web-based search for all individuals in this master list and therefore the study team decided to only inquire about the contact information in 23 of the fifty disciplines, all which were expected to yield a significant sample of the overall population within a certain subject area. This web-based search of 930 names of award recipients, or 75% of the total population in the list, resulted in more than 400 email addresses.

As was the case of the SSHRC web-based search, only a certain proportion of these email addresses were still valid at the point the on-line survey was submitted to the respondents. Table 2 outlines the detailed breakdown of found addresses and actual received surveys by main disciplines of scholarships and fellowships awarded, and the country where the awarded host institution is located. Once the survey was officially closed this table was updated to reflect the individual response rates in each of the categories.

More than 300 individuals who were awarded a scholarship or fellowship from the NSERC to study outside Canada in the ten-year period actually received the survey. Almost every second of these recipients decided to participate, which resulted in more than 140 responses. The received responses are distribution across 22 of the 23 selected disciplines. In terms of the locational breakdown of host organizations the fast majority of NSERC funding in the observed time period was awarded to universities in the United States, the United Kingdom and France. Accordingly most of the responses, more than 90%, are from individuals who have studied in either of these three countries.

Table 2. NSERC Scholarship and Fellowships Recipients in the Time Period of 1990/91 to 2000/01 who Studied Outside Canada.

Location of Awarded Organization / Main Discipline	AU	BE	CH	DK	FR	GE	IL	IT	JP	NL	NZ	PO	SE	UK	US	TOTAL	EMAIL ADD. FOUND	EMAIL ADD. % OF TOTAL	EMAIL ADD. VALID	EMAIL ADD. % OF FOUND	RESPONSES RE-CEIVED	RESPONSES PRTICI-PATION RATE
Analytical Chemistry	1	0	0	0	0	3	0	0	0	0	0	0	0	0	18	**22**	10	*45%*	10	*100%*	3	*30%*
Applied Mathematics	1	0	3	0	7	1	0	0	0	0	0	0	0	7	39	**58**	29	*50%*	20	*69%*	10	*34%*
Astronomy and Astrophysics	4	0	0	0	5	0	2	0	0	4	0	0	0	9	31	**55**	11	*20%*	8	*73%*	5	*45%*
Atomic and Molecular St.	0	0	0	0	0	0	0	0	0	0	0	0	0	2	6	**8**	0	*0%*	0	*0%*	0	*0%*
Biochemistry	1	0	4	2	3	0	0	0	0	0	0	0	0	11	72	**93**	32	*34%*	26	*81%*	8	*25%*
Biophysics	0	0	1	1	4	6	0	0	0	0	0	0	0	3	31	**46**	7	*15%*	7	*100%*	2	*29%*
Cell Biology	1	0	0	0	4	0	0	0	0	0	0	2	0	9	62	**78**	38	*49%*	31	*82%*	14	*37%*
Condensed Matterphysics	0	0	2	2	11	5	0	0	0	2	1	0	0	16	77	**116**	14	*12%*	12	*86%*	4	*29%*
Genetics	0	0	0	0	1	1	0	0	0	0	0	0	0	16	43	**61**	32	*52%*	25	*78%*	14	*44%*
Inorganic Chemistry	0	0	2	0	3	2	0	1	0	0	0	0	0	7	74	**89**	10	*11%*	9	*90%*	5	*50%*
Microbiology	0	0	0	0	3	0	0	0	0	0	0	0	0	3	23	**29**	14	*48%*	10	*71%*	2	*14%*
Molecular Biology	0	0	0	0	0	1	0	0	0	0	0	0	0	3	14	**18**	8	*44%*	7	*88%*	5	*63%*
Nuclear Physics	0	0	0	0	2	0	0	0	0	0	0	0	0	0	5	**7**	2	*29%*	2	*100%*	1	*50%*
Optics	2	0	0	0	12	0	1	0	0	0	0	0	0	1	12	**28**	8	*29%*	5	*63%*	1	*13%*
Organic Chemistry	5	0	2	1	3	0	0	0	0	0	0	0	0	9	139	**159**	51	*32%*	42	*82%*	18	*35%*
Particle Physics	1	0	0	0	0	2	0	0	0	0	0	0	0	2	49	**54**	9	*17%*	4	*44%*	3	*33%*
Physical Chemistry	1	0	3	1	1	3	0	0	0	0	0	0	0	4	66	**79**	6	*8%*	6	*100%*	2	*33%*
Physics	1	0	0	0	4	0	0	0	0	0	0	0	0	1	24	**30**	20	*67%*	15	*75%*	9	*45%*
Plasma Physics	1	0	0	0	1	0	0	0	0	0	0	0	0	0	6	**8**	4	*50%*	4	*100%*	3	*75%*
Polymer Chemistry	0	0	0	0	0	2	0	0	0	0	0	0	0	0	17	**19**	5	*26%*	5	*100%*	2	*40%*
Pure Mathematics	2	1	0	0	7	1	3	0	1	0	2	0	0	23	140	**180**	77	*43%*	62	*81%*	28	*36%*
Space Science	0	0	0	0	0	1	0	0	0	0	0	0	1	0	4	**6**	5	*83%*	4	*80%*	1	*20%*
Theoretical Physics and Chem.	1	0	3	0	8	0	0	0	0	0	0	0	0	19	72	**103**	9	*9%*	4	*44%*	3	*33%*
TOTAL	**22**	**1**	**20**	**7**	**79**	**28**	**6**	**1**	**1**	**6**	**3**	**2**	**1**	**145**	**1024**	**1346**	**401**	***30%***	**318**	***79%***	**143**	***36%***
FOUND EMAIL ADDRESSES	8	1	3	2	21	10	2	0	0	1	1	0	1	47	304	**401**						
SHARE OF TOTAL	*36%*	*100%*	*15%*	*29%*	*27%*	*36%*	*33%*	*0%*	*0%*	*17%*	*33%*	*0%*	*100%*	*32%*	*30%*	***30%***						
VALID EMAIL ADDRESSES	6	0	3	2	15	9	2	0	0	1	1	0	1	34	244	**318**						
SHARE OF TOTAL FOUND	*75%*	*0%*	*100%*	*100%*	*71%*	*90%*	*100%*	*0%*	*0%*	*100%*	*100%*	*0%*	*100%*	*72%*	*80%*	*79%*						
RECEIVED RESPONSES	3	0	2	1	5	3	0	0	0	0	1	0	0	14	114	**143**						
PARTICIPATION RATE	*38%*	*0%*	*67%*	*50%*	*24%*	*30%*	*0%*	*0%*	*0%*	*0%*	*100%*	*0%*	*0%*	*30%*	*38%*	***36%***						

Source:

NSERC list of doctoral fellowships held outside of Canada in the time period from 1992-93 to 2005-06 provided by NSERC specifically for the purpose of the current study.

The Canadian Institutes of Health Research List of Funding Recipients

The CIHR also provided a list of funding recipients in the time period of 1990-91 to 2004-05. The list contains awards granted inside and outside of Canada. Because of the limited time and financial resources available to undertake the present study it is not possible to utilize the CIHR list of funding recipients for the survey at this point in time.

The Survey of Canadian Professional Networks

The on-line survey, which was officially named "Survey of Canadian Professional Networks", was launched on October 27, and officially closed on December 18, 2005. Almost 600 invitations were sent out, however, 128 emails were undeliverable which indicates that the contact information, which was found through a web-based search, was outdated. 467 highly skilled individuals received the survey and in the following months 210 would fully complete the questionnaire which resulted

in a response rate of 45 percent. Out of these 210 respondents 106 have their place of residence and place of work in Canada whereas the remaining 104 reside outside Canada. This favorable distribution of almost 50% in each of the two main categories guaranteed an even sampling of the two main groups of interest in the analysis, i.e. Canadians at home and Canadians abroad. Furthermore, 170 individuals are currently employed at a university. The respondents' primary research activities stated in the survey covers 28 different disciplines in the social and natural sciences.

The results section of this report represents a detailed analysis of the response and the Appendix outlines a survey design providing details regarding the logic and various questions asked in the on-line survey.

RELEVANT LITERATURE

In addition to the policy-relevant surveys identified above, the role of professional and social networks in the migration of highly skilled individuals has been receiving increased attention in academic literature. Indeed, a social network perspective has been adopted in a significant number of studies in the field of international migration, determining that it is a "network-mediated" process (Wilson, 1994; see also Fawcett and Arnold, 1987; Portes 1995; Vertovec and Cohen 1999; Meyer, 2001). Networks yield resources such as information, assistance, influence, the ability to reduce risks, and provide channels for the migration process itself.

Within this literature the migration of knowledge workers is a relatively recent phenomenon that emphasizes *mobility* and *movement* at various points in their education and career, indicating a shift away from the notions of permanency or long-term immigration (Koser and Salt, 1997). The range of factors that shape such movements are understood to be multiple and overlapping, and a "network approach" is called for to understand the mobility of highly skilled persons (Meyer, 2001). Such an approach yields insight into the reasons people migrate, the effects of their mobility on their individual careers, the propensity of knowledge transfer to their new environments, and possible reasons that people choose to stay in or move to particular places. Unfortunately, however, there is a general dearth of empirical scholarship on the issue.

A few recent studies do, however, demonstrate that the kinds of social relations that an individual has (his or her ego-centric network) affects where they locate as skilled labour. Traditionally, family and community ties affected migration patterns (Boyd, 1989). Recent studies suggest that social and professional, as well as co-ethnic ties (shared ethnicity, language or nationality), are increasingly significant (Mitchell, 2000). The first of this type of networks found in the literature is the overseas alumni network. Those who conduct part of their studies in a country different from their birthplace create a social network that they may be able to draw upon later in their working life. Meyer writes (2001:98), "There is a continuity between the acquisition of an advanced degree and knowledge, and the exercise of a professional career, that is directly or indirectly related to this

education." Certainly, the experience in a different academic tradition, possession of recognizable academic credentials, and possibly new language skills will enhance an individual's career development in the country where the education took place. However, even more important, Li et al (1996) suggest, are the contacts that foreign students make. These contacts have value both in the location where the studies were completed and along the future travel paths of classmates (Li et al., 1996; Vertovec, 2002). School ties comprise part of a transnational social network that may provide valuable sources of information about employment-related opportunities abroad or collaborative work possibilities.

Beaverstock's (2005) study of British expatriates living in New York City as "transnational elites" in the financial sector is similar for noting the importance of transnational networks for providing information about new employment opportunities abroad. His study focuses on managers who have moved to different global city locations through inter-company transfers. He suggests that while their first step in an international career was within the same firm, this step enabled the worker to establish social contacts abroad that would inform them of other subsequent employment opportunities (outside their firm). In other words, this first phase of mobility instigated a larger "international career path" within the financial sector through the enlarged network of professional colleagues.

Social contacts may also influence or create opportunities for highly skilled individuals if there is a sense of responsibility for those contacts. In a study of Indian and Chinese knowledge workers in the Silicon Valley, Saxenian (2002) finds that shared ethnicity creates such a sense of trust and duty. Many foreign-trained scientists and engineers that studied in California that stayed as entrepreneurs drew heavily upon social and professional contacts of common ethnicity to enhance their business opportunities. Saxenian's study finds many first-generation immigrants *deliberately* maintain a range of professional ties with their home country and return regularly on business trips, as well as among the diaspora in the Valley, thus actively constructing and shaping the opportunities for their own international careers.

Meyer and Brown (1999) similarly document the growing trend of transnational ethnic or diaspora networks among professionals and find 41 such networks in 30 countries. Notably Canada does not appear on their list. Meyer and Brown look at diaspora networks created as part of a *national* strategy by countries normally suffering a net loss of highly skilled workers. The networks Meyer and Brown identify have the explicit purpose of connecting expatriates with one another and with the country of origin, with the desired purpose of "promoting exchange of skills and knowledge." The effort among the national governments to establish the diaspora networks seems to be to draw upon a sense of responsibility to other nationals as a relatively strong tie.

Looking specifically at academics, Mahroum suggests that because people ascribe greater prestige to certain universities or research centres, they seek out periods of mobility (for graduate studies or as visiting scholars) to well-known institutions to gain access to esteemed colleagues as social contacts,

as well as to obtain affiliation with prestigious institutions. Mahroum writes that wanting to move to these institutions is "an obvious tactic of *professional socialization* as a means of enhancing a person's prestige. Professional socialization brings access to formal and informal networks of scholarly power" (2000a: 515).

SURVEY RESULTS: WORKING AT HOME VERSUS WORKING ABROAD

Guided by the primary research question regarding the role of social networks in facilitating mobility, the aim of the survey was to obtain data which allows for analysis on whether Canadians who study abroad and return home have different career experiences than those who stay abroad after their studies. Of particular interest are the international aspects of their respective careers, and whether it is possible to detect differences in the extent to which these groups are linked both to the Canadian community of researchers, and to the wider international community. Closer links to Canadians and Canadian activities could suggest that the diaspora provides Canada with links to the international knowledge community. What is reported here is largely descriptive, having to do with perceptions and motivations, and with the different types of links individuals have to the research community. The extent to which a highly skilled individual's career is international is driven by many things, but the focus in the present study is on the following three: history, or previous experience and social ties; current location and position; and where the scientific centre of gravity lies for the individual's discipline.

For our sample, historical ties refer to shared Canadian nationality and the experience of a post-graduate training which took place, at least partly, abroad. Almost all the respondents in the survey sample are Canadian citizens, and 90% have undergraduate degrees from Canadian institutions. This study group represents the elite of Canadian university graduates as the individuals were awarded government funding for graduate study. These awards were made available through the Natural Sciences and Engineering Research Council (NSERC) and the Social Sciences and Humanities Research Council (SSHRC) of Canada on a competitive basis and were awarded through an independent, national peer-review process designed to ensure excellence.

The current location of our sample varies, with about half of the fellowship recipients working in Canada at the time they responded to the survey and half working elsewhere. Table 3 represents the current geographic location of the respondents.

Table 3. Current Place of Residence.	
Total respondents	**210**
Canada	50.5%
Outside Canada	49.5%
United States	37.1%
Australia	1.9%
Belgium	0.5%
Chile	0.5%
Finland	0.5%
France	1.0%
Germany	1.0%
Netherlands	1.9%
Singapore	0.5%
Sweden	0.5%
Switzerland	0.5%
United Kingdom	3.8%
Total	100.0%

All of the respondents hold Ph.D. degrees, and 55% of them were awarded by an institution outside Canada. All respondents have received at least part of their post-graduate training abroad, as they have been identified through the records of past SSHRC and NSERC as having received funding that was awarded to an educational institution located outside Canada. The two sub-groups, Canadians working at home and Canadians working abroad are remarkably similar with respect to discipline, at least in the cases where a considerable count exists. In both groups males account for about 70% of respondents. As would be expected of highly educated researchers and/or academics, most of the respondents, about 80%, work at universities. The distribution between respondents who work at universities and those who work elsewhere is the same for both study groups.

The point of interest lies in the differences between those currently located in Canada and those located abroad. In this report, we do not specifically address the issue of the scientific centre of gravity, that is, where scientists believe the centres of excellence in their fields are located, but do consider how they perceive their location in relation to such centres. Adding this to the analysis is an important next step, but because of the statistical complications it raises, it is set aside for the present study.

LOCATION MOTIVATION

One striking difference between Canadians at home and Canadians abroad is revealed in the motivations they provide for choosing where to live. Three aspects of motivation were queried: financial, professional, and personal. The survey asked that each of these factors be ranked on a 5 point (Likert) scale from 'Not Important' to 'Essential' (with 'Somewhat Important,' 'Important' and 'Very Important' in between).

Canadians at home are much less motivated by financial concerns: 62% stated that financial concerns were *not* important in making their current employment choice. By contrast, only one third of Canadians abroad considered financial concerns as not important. This is not surprising considering that 37% of Canadians abroad work in the United States where academic salaries are generally much higher. On the other hand, of the Canadians at home, one third saw personal reasons as essential in their locational choice, whereas personal reasons were essential for only 11% of Canadians abroad. Professional reasons were strong motivators for both groups, but again, there is a noticeable difference. About 60% of those at home, and 80% of those abroad, found professional reasons to be important, very important or essential, for their location choice.

It may be worth noting that of those currently working outside Canada 75% indicated that they pursued employment opportunities in Canada. However, only one-third of them state that they had received bona fide job offers in Canada when they accepted work abroad. This means that 66% did not have the option to return to Canada. This suggests that the highly advertised brain drain may be driven by the absence of jobs, or the quality of jobs, in the fields in which highly skilled individuals graduate. Forty-two percent of Canadians working at home had concrete job offers elsewhere but choose to stay in Canada.

Generally, what we observed is that those returning and those staying abroad are motivated in very different ways, and by different things. In particular, the open-ended responses reveal that many of the people returning to Canada are strongly motivated by their heritage and loyalty to Canada, and the desire to raise their families, and live in Canada.

GRADUATE SCHOOL EXPERIENCE

Overall those returning home and those staying abroad evaluated their graduate school experience in very similar ways. In both groups roughly one-third found that studying abroad was essential for their professional development. We suspect, but cannot tell from the data, that this is driven largely by two things: the perceived quality of the education and teaching they received; and more importantly, the perception of being, while in graduate school, in an environment containing scholars and scientists of world class quality and the opportunity to participate in research projects that extended their professional networks.

Personal and professional connections made in school can last beyond the duration of study, and one possible advantage to Canada of sending students abroad for graduate studies is that by spending time outside the country they develop long-term connections to the international community. The survey asked whether connections made during graduate school were still active.[2] When the question was posed in terms of "Professional Contact" 48% of Canadians at home, but 71% of Canadians abroad responded that they still maintain ties. When asked about "Professional

[2] The actual question was "Do you still have professional contact with the host institution where you undertook your graduate studies?"

Collaboration" Canadians in Canada responded even more differently to those abroad; in fact they collaborate much less with colleagues they met in graduate school, only 32% in comparison to 66%. Finally we also asked the respondents if their non-Canadian graduate school created professional opportunities for them. Forty-five percent of Canadians at home indicate that their international host institutions generated professional opportunities in comparison to 62% for Canadians living and working abroad. Table 4 provides a summary for these three important networking questions.[3]

Table 4. Graduate School Networking Questions.

***QUESTION**: Do you still have professional contact with the host institution where you undertook you graduate studies?*

PLACE OF RESIDENCE	CANADA	OUTSIDE CANADA
Total Responses	87	87
Yes	48.3%	71.3%
No	24.1%	21.8%
N/A	27.6%	6.9%
Total	100%	100%

***QUESTION**: Do you professionally collaborate with persons you met as graduate students while studying outside Canada?*

CURRENT RESIDENCE	CANADA	OUTSIDE CANADS
Total Responses	87	87
Yes	32.2%	65.5%
No	21.8%	16.1%
N/A	46.0%	18.4%
Total	100%	100%

***QUESTION**: Did your non-Canadian graduate school create professional opportunities for you (e.g. invitations to conferences or seminars)?*

CURRENT RESIDENCE	CANADA	OUTSIDE CANADS
Total Responses	87	87
Yes	44.8%	62.1%
No	5.7%	10.3%
N/A	49.4%	27.6%
Total	100%	100%

[3] People who accepted post-docs at the institutions from which they received their graduate degrees have been excluded in these particular frequency calculations. Obviously they would have both weak and strong ties to their graduate schools, just by virtue of their current or previous positions. The current study is not interested in this type of tie, but rather in networking effects.

What we observed suggests that tight links are easier to maintain for those working abroad, but even for Canadians returning, links created in graduate school do remain, though less frequently. This disparity is not entirely surprising, since location and distance are still relevant, and proximity makes it easier to maintain close ties. Nonetheless, looser ties should not be denigrated, as they are still useful in information transmission, and in creating research and dissemination opportunities for scientists. They can be seen as one of the positive benefits derived from Canadian students who go to graduate school abroad, as they can provide a direct link from Canada into the wider scientific community.

INTERNATIONAL NETWORKING

The strongest form of networking is collaboration on research projects, the attendance of professional conferences and seminars, and co-authorship of papers. Here we would expect localization to be strong. Information age notwithstanding, it is much easier to collaborate and write papers with local colleagues and to attend conferences and seminars which are held in geographic proximity to one's place of work. Nonetheless, we regularly observe international collaborations. Dividing the world into two, Canadians working at home and Canadians working abroad, we can inquire about the extent of collaboration between fellow Canadians. More than 80% of Canadians in Canada collaborate with professionals abroad and about one-third of them are collaborating with fellow Canadians who work outside Canada. Fifty percent of Canadians residing abroad work with either fellow Canadians who work in Canada or abroad, but only 15% collaborate with both Canadians located in and outside Canada. Canadians at home are 4.5 times more likely to participate in joint research projects outside Canada than Canadians who live abroad participate in Canadian joint research projects.[4]

However, this is slightly misleading. Consider this ratio under the assumption that there is no geographic component to choice of collaborative project partners. Canada and the U.S. jointly comprise over 90% of the respondents, but Canada and the U.S. vary significant in terms of size: the OECD reports Canada as employing about 113 thousand researchers, whereas the United states employs 1335 thousand.[5] Making strong assumptions about linearity, a researcher in Canada should be 12 times as likely to find a partner abroad, as a researcher abroad is to find a partner in Canada. In our data, a researcher in Canada is only 4.5 times as likely to find a partner abroad as a researcher abroad is to find a partner in Canada. Thus for Canadians abroad, Canada has a stronger pull than might be expected based just on its size. To do the next step in the analysis, which involves

[4] An interesting question, though, is whether Canadians abroad are more likely to collaborate with Canadians than are non-Canadians abroad, and similarly whether Canadians in Canada who have foreign degrees are more likely to have foreign collaborations than are those in Canada with Canadian degrees. To be able to answer those questions it would be necessary to create a matched-pairs sample for the respondents of the current survey which could be carried out in a possible follow-up project to the present study.

[5] Data refer to 2003, and are taken from OECD(2005), "Key Figures".

comparing Canadians abroad to similar non-Canadians abroad, demands richer data than are currently available.

A second type of international networking involves conference, seminar and workshop participation. We asked respondents to indicate how frequently they have participated in international conferences/workshops and seminars held in or outside of Canada in the past 12 months. In addition, we also inquired about their participation in thesis examination committees in the same time period. Seventy percent of the sample that reside in Canada did attend international conferences or workshops outside Canada in comparison to 85% of Canadians living abroad. The average participation frequency in such events is two attendances per annum in comparison to three per annum respectively. Given issues of geographical localization, financial and time costs of travelling, these responses seem to indicate fairly similar behaviour. Outward mobility of Canadians working in Canada seems strong. To compare, respondents were also asked about their involvement in international conferences or workshops held in Canada. Fifty-one percent of Canadians attended, on average, 1.6 conferences in Canada compared to 19% and 1.2 for Canadians working abroad. At first glance, inward mobility of Canadians working abroad seems much weaker.

When asked about their participation in seminars held in and outside Canada, the two groups showed similar patterns to those observed in the questions about international conferences and workshops. Table 5 summarizes the participation rates and frequencies in these events. One has to be cautious when interpreting these results, though, because international conferences outside Canada will be in some cases more accessible and convenient due to their geographic location for Canadians who reside abroad. This is especially true in the case when an international conference takes place in the same country where Canadian professionals reside.

The overall pattern of collaboration and participation in conferences, as well as thesis examination committees, suggests that Canadian professionals are somehow less constrained by localization effects, and thus that they engage more heavily in international networking. This must be interpreted very cautiously however, because it is confounded in several ways. We can see three motivating factors when Canadians, either at home or abroad, find collaborators: the effects of distance; the effects, if they exist, of shared Canadian background; and the effects of the search for excellence. These three effects are all entangled in the numbers just presented. They cannot be disentangled without very detailed data on conference international participation and travel, location, dates, and nature of the events.

Table 5. Participation in any of the Following in the past 12 Months.		
International conferences/workshops held in Canada		
PLACE OF RESIDENCE	CANADA	OUTSIDE CANADA
Participation Rate	50.9%	19.2%
Average Participation Frequency	1.6	1.2
International conferences/workshops outside Canada		
PLACE OF RESIDENCE	CANADA	OUTSIDE CANADA
Participation Rate	69.8%	84.6%
Average Participation Frequency	2.0	3.1
Canadian conferences or workshops		
PLACE OF RESIDENCE	CANADA	OUTSIDE CANADA
Participation Rate	65.1%	10.6%
Average Participation Frequency	1.7	1.3
Seminars held in Canada		
PLACE OF RESIDENCE	CANADA	OUTSIDE CANADA
Participation Rate	53.8%	13.5%
Average Participation Frequency	6.7	1.4
Seminars held outside Canada		
PLACE OF RESIDENCE	CANADA	OUTSIDE CANADA
Participation Rate	23.6%	66.3%
Average Participation Frequency	2.4	7.9
Thesis examination committee in Canada		
PLACE OF RESIDENCE	CANADA	OUTSIDE CANADA
Participation Rate	50.0%	1.0%
Average Participation Frequency	2.9	2.0
Thesis examination committee outside Canada		
PLACE OF RESIDENCE	CANADA	OUTSIDE CANADA
Participation Rate	6.6%	38.5%
Average Participation Frequency	1.9	2.8

The most striking finding in regards to these networking questions is the low participation rate of Canadian professionals living abroad in international conferences and workshops held in Canada. Only 19% participated on average in such an event over a time period of 12 months. This could imply that there is either a lack of such events, or the ones that take place do not attract, for either intellectually or theme related reasons, Canadians who work abroad. But this initial impression may

be mis-leading. A rough calculation suggests that this is actually quite a high participation rate.[6] There is clear evidence that there is a tendency for the diaspora to return to Canada for conference presentations, presumably thereby increasing general access in Canada to new developments made abroad and adding to the overall national innovation system. Indeed, using formal statistical significance as the measure, there is no difference in behaviour between Canadians resident in Canada and that resident abroad, in terms of international conference participation either in Canada or abroad. Again these results must be treated with some caution though. The participation rates have in most cases high standard deviations, which explains the statistical similarity of some of the means. It is quite possible that on a larger sample the standard deviations would fall without considerably changing the means. This would indicate a significant difference in behaviour with regard to conference location for our two sub-populations.

Co-authorship of refereed articles and books is another form of networking, and again we would expect a strong localization effect, observing a higher number of local collaborations over international ones. We asked two sets of questions in this regard, one referring to co-authorship with fellow Canadians and the other inquiring about co-authorship with non-Canadians. In order to reflect the intensity of professional networks, the individuals were asked about the actual number of professionals they work with, including counties they reside in and the frequency of publications they have produced with them since finishing graduate school. Because the years in which the respondents in the sample received their PhD vary, from very recent back until 1990, it was necessary to adjust the absolute responses to per year average values in order to compare and draw conclusions between the received results.

Refereed articles are probably the most frequent way academics and researchers communicate their research findings. This also explains the high response rates concerning this type of publication with 79%, and 86%, for Canadians working at home and abroad respectively. More interesting is co-authorship since co-authorship of an article indicates significant cooperation, and presumably, knowledge transfer from one author to the other. The results here are somewhat surprising, as they indicate that more professionals abroad co-author with fellow Canadians (89) than Canadians working in Canada (84). However, in terms of intensity Canadians at home joint publish with more fellow Canadians, on average with 0.8 per annum, compared to Canadians working abroad who co-publish on average with 0.5 fellow Canadians in the same time period. Similarly Canadian professionals working at home also co-publish more frequently, again 0.8 p.a., compared to 0.5 p.a. Nevertheless the results indicate that on average Canadians abroad published one article they co-authored with one fellow Canadian every two years. When asked about the frequency of co-

[6] Based on the ratio calculation applied to joint research projects above, if conference participation shows no localization effects, and in effect scientists choose conferences (geographically) at random, we would expect that participation frequencies for conferences in Canada should be 1/12 (0.08) that of rates for conferences in the U.S. For Canadian residents, this ratio is much higher: 1.6/2.0 = 0.8. For Canadians resident outside Canada the ratio is also higher: 1.2/3.1 = 0.39. Even though the participation ratio is much lower for Canadians outside Canada, it is still much higher than what we would expect if conference participation were geographically random. This suggests that the diaspora does return when offered this sort of opportunity.

authoring books with Canadians since graduate school the responses show the same tendency in terms of intensity between the two groups, however, once again many more Canadians abroad indicated that they have co-authored books than Canadians at home, 31% compared to 69% respectively.

One possible explanation would be if, on average, the sample of expatriate Canadians received their degrees longer ago than their counterparts who work at home, as it may take some additional time after graduate school to establish networks which lead to co-authorships. A closer look at the distribution of granting dates of PhDs shows that there are no significant differences between the two groups in the sample, and therefore this cannot explain the differences in the intensity of co-authoring. Table 6 summarizes the results concerning the questions about co-authored publications with Canadians since graduate school.

Table 6. Co-Authored Publications with Canadians since Graduate School

The respondents had the option to indicate with how many Canadian professionals they have co-authored in either of the three types of publications since finishing graduate school.

1. Total Positive Responses for Type of Publication 2. Number of Distinct Co-Authors *(average p.a.)* 3. Number of Publications *(average p.a.)*	CURRENT PLACE RESIDENCE / WORK	
	Canada	**Outside Canada**
Total Sample Size	**106**	**104**
REFEREED ARTICLES		
1. Total Positive Responses	**84**	**89**
2. Number of Distinct Co-Authors	*0.79*	*0.48*
3. Number of Publications	*0.84*	*0.47*
BOOKS		
1. Total Positive Responses	**33**	**72**
2. Number of Distinct Co-Authors	*0.58*	*0.34*
3. Number of Publications	*0.50*	*0.31*
OTHER PUBLICATIONS		
1. Total Positive Responses	**37**	**73**
2. Number of Distinct Co-Authors	*0.62*	*0.41*
3. Number of Publications	*0.76*	*0.39*

The respondents were also questioned about to their co-authorship activities with non-Canadians. Following the same logic as in the previous question, of particular interest are the location of co-authors, the total number, and the frequency of collaborations that resulted in refereed publications. The survey layout gave the respondents the opportunity to select up to five countries, along with the number of professionals and publications they have published with. The results, summarized in table 7, indicate that about 81% of Canadians who reside abroad and some 68% of Canadians at home have produced at least one refereed publication with a non-Canadian since they finished graduate school. In terms of where these professionals were located at the time the co-authorship took place, professionals from the United States dominate both groups in similar rates as the overall

publishing activity, 65% and 81% respectively. However, Canadians who currently work abroad have published with twice as many non-Canadian co-authors per year, on average 1.4 compared to 0.75, than professionals currently working in Canada. The actual annual frequency of co-authored refereed publications with non-Canadians is again much higher for Canadians abroad, 1.24, than it is for Canadians at home, which indicates that they have produced on average 0.75 publications with non-Canadians per year.

Table 7 shows that this trend continues throughout the selected countries. Due to the variance in the years that professionals in the sample finished graduate school, the frequency of co-authorship with non-Canadians sharply declines down the selection list. Only 9% of Canadians working abroad and 8% of Canadians working at home have published with professionals from five different countries. However, even in this relatively small sample, Canadians who work abroad show much higher annual frequencies of publications with non-Canadians than the group of Canadians who work at home.

Similar to the previous question regarding co-authorship with Canadians, the localization effect seems to play an important role in the context of co-authorship with non-Canadians. Examining the overall responses in terms of current place of work and the geographic location of co-authors, it is clearly evident that Canadians who currently reside in a particular country most frequently have co-authors in that country. For example, Canadians working in Australia, France, Germany or the United States at the time the survey, co-authored 38%, 30%, 40%, and 55% respectively of all their refereed publications with non-Canadians, with peers in the country they currently reside in. The only exception are Canadians who work in the United Kingdom who indicated that they have only co-authored 8% of all their refereed publications with non-Canadian colleagues from the U.K.

It is very likely that once the localization effect is accounted for, that Canadians working at home actually collaborate in the same intensity with non-Canadians as do Canadians who work abroad. However, there are two limitations in the current survey that prevent a formal analysis of that issue: the small sample size of Canadian professionals working abroad other than in the United States, and the lack of information regarding the actual timing of publications with non-Canadians, which, if present, would allow for the cross-tabulation of the place of residence and country of the co-author at the time the collaboration actually took place. Considering that more than 90% of respondents in both groups have resided in a different country prior to their current place of residence, (which is another indicator that we are dealing with highly mobile individuals), it is clear that such an analysis could reveal further information regarding the composition and intensity of professional networks for highly skilled Canadians. One possible way to accomplish a more detailed analysis of the co-authorship activity of individuals in the current sample would be to complement the survey data with relevant information from the Institute for Scientific Information (ISI) publications database, which, through the institutional affiliation and the date of publication field, would allow for further analysis and the isolation of localization effects.

Table 7. Co-Authored Refereed Publications with Non-Canadians since Graduate School

The respondents had the option to enter up to five countries and the responding number of professionals and publications they have co-authored with individuals in these locations since graduate school.

	1. Co-Author/s Country *(Total Positive Responses)* 2. Number of Distinct Co-Authors *(average p.a.)* 3. Number of Publications *(average p.a.)*	CURRENT PLACE OF RESIDENCE / WORK	
		Canada	**Outside Canada**
1. SELECTION	United States	47	68
	European Countries	20	12
	Other Countries	5	4
	Total Positive Responses	**72**	**84**
	Distinct Co-Authors	***0.75***	***1.43***
	Publications	***0.75***	***1.24***
2. SELECTION	United States	5	7
	European Countries	18	22
	Other Countries	10	13
	Total Positive Responses	**33**	**42**
	Distinct Co-Authors	***0.35***	***0.79***
	Publications	***0.45***	***0.72***
3. SELECTION	United States	1	0
	European Countries	13	20
	Other Countries	5	7
	Total Positive Responses	**19**	**27**
	Distinct Co-Authors	***0.28***	***0.96***
	Publications	***0.28***	***0.63***
4. SELECTION	United States	2	1
	European Countries	8	11
	Other Countries	6	4
	Total Positive Responses	**16**	**16**
	Distinct Co-Authors	***0.41***	***0.79***
	Publications	***0.34***	***0.66***
5. SELECTION	United States	0	0
	European Countries	4	5
	Other Countries	4	4
	Total Positive Responses	**8**	**9**
	Distinct Co-Authors	***0.24***	***1.76***
	Publications	***0.24***	***0.73***

Table 8 shows a summary of collaboration behaviour, comparing Canadians in Canada with those abroad.[7] Again we apply the ratio calculation, previously used in the analysis of research project collaboration and conference participation, which is based on strong linearity assumptions. The null hypothesis is that collaborators are chosen at random from the entire world. As a reasonable lower bound for "non-Canada" we can again use the United States, since Canada plus the United States jointly encompass 90 percent of the sample. Again, simply using numbers of employed researchers, non-Canada is at least 12 times as big as Canada. Therefore, on the assumption that collaborators are chosen randomly from the world, an upper bound for the ratio of Canadian to non-Canadian collaborators, is 1/12, or 0.08. This number can be compared with the Canadians to non-Canadians ratios for each type of collaboration in table 8. All calculated ratio values are well above the upper bound of 0.08, indicating that regardless of where Canadians reside they proportionally collaborate with more fellow Canadians than expected. The "random collaborator selection" assumption is obviously too strong, since it is well-known that even today localization effects are important. But for Canadians in Canada, including localization effects will increase the predicted ratio of Canadian to non-Canadian collaborators above 1/12, while for expatriate Canadians it will lower it below 1/12. This correction will only strengthen the implication that the ratios for Canadians abroad are more than proportional. The conclusion is that the Canadians abroad do have ties to Canada, and these ties are manifest in collaborations that involve knowledge flows.

[7] The values found in the first type of collaboration in table 8, collaborations with Canadians and with non-Canadians, are based only on the respondent's involvement in co-authorship with either Canadians or non-Canadians on a yes/no basis, and show the proportion of positive responses.

Table 8. Collaboration Ratios between Canadians and Non-Canadians & Canada and Abroad			
TYPE OF COLLABORATION	**Residential Location**		**RATIO:**
	CANADA	**ABROAD**	**CANADA / ABROAD**
Collaborations with Canadians	0.79	0.86	**0.92**
Collaborations with Non-Canadians	0.68	0.81	**0.84**
RATIO: CANADIANS / NON-CANADIANS	**1.16**	**1.06**	
TYPE OF COLLABORATION	**Residential Location**		**RATIO:**
	CANADA	**ABROAD**	**CANADA / ABROAD**
Canadian Collaborators per annum	0.79	0.48	**1.65**
Non-Canadian Collaborators per annum	0.53	1.17	**0.45**
RATIO: CANADIANS / NON-CANADIANS	**1.49**	**0.41**	
TYPE OF COLLABORATION	**Residential Location**		**RATIO:**
	CANADA	**ABROAD**	**CANADA / ABROAD**
Joint Publications with Canadians per annum	0.84	0.47	**1.79**
Joint Publications with Non-Canadians per annum	0.54	0.94	**0.57**
RATIO: CANADIANS / NON-CANADIANS	**1.56**	**0.50**	

There is an additional key issue in terms of networking. For an active scientist, having access to world experts and the international community is highly desirable. This does not necessarily mean collaborations with the latest Nobel prize winner, but more a feeling of being strongly connected in an active way with the best parts of the world scientific community. Here there is a slightly distressing result, Canadians at home feel much less connected. In response to the questions "Are there barriers to contact with fellow experts in your discipline related to where you currently work?" and "Are there barriers for you to be well connected to the international research community related to where you currently work?" Canadians at home responded "Yes" 21% and 24% of the time, whereas Canadians abroad responded "Yes" 9% and 10% of the time. Some of this may be driven by the fact that more Canadians abroad are located at centres of international excellence, and so by definition have no barriers, but this is unlikely to be the entire explanation. Understanding why there is this disparity in responses could be very important in making Canada a more attractive place for top scientists.

CONCLUSIONS AND POLICY RECOMMENDATIONS

The objective of this study was to shed some light on the nature of social and professional networks of highly skilled workers. Of particular interest is the impact on the mobility of highly skilled workers and the level of intensity and activity of these networks in Canada. The relevant research questions which guided this research were summarized in the project outline at the beginning of this

report. The on-line survey was intended to further explore findings of the relevant literature, and in particular to add empirical results to the field of network studies which is predominantly theoretical.

The results outlined above provide an evaluation in terms of intensity and activity of professional networks for the two sub-populations in the survey: Canadians who work at home, and Canadians who work abroad. We focus on the intensity and activity of professional networks between national economies other than Canada and the United States. About 70% of all SSHRC and NSERC funding, in the analysed time period, for postgraduate studies outside Canada was awarded to institutions located in the U.S. Following this, it is not surprising that 79% of the 210 professionals who responded to the invitation to participate in the current study have been trained there.

In terms of brain drain versus brain circulation, the results of the study suggest that Canadians living abroad do not constitute a pure brain drain. Their participation in the Canadian knowledge economy, through conferences and collaborations, is higher than would be expected if they had no historical ties to the country. Because of the data available, the calculations on which these conclusions are based are very approximate, but the results are strong enough that they must be considered. At the same time, though, while some Canadians in Canada feel able to continue with international connections, many feel only loosely connected to the broader intellectual network. This observation raises several immediate questions. How does the former group manage, and what properties do members of this group have? In the second group, what are the bottlenecks to stronger international participation? Both of these questions could be answered by further detailed survey work.

Professional networks have been the focus of the quantitative component of the on-line survey, but remarks made in the open-ended question towards the bottom of the questionnaire, which asked for any additional comments, provide some qualitative results regarding the role social networks play in the context of HSL mobility. Respondents who work in Canada in many instances indicated that personal reasons were stronger than professional ones when they choose their current place of residence. Family and cultural ties also seem to be important factors for Canadians who currently work abroad, but who are considering returning to Canada in the future.

"I would prefer to work in Canada, however when I graduated there were no jobs." Numerous professionals who work abroad reported that they faced this situation once they finished their training outside Canada. Finally, it appears that professionals often have to make an ultimate decision between better career perspectives and intellectual environment or a preferred social and cultural setting, which in most cases was not offered in the same location, when they searched for jobs following graduate school. For example, the desire to work at, or close to, the centre of excellence in their discipline was the main reason many professionals decided to located outside Canada, although they would rather live and work in Canada. On the other hand, respondents working in Canada recognized that they may not work within a centre of excellence, but because of the quality of live available to them in Canada they are willing to make this sacrifice. Additionally

another group of professionals has found a way to stay in Canada and still be connected to excellence centres as following quote illustrates: "With email and easy travel, my location is completely compatible with conducting quality research". These types of professionals should be studied in more detail, as they constitute a group that found it possible to effectively network without changing their location. Furthermore these professionals could also contribute to the answer of one of the additional research questions identified by the project team: Can social and professional networks enhance the productivity of Canadians and decrease the motivation to migrate?

A number of professionals seem to be very frustrated with the fact that they cannot find suitable job opportunities in Canada, as one respondent indicates, "despite having very high credentials in my field (my current supervisor is a Nobel laureate), I have had no success in applying for academic positions in Canada. I suspect [..] those of us who have done graduate and post-doctoral work abroad are at a disadvantage when compared to internal candidates." In the same line of thought another professional commented, "when you ask for reasons why I am employed outside Canada you're missing the point. I didn't leave because of better opportunities abroad, I was forced to leave because I could not find a job in my field in Canada. If there had been a job I most certainly would have stayed (or returned). And note that I would have been willing to accept less money and a weaker research environment than I now have at my current institution in the UK." The significant role social and professional networks play in the mobility of highly-skilled individuals is intertwined with personal- and career-motivated reasoning, however, the lack of appropriate jobs seems to be a dominant factor that is hindering the return of many Canadian professionals who currently work outside Canada.

The survey results presented here respond to and answer most of the research questions put forward and should be extremely useful in the development of relevant policies that support and improve existing and facilitate the development of new social and professional networks, which is essential for a competitive Canadian economy. However, in order to fully explore the extent and impact of social and professional networks in a Canadian context, further research is required.

Our results suggest that there are several directions that policy could pursue in order to enhance the role of networks involving Canadian professionals:

1) Many individuals currently working elsewhere indicated that they wanted to return to Canada or that no jobs were available for them. This suggests that additional outreach on research projects might be a way to keep their Canadian connections vibrant and to perhaps allow them to make connections that might allow them to return home.

2) Graduate school constitutes an important entry point to professional networks, and contacts tend to be maintained. However Canadians who return home have weaker connections to

their graduate schools than those abroad. Strengthening those ties may be a way of reducing feelings of isolation for Canadians in Canada.

3) Travel, and the resulting face-to-face contact remains an important factor for maintaining connections. Supporting measures for international travel that facilitate temporary mobility, e.g. to attend conferences and to bring international speakers to Canada, not only would strengthen links created during studies abroad, but even more importantly could possibly create stronger international networks.

4) Finally, temporary mobility, e.g. professional sojourns, which allows professionals to engage on a personal level, is very important for the exchange of tacit knowledge, as opposed to codified knowledge that is less localized due to the fact that it can be easily transmitted in written form, such as publications. To have access to tacit knowledge, which is embedded in individuals and cannot be transferred through conventional channels other than personal interaction, could potentially be a significant asset for the support of an innovative Canadian economy.

FURTHER RESEARCH SUGGESTIONS

Our small pilot study reveals that there are differences between Canadians working at home and those working abroad, yet to really be able to measure differences would require a larger study that examined the behaviour of these groups against the counterfactual case. For example, we would like to compare Canadians working at home who did not have the graduate study abroad experience to those who did, and similarly we would like to compare non-Canadians to Canadians working abroad. This would allow us to isolate more precisely the effect of studying abroad and the social networks that result. Relatively straight-forward matched pairs sample technique exist for doing this sort of study, and the ground work has been laid by the current study.

Our survey could not compare the productivity of the two groups of researchers. Doing so would permit controls that would make results on conference participation and collaboration more robust. This would require accessing independent sources such as the Institute for Scientific Information (ISI) publications database, which is a time-consuming exercise.

The current study, and indeed the current research programme, has been premised on the idea that international networking is good for the knowledge economy of a country. As a first approximation this seems obviously correct. But it is a very broad statement. There are many different types of networking activity, and many different types, styles or architectures of networks. To understand how to tap the potential of ex-patriot Canadians, or how to use the links created during graduate studies abroad most effectively, knowledge networks more generally must be understood. To take the most obvious question: supposing that resources are devoted to strengthening international

networking, how should they be concentrated? Is it better to have all Canadian researchers networking a little bit, or would it be better to concentrate resources, creating a smaller number of nodal players who connect Canada to the rest of the world. Answers to general questions of this nature can be important in designing policies to make the most of the potential of international knowledge networks and the entry to them provided by Canadians studying abroad.

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APPENDIX

SURVEY

The following pages show a flowchart of the conducted on-line survey. The survey contains the following major sections:

- Personal Information
- Professional Information
- Location of Work Activities
- Extent of Networking Activities

Figure A1 – On-line Survey Flowchart, part 1.

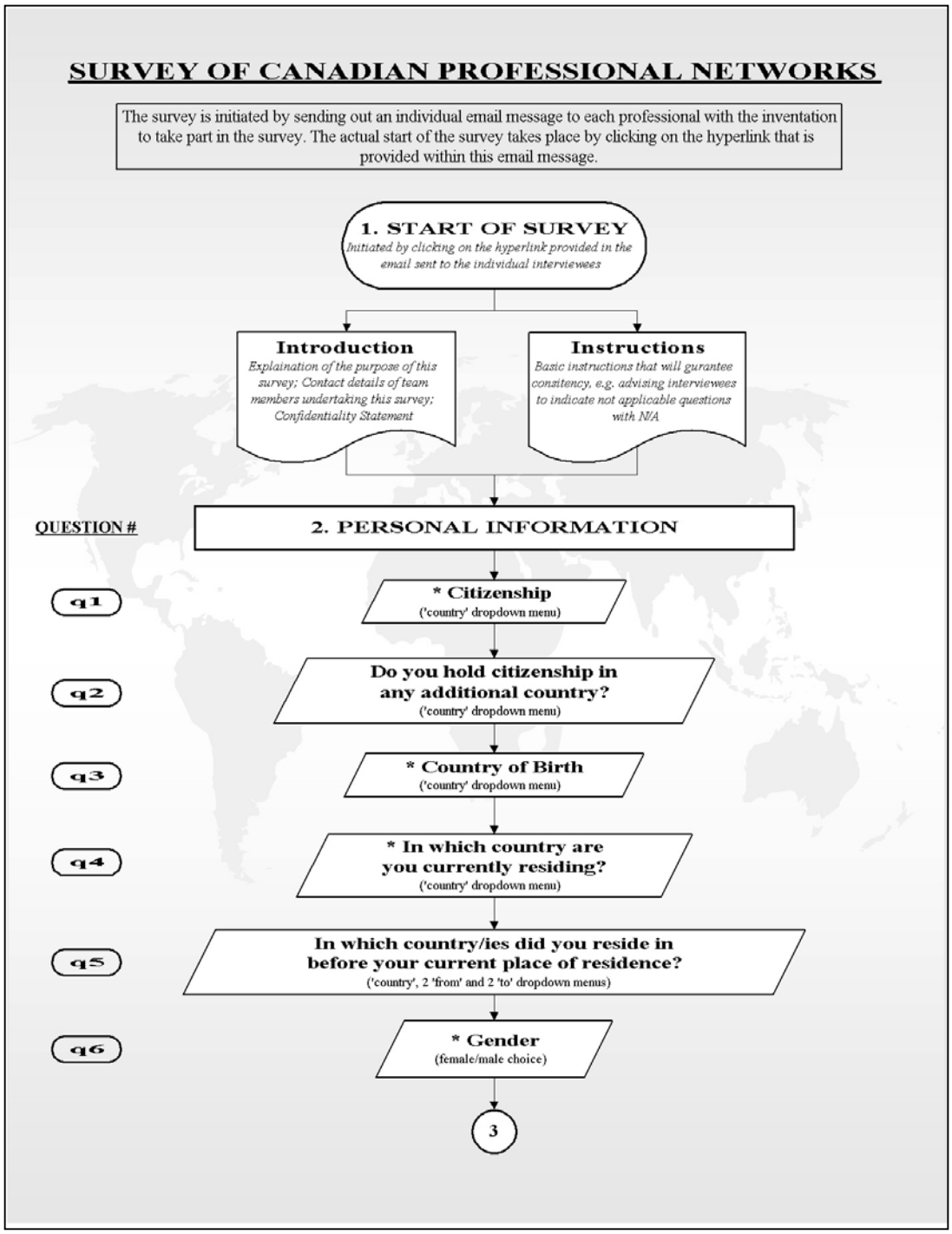

Figure A2 – On-line Survey Flowchart, part 2.

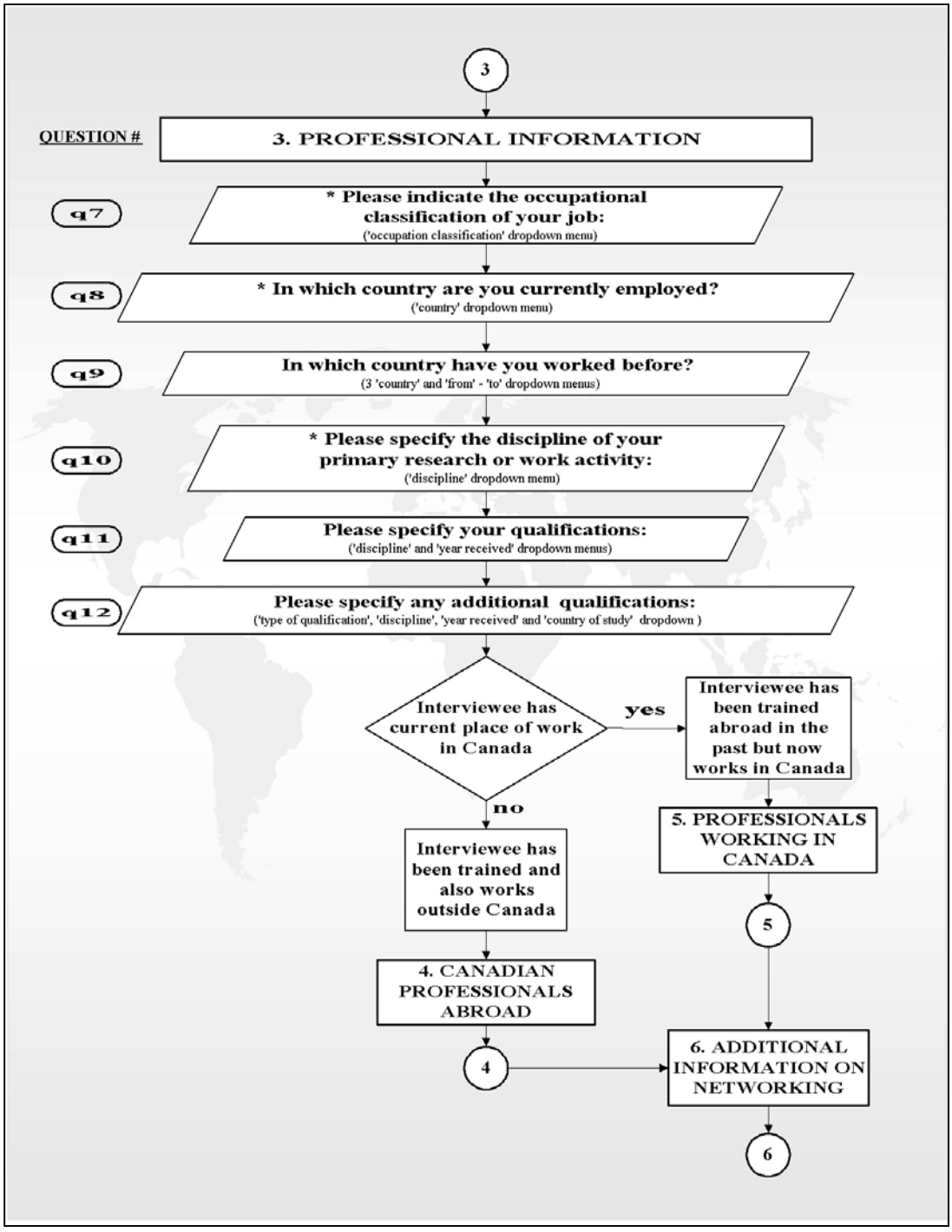

Figure A3 – On-line Survey Flowchart, part 3.

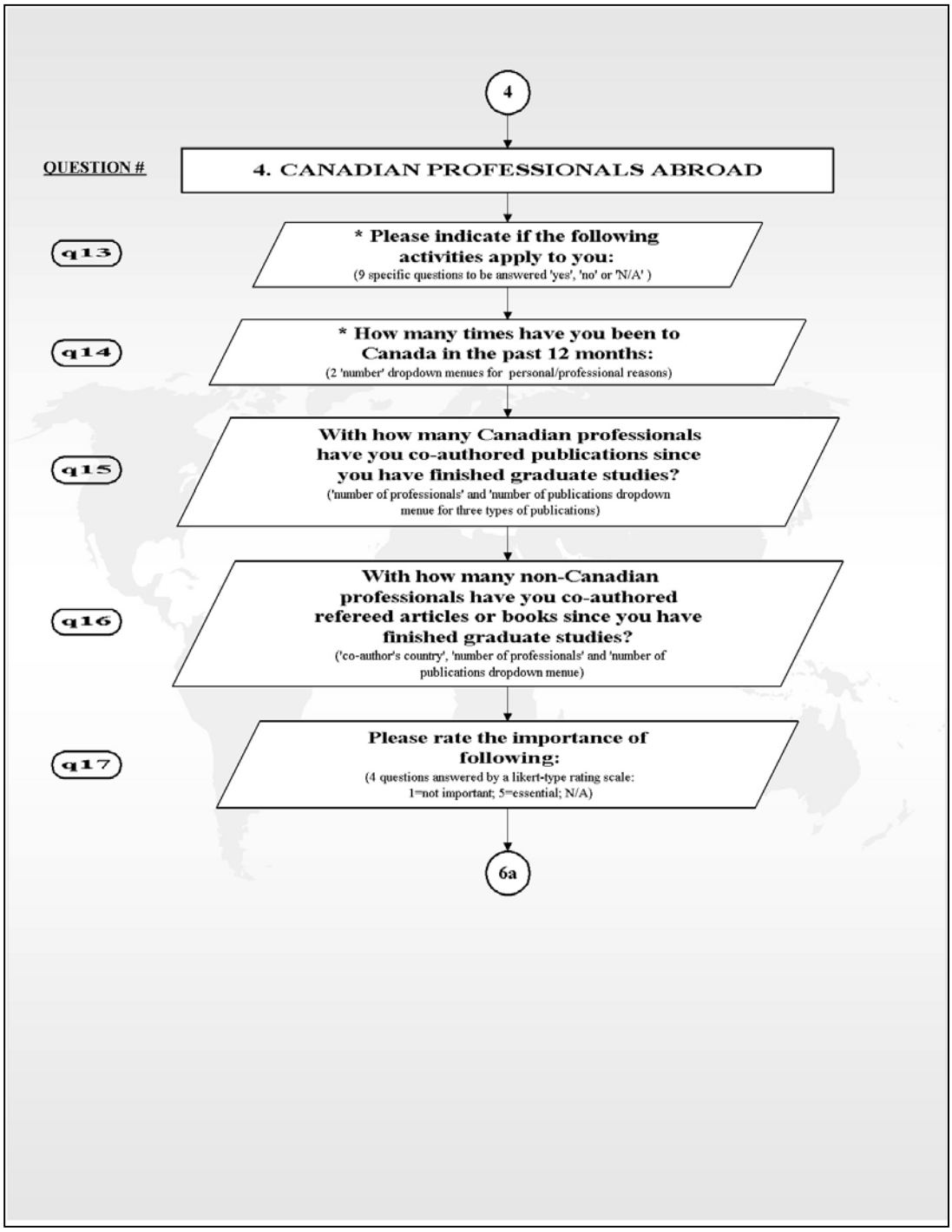

Figure A4 – On-line Survey Flowchart, part 4.

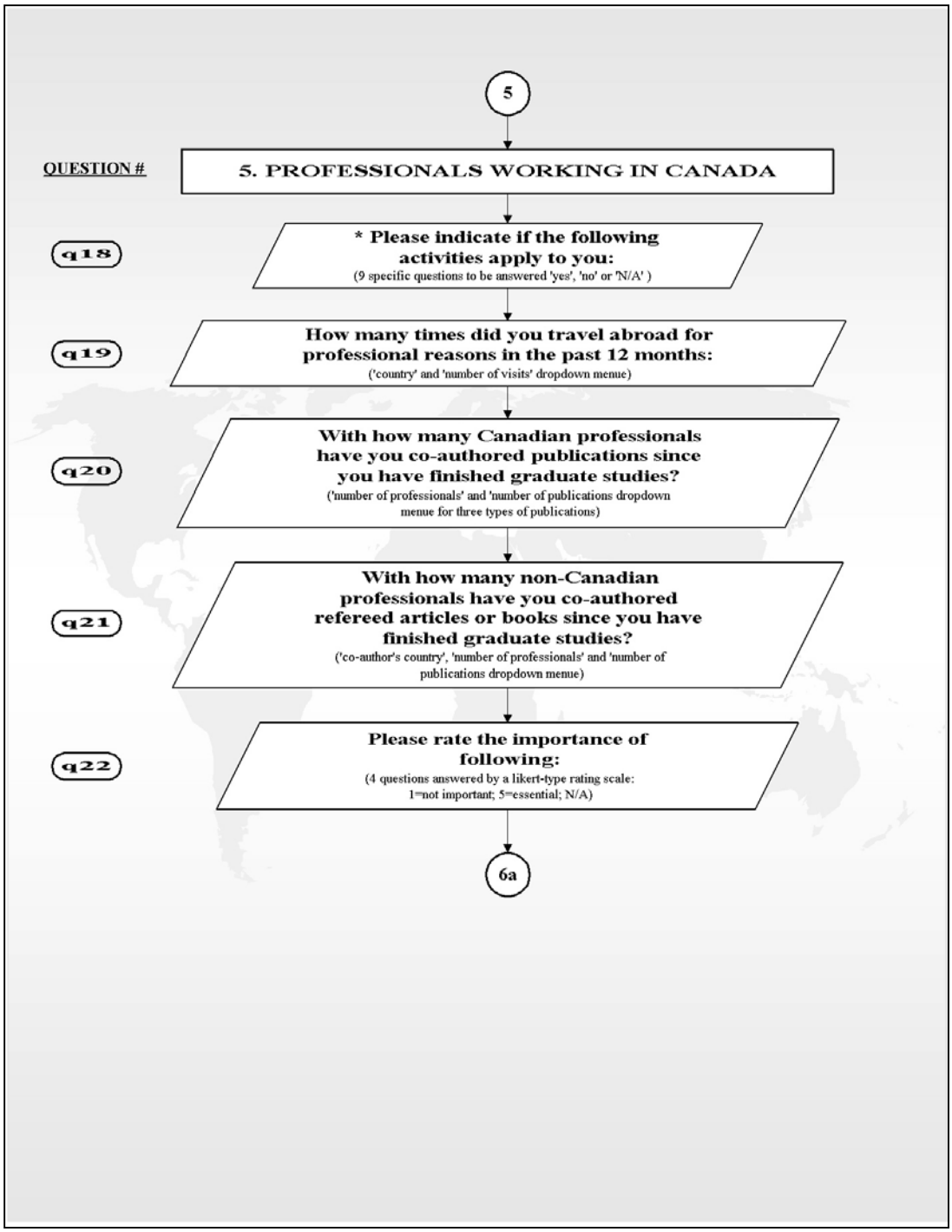

Figure A5 – On-line Survey Flowchart, part 5.

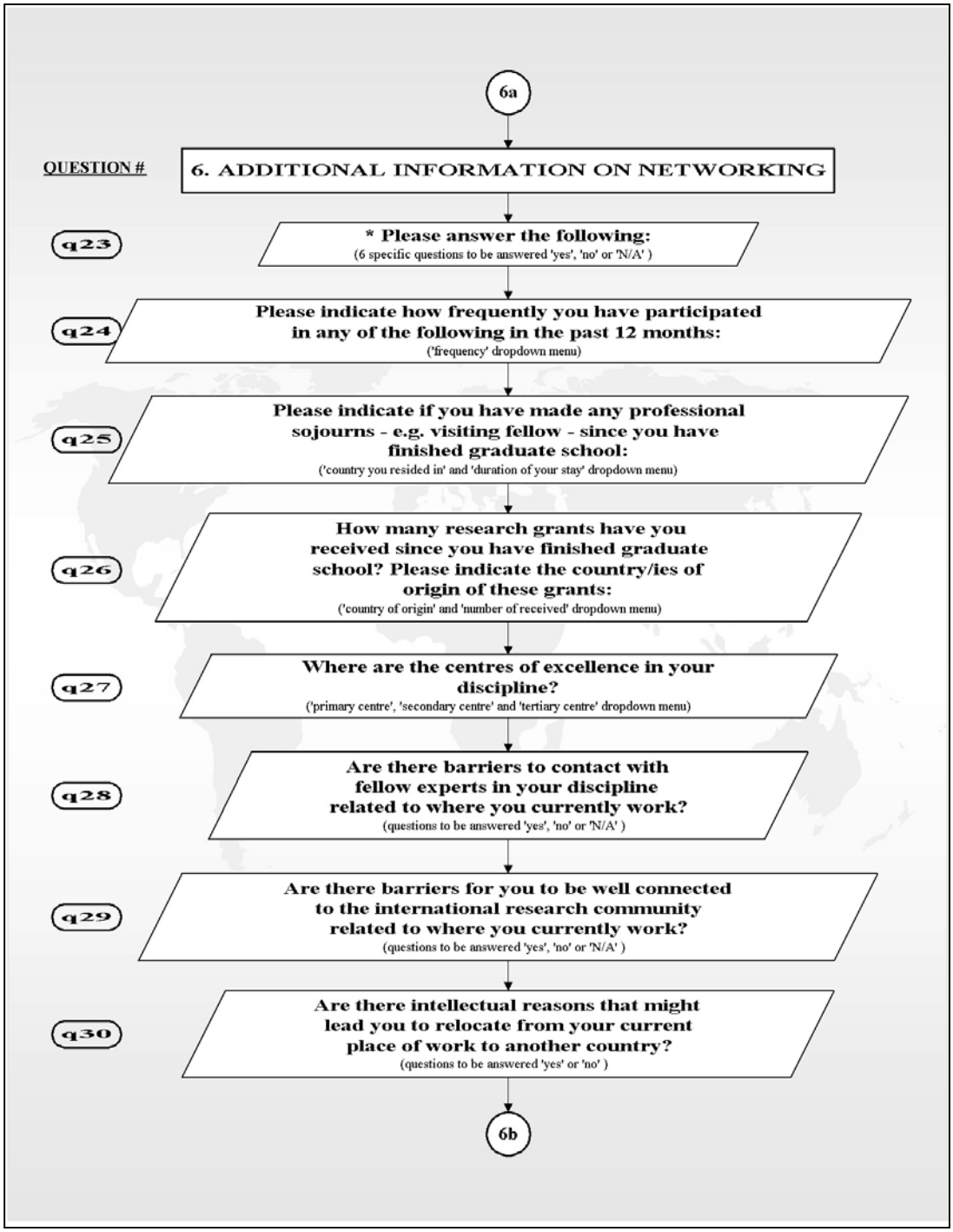

Figure A6 – On-line Survey Flowchart, part 6.