Cross-National Comparison of Information Technology Employment

WANE International Report, no.5

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Workforce Aging in the New Economy

A Comparative Study of Information Technology Employment

WORKFORCE AGING In The NEW ECONOMY (W.A.N.E.) explores the relationships among workforce aging, employment growth in information technology (IT) labour markets, and the transformation of employment relations in the new economy. This work involves a multi-dsciplinary, cross-national comparison of IT employment and workforce aging in Canada, the United States, the European Union, and Australia.

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Executive Summary

This report is a component of the international research program entitled, *Workforce Aging in the New Economy: A comparative study of Information Technology Employment (WANE)*. This cross-national, comparative research program investigates high-skill IT work in the countries of Canada, the United States, Australia, the United Kingdom, Germany and the Netherlands. Throughout this report, these countries will be referred to as our 'study countries.' The present report examines the intersections of workforce aging and IT employment relations in the study countries, providing the contextual background for our case study analysis of high-skill IT work. This synthesis is based primarily on the reports generated by the research groups representing the study countries. Although we are chiefly interested in the IT service sector, many government and industry reports on this sector treat it as a component of the broader ICT sector, which includes IT hardware and telecommunications equipment businesses. The extraction of the impact of the IT sector alone was not always possible in these analyses, particularly in discussions of national economies and information technology.

In our country reports, the general industrial and occupational context of IT was examined including: the relationship between ICT and national economies, industrial sectors dependent on IT employment, the stability of IT employment, the age composition of IT workers, the relationship between IT employment and the class, age, gender and ethnicity/race of IT workers, issues of supply and demand in IT work, and recent employment shifts in IT.

Our findings show that in each of the study countries the current outlook in IT is one of stabilization and re-growth. In terms of employment, the IT recession affected our study countries at different points in time. Numbers of IT women started declining after 1999 in the UK, but after 2000 for men. In the Netherlands, core IT employment started to fall after 2001. The general trend has been for growth in the IT and ICT industries to surpass total economic growth over the same time period. For example, the growth of the Canadian ICT sector from 1997-2002 was "more than four times" that of total economic growth (Statistics Canada, 2003, p.10). IT and particularly the IT services industry are significant contributors to the economies of the study countries. The United States stands out in particular, as a global leader in exporting IT services and in investing in IT research and development. Analysts suggest that the ICT sector is a lead force in the globalization of business, and IT work must be seen in this context (OECD, 2002).

Over the past decade, employment prospects in high-skill IT occupations have grown enormously in each of the study countries. For example, Australian IT professional employment from 1993-2003 grew 142% (Brooke et al., 2004). Yet, globalization has proved to be a mixed blessing for high-skill IT workers across the study countries. Traditionally, unemployment rates in IT occupations have been low and it has been lower-skill IT workers who were more vulnerable to unemployment and market forces; however, high-skill workers are increasingly being affected. There has been a strong shift to 'offshore' high-skill IT work to countries where labour is less expensive. Domestic IT workers suggest that the discourse on 'skill shortages' in IT has been used unfairly to

justify offshoring and immigrant labour solutions in place of re-training and recruiting domestic workers. High-skill IT workers in the study countries, especially in the US, are fearful that thousands of jobs will be lost as large firms seek to cut costs and maximize their profits overseas.

High-skill IT work is predominantly full-time and permanent work; however, there are indications from the European study countries that contract IT work is on the rise. In fact, there are additional features in the structure of IT work that could contribute to growing employment instability for high-skill IT workers. In Canada, Australia and the United Kingdom, IT businesses in the computer services industry are largely micro-enterprises employing fewer than ten workers. Existing studies of these firms show them to be exceedingly vulnerable to failure. For example, only half of Canadian businesses in this industry survived to their third year. These developments have implications for the future of high-skill IT work in the study countries, as domestic IT workers face challenges to their employment security on many different fronts. The relatively high employment turnover rate for IT workers must also be re-evaluated in light of these findings.

High-skill IT workers of different ages, ethnicities and gender are clustered into different IT occupations. Little is known about the social class origin of IT workers and this is an area for further research. We do know that IT workers in all of the study countries are more highly educated than the labour force at large; however, they do not typically tend to have degrees in IT or in IT-related fields. This non-traditional career trajectory in IT contributes to the difficulty in quantifying issues of supply and demand in IT employment. Women account for approximately 14-25% of high-skill IT workers and they are especially prone to enter IT without an IT-related degree. Furthermore, women in IT professions are clustered in the lower paying and less prestigious occupations and their representation in the profession is falling in all of the study countries with the exception of Australia.

Across the study countries, IT workers are predominantly white; however, there is greater ethnic diversity in IT than in the total labour force. Yet, this diversity does not reflect the ethnic diversity within the study countries. Instead, ethnic workers in IT are predominantly foreign-born, largely from Asian and Indian countries, and they tend to be younger, more highly educated and clustered into software engineering occupations. A concerning element of the debates of domestic IT workers over offshoring has been the tendency to ‘racialize’ the debate and to cast blame on ‘foreign workers’ in IT ‘taking away’ jobs from domestic workers. The potential acceleration of racial discrimination in the IT work environment as a consequence of offshoring is an area that will be further explored in our case studies.

Across the study countries, the IT workforce is younger than the total labour force; however, the IT workforce is aging. Approximately one-fifth to one-quarter of high-skill IT workers in the study countries are over forty-five years of age and in the high status IT occupations of engineer and analyst this trend is even more pronounced. There is significant variance in the age composition across IT occupations. Younger workers are clustered in the highly technical IT positions that require frequent skill-upgrades. Of note,

are recent studies in Australia and the United States suggesting that age bias in IT is one of the more prevalent forms of discrimination, particularly regarding the technical abilities of older workers (see Brooke, Rolland, Jones & Topple, 2004; Morgan, Marshall & Moloney, 2004). One question to explore in our case studies will be whether workers in IT are pushed out or voluntarily opt-out of certain IT positions as they age. Workforce aging in IT carries important consequences in terms of the development of ongoing employee training opportunities, human resource policies and retirement transitions: all understudied areas to be addressed in the case studies of this research program.

Introduction

This report examines various aspects of Information Technology (IT) employment in Canada, the United States, Australia, the United Kingdom, Germany, and the Netherlands. It presents a synthesis of the findings from phase one of the project, *Workforce Aging in the New Economy: A comparative study of Information Technology Employment* (WANE). WANE is an international research program funded by the Social Sciences and Humanities Research Council of Canada (SSHRC). WANE's primary aim is to examine employment and human resources issues in the information technology sector.

Three things are happening in most developed countries that have significant implications for Canadian and global economies: 1) workers are getting older; 2) the way work gets done in the new economy is changing and; 3) there has been substantial growth in IT employment. In the first phase of WANE, we addressed the following six research questions that are related to the intersection of these trends:

1. What constitutes IT industries and occupations internationally?
2. How important is the IT industrial sector to national economies?
3. What other industrial sectors are heavily reliant on IT employment?
4. How stable is employment in the IT industry?
5. What is the class, age, gender, ethnicity and race composition of IT employment?
6. What are the central supply and demand issues in IT labour markets? What is the relationship between workforce aging and the supply of and demand for IT workers? Has it changed over the last 10 years?

To answer these questions, WANE researchers in Australia, Canada, the European Union (the United Kingdom, Germany and the Netherlands), and the United States have produced a series of working papers and international reports. These reports are available on the WANE website at www.wane.ca.

The primary purpose of the present report is to synthesize the working papers and country reports to provide a comprehensive and comparative international profile of IT employment. Because the country reports were not always directly comparable on key issues or variables, information from other sources is also included in this report. This paper begins with a brief comparison of the phenomenon of population and workforce aging and new economy initiatives in each of the study countries. Next, it addresses each of the research questions by comparing and contrasting the IT industries and occupations in each of the study countries.

Population and Workforce Aging

As Martin Cooke's (2003) working paper, *Population and Labour Force Ageing in Six Countries* shows, populations in the industrialized West are living longer. All of the study countries are experiencing population aging in unprecedented forms. The

European study countries have comparatively older population age structures than the North American and Australian study countries. Germany and the United States comprise the two population extremes, with Germany having the oldest population and the United States having the youngest. These differences can be partially attributed to the larger and more extended baby boom and higher immigration rates that occurred in North America. In Germany, and the Netherlands, declines in fertility rates happened earlier and were more abrupt. Therefore, the precise timing and effect of population and workforce aging will vary across the study countries (see Cooke, 2003 for more detail). But these are relatively small variations in the scope of the broader trend to widespread population aging.

As the populations of the study countries have been growing older, the age structure of the workforce in these countries has also changed. This is true of most industries and occupations, including IT. Workers are growing older but they are also exiting the labour force earlier, though this is largely a male phenomenon. Yet, even in the face of earlier male retirements, there are increasing numbers of older IT workers (e.g. aged 55-64) in the labour force (de Hoog et al., 2004). Some of this growth may be attributed to population aging and to the increase in "non-standard," part-time and/or 'flexible' employment for all age groups, especially in Australia, Canada, the United States and the United Kingdom.

Far fewer older people are active labour force participants than those between the ages of 25-54 and there is diversity among the study countries in the labour force participation rates of older people. For example, the two extremes are the Netherlands, where 43% of those aged 55 to 64 were labour force participants and the United States, where 62% of those aged 55 to 64 were labour force participants (Cooke, 2003, p.4). Women's labour force participation rates have been increasing for all ages, though they remain lower than men's workforce activity overall. These developments have led to fears that there will be worker shortages and lowered economic productivity in the decades to come.

Across the study countries, policy initiatives have attempted to re-structure retirement in order to reduce the flow of early labour force exits, in addition to implementing anti-age discrimination laws and training and educational programs aimed at older workers. Still, policies in the study countries have been largely piecemeal in their treatment of policy initiatives directed at issues of workforce aging and retirement. In other words, policies regarding health, work and family over the life course are seldom integrated or considered in a holistic way. Australia has been a leader in terms of legislation and policy development related to combating age discrimination and integrating older workers into the workforce. These are important steps, as there have been suggestions that age discrimination has been on the rise, especially within the fields of information technology and those occupations that demand frequent re-training and up-skilling initiatives (Cooke, 2003; Morgan et al., 2004; Platman, 2003). Ultimately, policy initiatives for the phenomenon of workforce aging need to form an "integrative approach," dealing not only

with the present and coming challenge of workforce aging through employment, retirement and training policies but also embracing the development of policies addressing health and social benefits from birth through the older ages (Cooke, 2003, p. 19).

Policy directives for the "New Economy"

Each of the study countries has developed policies and initiatives directed at maximizing their potential economic and social performance in the climate of the 'new economy.' Gillian Ranson's (2003) working paper, *Understanding the "new economy": A conceptual journey*, examines the many definitions and conceptualizations that have abounded concerning the proposed 'new economy.' She concludes that the 'new economy' can be conceptualized as a "variety of economic practices which are socially embedded, and which have a wide range of social and economic consequences" (Ranson, 2003, p.9). A key issue outlined by Ranson (2003) is the importance of distinguishing between discussions that highlight the economic impacts of the 'new economy' and those that focus on the 'social impacts.' Some of the confusion and divergence in terms of interpreting the impact that this 'new economy' will have has occurred because analysts and academics have been looking at different issues (Ranson, 2003). Again, Ranson (2003) points out that much of the national literature on the 'new economies' adopts the viewpoint of the economic accounts, where global competitiveness and an educated and skilled workforce are the key concerns.

The governments of the study countries have also tended to focus more on the 'economic referents' of the 'new economy,' including ways in which to increase productivity by developing innovative technological and business practices, and by increasing the skills and abilities of their nation's workforce. In other words, the issue of access to technology has been primarily addressed through "market mechanisms" (de Hoog et al., 2004; OECD, 2002, p.252). Within these dialogues, the United States continues to emerge as the "world's benchmark economy," against which all others are measured and strive to compete (Industry Canada, 2001, p.3). These directives have tended to encompass both knowledge and skill development and innovation strategies. Canada's 'Innovation Strategy' called "Achieving Excellence: Investing in people, knowledge and opportunity,' has set specific targets in their goals to compete in the global world. Some of the targets set by Canada include developing a favourable profile with international investors and increasing the number of Master's and PhD students from Canadian universities by at least 5% per year up to 2010 (Industry Canada, 2001, p.9). In the United Kingdom, there is a similar initiative laid out in two 'white papers' called the *Science and Innovation White Paper* (2000) and the *White Paper on Enterprise, Skills and Innovation* (2001) (de Hoog et al., 2004). The Australian government has developed a National Office for the Information Economy (NOIE) that is geared toward maximizing the country's economic competitiveness through ICT innovations (Ranson, 2003, p.5). Essentially, these programs have aimed at exploiting national strengths in

science and technology and in developing and promoting innovation and skills among its businesses, educational institutes and citizenry. In all study countries, IT is seen as critical to the success and innovation in national economies.

Indeed, policy directives across the study countries in relation to information technology are similar in scope and objective. Many of the study countries have overall policies directed at establishing leadership roles for themselves in the global information economy (OECD, 2002). Of most interest here are those policies with direct IT workforce implications, including skill development, educational initiatives, immigration/global trade legislation and assistance for innovative R&D and IT business start-ups. In the study countries, there are joint initiatives aimed at promoting innovation in science, technology and business, in conjunction with a strong emphasis on skills development for the 'knowledge economy' (Brooke et al., 2004; de Hoog et al., 2004; OECD, 2002). In the Canadian context, the focus is on 'innovation' in research and thinking and 'skills' development in the 'knowledge economy.' In Australia, the federal government's 2001 plan entitled, 'Backing Australia's Ability' aims to invest 8.3 billion dollars through to 2011, in order to promote innovative ideas, applications and technological skills (Department of Education, Science and Training, 2004). The ability to measure and standardize definitions of 'skill' has also been a major theme across the study countries and frameworks have been developed in Canada, the UK, the US and Australia that re-conceptualize what is meant by 'skill' (OECD, 2003, 2002; Platman, 2003). The National Occupational Classification (NOC) framework of IT occupations, which is discussed in the next section, is an output of these efforts on the part of Canadian agencies to better define IT work and occupations.

Information Technology Industry and Occupational Definitions

As Tammy Duerden Comeau (2003) demonstrates in her working paper, *Information Technology (IT) Employment: What is IT?*, measuring and comparing the IT workforce within and across countries presents significant challenges (see also OECD, 2000). In defining IT, it is important to distinguish between IT industries that manufacture goods and distribute services and IT workers who are employed across a diverse array of industries (Comeau, 2003). For example, the broader ICT sector includes workers who deal with information technology in vastly different ways (e.g. cable line technicians, data-key entry operators, hardware maintenance). In addition, it is necessary to make a distinction between 'expert users' of IT and those who are specifically engaged in programming and analytical IT work (e.g. innovative high skill IT work) (Comeau, 2003; Morgan et al., 2004). There have been serious international efforts, led by the OECD to develop measurement tools and industry concordance tables across countries and therefore, formal comparisons are available at the industry level across the study countries. Here the OECD (2002, p.81) has defined the ICT sector as "a combination of manufacturing and services industries that capture, transmit and display data

and information electronically." This enables us to provide a general ICT context but it does not alleviate the difficulty in comparing specific IT industry and occupational categories. For the WANE study, the finer industry focus is on the North America Industry Classification System (NAICS) 54151 Computer Systems Design and Related Services Sector, and there are international equivalencies for this NAICS sector across the study countries. However, even this does not solve the dilemma that the workers examined under this heading in existing reports include a number of non-IT workers who are essential to the operations and existence of the firm.

The WANE project focuses on high-skill IT/computer workers. This explains our use of the NOC Code comprised of 21 IT occupational groupings and developed by the Software Human Resource Council and Human Resource Development Canada. In the NOC classification, IT occupations are "those whose primary functions are the management, design, development, analysis, implementation or maintenance of computer telecommunications hardware, software, networks or information systems" (SHRC/HRDC, 2001, p.9). This is a skill-based definition and these frameworks are in development across the study countries (de Hoog et al., 2004).

Governments are currently incorporating more finely honed definitions and classifications of IT workers; nevertheless, at the present time the existing classifications of IT workers continue to vary significantly across government studies, industry studies and academic work (Brooke et al., 2004; Comeau, 2003; de Hoog, et al., 2004; Downie et al., 2004; Morgan et al., 2004). In other words, existing comparative data at this level of analysis are not available across the study countries in purely concordant terms. Therefore, the focus on the cross-country comparisons has been on the more recent government, organizational and academic studies of what would be considered the highly skilled computer worker in IT.

In the existing data collections, the 'core' or highly skilled IT worker typically includes those workers under the categories of computer analysts and programmers. In the European Country Report (de Hoog et al., 2004), the authors drew upon data from the ISCO categories 213 (Computing Professionals, system designers, analysts and programmers), and ISCO 312 (Computing Associate Professionals such as computer assistants, computer equipment operators and industrial robot controllers) (de Hoog et al., 2004, p.16). One drawback to this grouping is the exclusion of computer engineers and IT managers (de Hoog et al., 2004). The Australian definition of Computing Professionals (2231) and Information Technology Managers (1224) is more inclusive and aligns closely with the Canadian NOC classifications (Brooke, et al., 2004, p. 5-6). In the United States government classifications, the 'high-level' IT-related occupations include computer programmers, computer engineers, analysts and administrators; however, data are not always broken down by skill level and often other groupings (medium skill and low skill) are included (U.S. Department of Commerce, 2003, p. 26).

IT workers, as they are defined in this study, make up a significant portion of the workforces in all of the study countries. And in these countries there has been substantial employment growth in these highly skilled IT professionals over the past decade. In this synthesis, the focus is on cross-country comparisons between computing professionals and/or the 'core' computer workers in as close an approximation as possible to the Canadian NOC codes. International work in the form of OECD reports and analyses are also drawn upon in this synthesis, in order to confirm and clarify cross-country commonalities and differences. In the following sections, the disentanglement of the smaller IT segment from the broader ICT sector (which includes the manufacturing sector) is at its most pronounced. This issue is complicated by the fact that in some cases, government and industry documents discussing 'IT' are actually referring to the broader ICT sector. The OECD and much of the existing government data within the study countries examine the impact of IT and the economy through the broader ICT sector, therefore when the term ICT is used below, this refers to the information technology manufacturing and service sectors combined. In some cases, reports do deal with the smaller IT service segment and in these cases, the term 'IT' will be used.

ICT/IT and the Economy

To address how important the ICT industrial sector and the more specific IT services sector is to national economies we examine the following: globalization and regional concentration of ICT/IT employment; economic growth and GDP; revenues and expenditures; investment in research and development; and global trade.

Global and Regional ICT industry Factors

The ICT market is a global endeavour and there are many interconnections between the ICT landscapes of the study countries (OECD, 2002). According to the OECD (2002, p. 79), the "ICT sector has been and remains, at the forefront of industrial globalisation." OECD data suggests that ICT trade is outpacing total trade growth (OECD, 2002, p. 80). For example, "overseas sales by US foreign affiliates are approximately three times the exports of ICT products by US related parties" (OECD, 2002, p.14). This globalization is evident in the prevalence of foreign affiliates and in the international migration of ICT workers (OECD, 2003; 2002). There is evidence of growing concentrations of skilled workers from particular countries, moving to particular regions in order to meet the demand for niche IT occupations (Morgan, et al., 2004; OECD, 2002; U.S. Department of Commerce, 2003). One of these trends has been the migration of skilled workers from Asia to Canada, Australia, the United States and the United Kingdom (OECD, 2002, p. 230). In fact, the current statistics are likely undercounts, as they exclude international students who migrate for their studies and are then later employed in the host country (OECD, 2002).

The globalization of IT work has not been restricted to migration. One of the peak issues at the moment is the trend in the offshoring of IT service work to Indian and Asian countries (The IT

Workforce Data Project, 2003). Outsourcing of IT functions within companies has been occurring for some time and is significantly different from the current phenomenon of offshore outsourcing (U.S. Department of Commerce, 2003). Outsourcing is now global but its effect on the study countries varies (Morgan, et al., 2004; Platman, 2003). Some Canadian IT firms have been marketing the idea of 'nearshore' IT services. The concern in Canada has been less about the phenomenon of outsourcing of IT labour and more about Canada's positioning in the competitive global market, a debate which raises some common issues across the study countries. Those agencies representing domestic IT workers within the study countries have been apprehensive about the trend to offshore outsourcing for some time (Morgan, et al., 2004). The United States IT industry has already imported IT services in 2001 of 1.2 billion (US$) (The IT Workforce Data Project, 2003). According to the US Country Report (Morgan et al., 2004), large American firms are increasingly outsourcing IT work to existing foreign contracting firms in India and other countries. Here the work most likely to be outsourced was 'programming or software engineer positions' (67%), network design (37%) and 'web development jobs' (30%) (Morgan et al., 2004, p.18). The IT Workforce Data Project (2003) reported that the offshoring of IT technical work from the United States jumped from under 300 million (US$) to more than 1.2 billion (US$) from 1995 to 2001. One source suggests that "offshore outsourcing has become the fastest growing IT industry segment" (The IT Workforce Data Project, 2003, p. 5). The Australian Country Report (Brooke et al., 2004, p.10) noted that the trend to outsource IT varied according to business size with large businesses and corporations being more likely to outsource specialized IT requirements to other countries. Australia's leading telecoms and information services company, Telstra, has been involved in negotiations that could result in the loss of thousands of IT jobs (Brooke et al., 2004, p. 11). A critical issue raised in the debate is that the reported 'skills shortage' has been used as "a rationale for looking overseas for additional employee options" (Morgan et al., 2004, p. 11). There are similar worries in the UK and the fear for older workers is that instead of retraining, the trend will be to offshore IT work to less expensive and younger workers in Asian and Indian countries (Platman, 2003). These trends threaten the motivation to train, and renew talent in large corporations when 'flexible,' less expensive and contingent labor arrangements are available 'offshore' or even 'nearshore.'

A commonality among the study countries is that IT industries and IT workers tend to be clustered in specific regions within nations. IT workers tend to be concentrated in the most populous and urban areas in the study countries (Brooke et al., 2004; Beckstead, Brown, Gellatly & Seaborn, 2003; Industry Canada, 2002; Platman, 2003). In Canada, there is a strong concentration of IT workers in the province of Ontario, where in 2001 "one in every two IT specialists in Canada" could be found (Habtu, 2003, p. 7). This is the pattern in the United Kingdom, where 32% of IT professionals are located in London and South East England (Platman, 2003 p. 20). There are IT industry concentrations as well. For example, in Australia,

almost three-quarters of computer service industry businesses were located in the two most populated areas (New South Wales and Victoria) (Brooke et al., 2004). In the United States, there has been a noticeable shift in the concentration of IT work from the West and the Mid-Western regions to the South (Morgan et al., 2004). The study regions of North Carolina and Florida in the US have large concentrations of IT workers, with one estimate suggesting that in the 4,000 or more IT firms in the state of North Carolina, there were more than 200,000 IT workers employed (Morgan et al., 2004). These regional relocations in the United States have been motivated by the need to reduce company expenses in the form of worker salaries, as there are significant differences in the average salaries for IT workers across the US (Morgan et al., 2004).

Growth and GDP

ICT industries in each of the study countries continue to make substantial contributions to economic growth (Brooke, et al., 2004; de Hoog et al., 2004; Downie et al., 2004; Morgan et al., 2004). Despite the global down turn of the ICT industry post-2000, our comparative research in all of the study countries shows, ICT, and especially IT industries, emerging from the downturn and the theme of economic recovery and resilience is a strong one. The US Digital Economy Report (U.S. Department of Commerce, 2003, p. i) suggests that there are indicators of the return of IT as a "dynamic" force in the economy. This is evident in the contribution of ICT to the growth of the GDP compared to the contributions of other sectors within the study countries. The ICT industry is highly influential in the United States and when its relative size is taken into account, its contribution to GDP is approximately "three times that of other key industries including: transportation, retail trade, finance, etc." (Morgan et al., 2004, p. 9-10). In the Canadian context, "ICT sector growth over the 1997-2002 period was a remarkable 79.3%, substantially higher than business sector growth and more than four times the growth of the total economy" (Statistics Canada, 2003, p.10). The general trend in the study countries was for growth in the IT and broader ICT sector to surpass total economic growth over the same time period. For example, in Australia, ICT production grew at a rate of 12.3% a year, in comparison to total economic growth of 4.1% in the mid-1990s (1995-96) and in the millennium year (2000-2001) (Brooke et al., 2004, p. 8).

The process of contextualizing IT work and the broader ICT industry requires some understanding of the immense industrial and occupational growth that was experienced throughout the 1990s, alongside of the more recent downturn and drop in demand for ICT goods and to a lesser extent IT services. The study countries have collectively experienced a 'boom and bust' phenomenon in ICT; however, the strong role that IT service industries play in these countries has buffered the impact of the decreased demand for ICT goods (Downie et al., 2004; OECD, 2002). For instance, the ICT sector in the UK is particularly reliant on its service component, with over 75% of the value added to GDP in the year 2000 coming from ICT and telecom services (Garland, 2003, p. 4). Even through the recession of 2001, IT services maintained its growth and helped to stabilize the industry during

the sharp decline in ICT manufacturing (Downie et al., 2004; Morgan et al., 2004; U.S. Department of Commerce, 2003). In this sense, the dip in ICT manufacturing must be seen in the context of the continued overall growth in the broader sector (Morgan et al., 2004).

Thus far, compared to ICT manufacturing, the IT service industry has remained comparatively stable and has steadily grown. Although, there have been some more recent indicators that IT workers in the ICT service sector are also experiencing fall-out from the downturn (Industry Canada, 2003a; U.S. Department of Commerce, 2003). Initial research on the effects of the downturn in technology reported that the job losses were primarily those in lower-skill and ICT manufacturing jobs (Bowlby, 2003; U.S. Department of Commerce, 2003). In the United States, "employment declined 8.8% for IT services and 15.8% for IT manufacturing services, much faster than the 1.6% average rate of job loss for all private industries" (U.S. Department of Commerce, 2003, p. 24). The IT Workforce Data Project (2003, p.2) in the US reported that nearly two-thirds of the losses in IT jobs in 2001-2002 were under the designation of 'programming': a grouping that encompasses both high and low skill IT jobs. In addition, a recent Canadian industry report saw declines in the software and computer services industries where employment in this sector dropped by 6.1% over the course of 2003 (Industry Canada, 2003a, p. 2). One of the off-shoots of the downturn in technology is that it has allowed IT employers to become more selective and demanding in the educational and skill requirements of potential employees (Platman, 2003). It is important to note that the ICT downturn was experienced at different points and with varying intensities in the study countries. For instance, numbers of UK women computer professionals began to drop after 1999, which was earlier than their male counterparts in the UK. Falls in employment among IT computer professionals in Germany and the Netherlands started later than for the UK.

Revenues and Expenditures

Overall, the impact of ICT on the economy is reflected in the huge sums of money that are exchanged in this sector's operations. Even with the unprecedented US foreign trade ICT deficit, American ICT companies made over one trillion dollars in the year 2002 (U.S. Department of Commerce, 2003, p. ii). In spite of the revenue decline in 2001, the ICT sector continued to make up 5.7% of the total industry revenue in Canada and the services revenue appeared largely unaffected, recording a 75.1% share of total industry revenue in 2001 (Statistics Canada, 2003a, p. 21). When a slightly longer comparative view is taken, we can see that the revenue growth over the course of the 1990s was staggering. In Australia's computer consultancy IT industry, the revenues increased 414% between 1991 and 2001 (Brooke et al., 2004, p. 9). Again, IT services played a predominant role in this growth. In Canada, the revenues of the software and computer services industries led the way in ICT sector revenues with a compound annual growth rate of 15% from 1995-2002 (Industry Canada, 2003b, p. 1).

Some sharp changes and revisions in spending on ICT surfaced after the post-2000 recession. The reduction in ICT spending is a worldwide trend and some have called this the 'maturation' of the ICT sector (Garelli, 2003). For example, capital expenditure on ICT worldwide made up approximately 50% of company investments in 1999; however, in 2003 there were predictions of a 20-25% reduction in spending (Garelli, 2003, p. 35). This is reflected in the study country forecasts for ICT expenditures. In Canada, there has been a contraction in capital expenditures on ICT, dropping from 8.3% in 2001 to 5.9% in 2003 (Statistics Canada, 2003a, p. 21). This indicates two consecutive years of reduced capital expenditures in ICT (Statistics Canada, 2003a). Similar investment reductions have been noted in the US (U.S. Department of Commerce, 2003). The move is generally towards less speculative and more secure ICT investments in response to the bottoming out of less stable internet stocks (Brooke et al., 2004).

Research and Development

In the study countries, spending on research and development has also declined from the major influx of funds in research and development that took place in the 1990's. Nonetheless, the spending on ICT research and development continues to be significant. In the study countries, the percentage of expenditure on ICT comprised a significant proportion of the gross domestic product. The US is a worldwide leader in spending on research and development (OECD, 2003). The US and the UK both spend upwards of 5% of their national GDP on ICT (Eurostat, 2004). In fact, in Australia, R&D expenditures on ICT accounted for nearly one-quarter of all R&D investment between 2000 and 2001 (Brooke et al., 2004). According to the US Digital Economy Report (U.S. Department of Commerce, 2003, p. 17), "the [ICT] sector uses more R&D inputs than other areas of the economy and its R&D intensity is three times the national average." In the US, in the computer systems design component alone, this amounted to 8.7 billion dollars in 2001. Canada's ICT sector contributed half of total private sector Research and Development, which was "quite disproportionate to its GDP and employment shares" (Statistics Canada, 2003a). Unfortunately, these large investments by the Canadian ICT sector have not been matched by government investments. Of note, is the low federal funding allotted to ICT disciplines. For example, "although core IT hardware companies undertake almost 30% of Canada's private sector R&D, federal programs that support university research allocate less than 5% to these disciplines" (Downie et al., 2004, p. 7). The recent downturn in ICT presents an opportunity for governments to invest in ICT research in order to maintain and kick-start new initiatives and knowledge growth.

Global Trade and Import/Export

ICT is a global endeavour on a large scale and foreign investments and trade relationships among the study countries illustrate this trend. The United States is the major leader and is the biggest exporter in the world of ICT products and services (U.S. Department of Commerce, 2003, p. ii). There is some degree of specialization in the balance of

imports and exports. Germany and the US are unique in that they produce the majority of their own ICT hardware goods (Downie et al., 2004, p. 5). In contrast, the United Kingdom and Ireland rely almost entirely on foreign affiliates for their ICT hardware (Downie et al., 2004). Countries like Canada have developed specialized niches in the international market. For example, Canada is an acknowledged communications specialist and this sector accounts for approximately one-third of exports and imports (Industry Canada, 2003c).

Trade deficits in ICT imports/exports are a fact of life for all of the study countries (OECD, 2003, p.101). Nonetheless, the degree of these deficits varies widely between countries. For example, in an OECD comparison of ICT sector trade balance, the United Kingdom had the smallest deficits among study countries (OECD, 2003). The Netherlands and Germany had slightly larger ICT trade deficits but they were still under 5%. Within the European Union itself, Germany, the Netherlands and the United Kingdom are collectively responsible for "64.9% of the EU's ICT imports and 51.2% of its exports" and their ICT trade deficits are the highest among the European Union countries (Eurostat, 2003, p. 34). Although the United States foreign trade deficit is large, their large international profits mean that their trade deficit is only slightly over 5%. Canada and Australia have the most marked ICT trade deficit, with Australia's having the highest among the OECD countries examined at 17% and Canada coming in at around 10% (OECD, 2003, p. 101). It is important to note that although trade deficits exist in the ICT sectors of our study countries, the smaller IT service sectors show trade surpluses. For instance, in Canada in 2002, the software and computer services had a trade surplus of $3 billion (Canadian) (Industry Canada, 2003). Similarly, in the United States, the computer and data processing services showed a trade surplus of $2 billion (US) in 2002 (Digital Economy, 2003, p. 38).

Reliance on IT employment in other sectors

There are differences in the industry concentrations of IT workers across the study countries; however, some of these discrepancies may result from different aggregations of IT workers (e.g. including a broader definition of IT work versus a focus on the highest skill IT workers) and of different aggregations of industry. In Canada, "seven in ten IT specialists worked in just four industries-one in four in professional, scientific and technical services alone, information and culture 12%, manufacturing 10%, public administration 9%....by contrast, only one in three of all workers worked in these four industries" (Downie et al., 2004; Habtu, 2003, p. 7). European data (de Hoog et al., 2004, p. 19) shows that the bulk (38-47%) of IT workers are located in 'computer and related activities industries' although the remaining IT workers are scattered throughout industries. In the European data, the largest category after 'computer and related activities' is 'Other' industries (21-29%) and this is followed by financial intermediation (9%) and utilities (9-10%). Some light is shed on these 'other' industries by Platman (2003, p. 19), who notes that "the IT professional workforce in non-IT

industries is concentrated in public services, sales, and leisure and business services." Along with public service, business and financial industries also hold significant concentrations of IT workers across the study countries. In Australia, the "greatest proportion of people employed in IT occupations (43%) was employed in the Property and Business Services industry in 2001...the second largest was Manufacturing... and the third highest was in Finance and Insurance and the Communication Services Industry" (Brooke et al., 2004, p. 14). In the US, "nine out of ten IT workers are found in banks, insurance companies, manufacturing plants or other non-IT businesses" (Morgan et al., 2004, p.9). Therefore, the concentrations differ somewhat in each country.

These concentrations have implications for the degree of unionization in IT occupations. Information from Australia and Canada shows that a minority of IT workers are active union members (Brooke et al., 2004; Wolfson, 2003). According to Wolfson's Canadian report, although 20% of IT workers were covered by a Collective Bargaining Agreement, only 17% were active union members (Wolfson, 2003, p. 21). Australian 2001 data shows a similar breakdown, with 15% of IT workers having belonged to a 'trade union' (Brooke et al., 2004). One interesting finding is that men and older workers were more likely to be union members than women (Brooke et al., 2004). Similarly, recent data from the US government show that in the computer systems design and related services industry, less than 2% of workers were unionized or covered by union contracts in comparison to 15% of workers in private industries (US Department of Labor, 2004, p. 189). There was no data on unionization for the European countries.

Stability of IT Employment

We address the stability of IT employment by first considering firm size and tenure and then considering various aspects of the IT labour market including employment turnover in IT occupations.

Firm Size and Tenure

In the study countries, the computer systems services industry businesses are predominately small or micro-enterprises. There are significant differences in the number of workers employed per firm in the computer services industries compared to manufacturing industries. For example, a Eurostat analysis found that in manufacturing, the average firm employs thirteen people, whereas the average number of people employed per firm is six in the computer services industry (Bjornsson, 2001, p. 5). In the UK, more than 93% of computer service businesses have fewer than 10 employees, in contrast with 81% in manufacturing (Bjornsson, 2001, p. 5). In Australia's computer services industry in 2001-2002, 88% of firms employed between 1-4 people (Brooke et al., 2004, See Appendix 5). Canadian computer systems firms are also overwhelmingly dominated by micro-businesses, with more than 50% of these firms being classified as 'non-employers' and having no staff at all (Da Pont, 2003).

Large firms are in the minority in the computer services industry, but they are more often able to provide diversified

services and they account for the majority of revenues generated in this industry (Da Pont, 2003). Still, small firms have a higher profit margin. Clearly, the lowered expenditure on employee wages is one major form of cost-savings (Brooke et al., 2004). More than half of IT workers in the Canadian computer systems and design industry were employed by small and medium firms (Da Pont, 2003). Canadian data show that the effects of the technology downturn in 2001 affected firms differently on the basis of their size (Da Pont, 2003). While small firm employment actually grew by 15%, the employment levels in large firms were stagnant and the employment levels in medium firms fell by 22% (Da Pont, 2003, p. 6).

Germany and the United States show slightly different firm-size patterns in the IT services industry. Germany has a much lower proportion (20%) of computer services industry workers being employed in micro-businesses (Bjornsson, 2001). This is likely a reflection of the importance of IT manufacturing in Germany and the US. According to the United States Office of Advocacy (Office of Advocacy, 2001, p. 16), in the computer systems design and related services industry, close to 20% of workers in this industry were employed in firms with less than 20 people and nearly 60% of workers were employed in firms sized between 60 and 500 people. Despite the fact that the majority of workers in this industry are employed in larger-sized firms, 78% of firms in the computer systems design and related services employed less than five workers (U.S. Department of Labor, 2004).

From the available Canadian data, it seems that the majority of IT firm start-ups are small business and service-based companies, which is consistent with the prevalence of IT micro-businesses (Da Pont, 2003; Downie et al., 2004). Business survival rates in Canada show that up to 83% of small businesses survive through their first year and almost 70% survive at least two years (Da Pont, 2003). Similarly, data from the UK, show that of those computer services enterprises born in 1998, 84% still existed in the year 2000, compared to a 78% survival rate for new enterprises in the business economy as a whole (Eurostat, 2003, p. 20). Another Canadian study found that IT firms face particular challenges over time (Baldwin, 1999; Downie et al., 2004). Among IT goods-producing company start-ups, less than half are still in existence after four years and the outlook is even worse for IT services, with more than half of start-ups failing before their third year (Downie et al., 2004). The predominance of small businesses and few employees per firm in the IT computer services industry presents unique policy challenges. The ability of IT micro-businesses to compete in a global economy will increasingly hinge on their capacity to retain and develop the skills of their workforce (Downie et al., 2004; Downie, 2003). This, combined with Canada's relatively low public investments in IT R& D and high failure rates of IT start ups, suggests that policy should focus on making IT business more viable in Canada. Policy initiatives in Canada have almost universally provided capital investment for manufacturing processes but have neglected human capital investment. Yet, for IT-related economic development policies to succeed, they

must factor in ever-increasing requirements for human capital in the labour force (Downie et al., 2004).

The IT labour market

The professional IT labour force in the study countries is large and it is getting bigger. In Canada, the total IT labour force in the summer of 2002 equalled 510, 000 workers or 3% of the total labour force (Downie et al., 2004, p. 10; Wolfson, 2003). In the European countries in 2002, computing professionals and computer associate professionals totalled 581, 900 workers in Germany, 230, 800 workers in the Netherlands and 607, 600 workers in the United Kingdom (de Hoog et al., 2004, See Table 30). As a share of total employment, computer professionals and associates made up 1.6% of the total labour force in Germany, 2.2% in the UK and 3.1% in the Netherlands (Eurostat, 2003, p. 59). In Australia, IT professionals in 2003 were estimated at 209, 200 (Brooke et al., 2004, p. 15). In the United States, there were 10, 312, 650 IT workers in 2002 (Morgan et al., 2004, p. 8). Over the past decade, employment prospects in IT occupations have grown enormously (Brooke et al., 2004; de Hoog et al., 2004; Downie et al., 2004; Morgan et al., 2004). For example in the United States, "ten of the thirty fastest growing occupations are computer-related" (Morgan et al., 2004, p. 4). Even through the IT downturn, employment in the Canadian ICT sector recorded a 30.7% growth between 1997-2001 and surged past the total employment growth of 9.7% (Statistics Canada, 2003, p. 11). Between 1995-2002, computer professionals in the European study countries grew by 56% in the UK, 97% in the Netherlands, and 135% in Germany (de Hoog et al., 2004). In Australia, the growth in IT professional employment from 1993-2003 was a whopping 142% (Brooke et al., 2004, p. 2). These long-term growth rates have to be kept in mind when assessing the downturn in IT and the current rates of IT unemployment.

IT workers enjoy a lower unemployment rate than the average for all industries; however, their unemployment rate has grown substantially over the past 3 years in the wake of the decline in IT (de Hoog et al., 2004; Downie et al., 2004). A recent Canadian study found that the unemployment rate for IT occupations was 4.7%, compared to 5.7% for all occupations (Habtu, 2003). In the UK, computing professionals comprise a larger segment of the IT practitioner workforce than in the Netherlands or Germany, and these UK IT workers were especially affected by the IT downturn, although these declines are now starting to abate (de Hoog et al., 2004). Germany's labour market for computing professionals appears to be one of the more resilient, showing smaller employment declines in comparison to the other study countries (de Hoog et al., 2004). In Canada, the unemployment rate across IT occupations was 5.5% by the end of 2001, having risen from 2% the year prior (Wolfson, 2003, p. 7). According to the US Digital Economy report (U.S. Department of Commerce, 2003, p. 30), the unemployment rate for computer related occupations rose to 5.2% in 2002, up from 3.7% in 2001 and 2.7% in the early 1990s (1990-91). The authors note that in the past, the unemployment rate for computer related occupations was far below that of other industries and that the recent sharp increase

suggests that other factors (e.g. immigration of workers on the H-1B visa) have resulted in the redundancy of some US workers (U.S. Department of Commerce, 2003, p. 30; Morgan et al., 2004). Still, blanket unemployment statistics hide the significant variation in unemployment by IT occupation (U.S. Department of Commerce, 2003; Wolfson, 2003). In general, the manager and engineer unemployment rates are lower than the average IT unemployment rates and the technician unemployment rates are somewhat higher than the IT average (Wolfson, 2003, p. 7-10). Again, this corresponds to the vulnerability of lower status jobs, as low status IT jobs were the hardest hit in an unstable technology market. As we have seen, this variance carries different implications for workers, as there are clusters of certain types of workers (e.g. age, ethnicity and gender) in specific IT jobs (Bowlby, 2003).

Employment Turnover in IT occupations

Australian and Canadian data show that IT professionals have changed jobs at a higher rate than those in other occupations (Brooke et al., 2004; Wolfson, 2003). According to the Canadian Country Report (Downie et al., 2004, p. 24) "approximately 60% of a sample of 401 Ontario enterprises reported some measurable loss, such as project delays, customer dissatisfaction or lost sales opportunities, all related to a lack of qualified IT professionals or unfilled IT positions." Wolfson's (2003, p. 19) Canadian research on the job tenure of IT professionals indicates that there is a growing number of IT workers with more than three years at the same job. He suggests that this may be an effect of the downturn and the contraction of the labour market. For example, 44% of the analyst workforce in Canada had at least three years of tenure at their current job (Wolfson, 2003, p.19). In fact, the current view of 'turnover' by Canadian IT firms differs from those expressed prior to the downturn in IT. A recent case study of the IT labour market in Canada found that all of the firms in their study did not consider IT employee turnover a problem (Stager, 2002, p. 10). Again, there was a decline in turnover from the year 2000, and in 2001 the turnover rates reported ranged from 5-15% (Stager, 2002, p. 10). Stager (2002, p. 11) notes "the turnover rate must be understood in the context of IT work, where it is expected that few workers will remain beyond three years." In Australia, job turnover by computing professionals remains relatively high, with 70% of this workforce having 5 years or less tenure at their current position (ABS, 2001). The authors of the Australian Country Report suggest that this perception of mobility on the part of IT professionals must be seen in the context of IT business failure rates. In other words, some of the low levels of job tenure are due to the short duration of many IT businesses (Brooke et al., 2004). In this case, the structural instability of IT work at the level of small business means that IT workers must always be looking for better and more secure opportunities. Still, at the industry level, firms continue to report some skills shortages and challenges in retention and recruiting skilled IT employees (Statistics Canada, 2003a, p. 199).

Training and Positive Mobility Opportunities

A variety of factors influence how likely firms are to provide training and employee opportunities for growth and advancement (Brooke et al., 2004; Downie et al., 2004). A Canadian study on workers in the IT industry found that "career development, not renumeration, was the more important factor behind employees leaving their last job" (O'Grady, 2002, p. 27). Early results from pilot studies on IT workers in Canada note "more than half the employers reported the need to provide training to new employees. Although the focus seemed to be on training related to systems and applications software, the former was provided by over 60% of firms in the selected industries and the latter by 45% or more of all firms" (Statistics Canada, 2003a, p. 199). According to the Australian Country Report (Brooke et al., 2004, p. 32), small businesses are much less likely to provide training opportunities to employees. Given the strong presence of micro-businesses in IT, this suggests that many companies in this sector may be unwilling and/or unable to assist employees with training. Still, the message is mixed. One Canadian study found that those companies that were the most innovative were also more likely to implement training programs for their workers (Baldwin, 1999; Downie et al., 2004). A Canadian case study done on IT workers in 25 firms across a variety of industries showed that these firms were very supportive of training and regarded it as an 'investment' in the firm; however, employees desired more training in regards to their individual career progression (Stager, 2002, p. 9). The average amount spent on training in most of these firms was between 5-6% of their payroll (Rifkin, 2002, p. 10). Although these firms more often used formal training resources, the majority did not have a "formal/systemic" way of assessing the training needs of their staff (Rifkin, 2002, p. 10). Systemic training methods and skills development are initiatives that need to be addressed.

There have been few studies on the prevalence and form of positive mobility opportunities for IT workers; however, there are indications that skills training and professional development have become increasingly important to IT workers and their employers (Agarwal and Ferratt, 2002; O'Grady, 2002; Schambah and Blanton, 2002). An American study examined 32 companies that were well known for their success in recruiting and retaining IT staff (Agarwal and Ferratt, 2002). Organizations that incorporated a "balanced vision of the work, the individual, and the organization" were among those more successful in the retention of staff (Agarwal and Ferratt, 2002, p. 76). In addition, attention to professional identity and career development were important. One of the obstacles in recruiting was communicating to HR staff the market difficulties in finding certain skills and the importance of appropriate renumeration. One successful solution was the development of a specific IT Human Resource (HR) person- someone who understood both the market demands of IT and the HR culture and could therefore communicate more effectively (Agarwal and Ferratt, 2002). The career trajectories of IT workers is an area where much more research is needed, as there is little available information on the choices and

rationales given by the IT employees themselves for their career moves and advancements.

Age, Gender, Class, and Ethnic/Race Profiles of IT Occupations

Age

We found that in all of our study countries, IT is a young, but not entirely young, occupational group and contrary to what one might expect, it is getting older. The IT workforce is comparatively younger than the total labour force in the study countries. The average age of Canadian IT workers was 36, in comparison to an average of 39 for all occupations (Wolfson, 2003). In Canada, one quarter of IT workers were aged 45 to 54 and only 3% were aged 55 to 64 (Downie et al., 2004, p. 14-15). In 1997, workers over the age of 45 represented approximately 25% of the US IT workforce, compared to 31.8% representation in the total workforce, and IT workers over the age of 55 comprised only 6.8% of the IT workforce (Morgan et al., 2004, p. 11). Of the European study countries, Germany's IT labour force had the largest proportion of those aged 55-64, where they comprised 5% of their IT workforce (de Hoog et al., 2004, p. 21). In Australia's 2001 data, 18% of IT workers were between the ages of 45-54 and this dropped to 5% for IT workers aged 55-64, while only 1% of IT workers were aged 65 and over (Brooke et al., 2004, p. 17). Similar patterns are evident in the European study countries, with more than 40% of the IT workforce under the age of 35 (de Hoog et al., 2004).

In spite of the relative youth of the IT workforce, there is evidence that this workforce is aging. For example, IT workers over the age of 50 exhibited the most growth between 1994 and 1998 in the United Kingdom, even though they comprise only 10% of IT workers (Addison & Dixon, 2000; from Platman, 2003). Contrary to media reports that suggest that older workers were disproportionately affected by the downturn in IT, data from the UK indicates that computing professionals aged 25 to 34 comprised both the bulk of those hired during the rapid industry growth in the 1990s and the bulk of those laid off when the demand dropped (de Hoog et al., 2004, p. 22). The authors note that "by 2003, unprecedented numbers of older computing professionals were also working in IT jobs in the UK" (de Hoog et al., 2004, p. 22). Germany's labour force appeared to be the most stable over the period of the IT downturn and even the proportion of very young IT workers (those workers who appeared to be more vulnerable in the other European countries) grew over this time period (de Hoog et al., 2004, p. 22). One explanation for this maintained growth suggested by the authors of the European Report is Germany's apprenticeship program in computing (de Hoog et al., 2004, p. 22).

There are also variations in the age composition of different IT occupations. Age specific IT occupational data from Canada shows that those in the higher paying IT occupations tended to be older than the age of the average IT worker (Wolfson, 2003). For example, the Canadian data suggest that IT programmers and technicians are somewhat younger, and that the

managers and analysts are somewhat older than the average IT worker. Nearly 30% of managers and analysts are over 44 years of age. In contrast, only 3 out of 10 web designers were over the age of 35 (Habtu, 2003). It is in those occupations that tend to require constant skill upgrades (e.g. software and systems designers) that younger workers predominate (Brooke et al., 2004). In the UK, workers over the age of 40 were more often computer systems managers (40%), software engineers (33%) and computer operators (33%), while workers under the age of 40 only made up 25% of computer engineers or computer analysts and programmers (Platman, 2003, p. 10). In Australia, in the occupation of Engineering Manager, nearly half were over the age of 45 (Brooke et al., 2004). This corresponds with Canadian data that suggest that the occupation of 'engineering' is especially subject to workforce aging and will be one of the more affected fields (R.A. Malatest and Associates Ltd., 2003). For example, close to half of engineers in Canada are classified as 'older workers,' with 23% over age 51 and 30% between 42 and 51 (R.A. Malatest and Associates Ltd., 2003, p. 20).

It is evident that IT managers and analysts tend to be comparatively older and well compensated relative to other IT occupations; however, it is important to ask whether the trend for these occupations to be relatively 'older' is a natural work progression or whether more overt 'push' factors are involved. Data from the Australian Country Report (Brooke et al., 2004, p. 19) suggest that some of the stereotypes of 'older' workers may advantage them in relation to the positions of managers and consultants where experience and business savvy are seen as more 'senior' skills; however, as workers age and become 'older' they are perceived to have less up-to-date technical skills and are therefore regarded as less employable in highly technical positions. In fact, in a survey conducted by the Australian Computer Society, the most common form of discrimination experienced by their members was age discrimination (Brooke et al., 2004, p. 19). According to the US Country Report (Morgan et al., 2004, p. 11-12), unemployed IT workers over the age of 40 have to make more compromise in their job search than unemployed IT workers under age 40, in order to find new employment. Furthermore, US studies have found that IT workers in programming over the age of 50 had a 17% unemployment rate and that IT employers rarely look for workers with over 10 years of experience (Morgan et al., 2004, p. 12). It seems as if the perception in the field is that workers are better off starting from 'scratch' than building upon their existing technical skills. One of the benefits of hiring younger workers, in the eyes of IT employers, relies more on their lower labour costs relative to having to pay a more senior and experienced worker (Brooke et al., 2004; Downie et al., 2004).

At the same time, however, another common emphasis among the study countries is for the IT sector to promote 'life-long learning' and the importance of education/skills renewal (Brooke et al., 2004; Platman, 2003). One aspect of this has been encouraging employers to view training and re-training strategies as beneficial to productivity and long-term growth for their organizations. One aspect of this would be to focus on

retaining the skills of aging IT workers (Brooke et al., 2004). According to Brooke and her colleagues (2004), there are policy gaps in the learning initiatives directed at older workers. Here the focus is often on learning basic IT skills, as opposed to re-tooling already skilled IT professionals.

Gender

Across the study countries, men constitute the majority of workers in the highly skilled IT workforce (Brooke et al., 2004; de Hoog et al., 2004; Downie et al., 2004; Morgan et al., 2004). In Canada, men make up more than three-quarters of the IT workforce (Wolfson, 2003). In the European study countries, 2002 statistics show that only 19% of computing professionals (including associates) in the United Kingdom and Germany are women and this drops to a mere 12% in the Netherlands (de Hoog et al., 2004). The rates are similar in the US, where women make up 20% of IT professionals (Morgan et al., 2004, p. 13). As the European authors note, the gendered make-up of IT professionals has been remarkably stable and resistant to policy initiatives designed to increase the number of women in the profession. There are two further notable trends in the majority of the study countries in terms of the gender composition of the IT workforce. The representation of women in IT has recently declined and women's representation in IT is clustered into particular occupations, namely those with lower prestige and lower salaries. For example, in the United States, there was a decline in women's representation over the course of the 1990s, going from 41% in 1996 to 34.9% in 2002 (Morgan et al., 2004). Likewise, in the United Kingdom, the proportion of women in the IT workforce has fallen (Platman, 2003). One exception was Australia, where in 1996, women comprised 19% of IT workers and contrary to the decreases in representation in other study countries, their representation increased slightly to 22% in 2001 (Brooke et al., 2004). Still, the general trend of downward representation for women in IT suggests that the technology 'bust' in 2001 had an impact. According to the European Country Report (de Hoog et al., 2004, p. 23), women computing professionals in the UK were hit particularly hard by the IT downturn with their numbers declining dramatically.

This vulnerability may stem in part from the uneven representation of women across IT occupations (de Hoog et al., 2004; Platman, 2003). It is clear from broader conceptualizations of IT work, that women are over-represented in lower status and lower paying IT occupations (e.g. 85% of data entry keyers and 60% of computer operators) (Morgan et al., 2004). In contrast, they represent only 28% of computer system analysts and scientists, and 31% of computer programmers. A Canadian study found that women were clustered in those occupations of database analysts and data administrators (42%), systems testing technicians (41%), and web designers and developers (33%) (Habtu, 2003). Similar to the findings in other study countries, women were concentrated in those IT occupations with lower pay and fewer IT technical skill requirements (e.g. Technical writers 50%, Graphic designers 45%), although some of the greatest increases in female representation have come in IT management, and software design (Brooke et al., 2004). This is true in the

UK as well, where women have made the greatest strides in the management position, and their representation jumped 12% over the course of one year (2001-2002). Even so, women represent only 19% of IT management positions and 13% of IT strategy and planning roles (Platman, 2003).

One finding of interest is the evidence of salary discrepancies between men and women working in IT, even when full/part-time status is taken into consideration (this element is of less importance in studies of IT work, as more than 90% of women working in IT work full-time); women had lower median earnings than men (Brooke et al., 2004; Downie et al., 2004). Even among the same occupations, there were significant differences in the wage differentials between men and women. This suggests that there are elements other than occupation and employment status that impact the salary and compensation levels for employees.

All of the study countries have implemented programs to address the gender imbalance in IT and to motivate girls and women to pursue educational and professional routes into IT and computing/technical occupations; however, as was noted above, these initiatives have had limited success. These barriers have been outlined in the country reports and include factors such as the perception that IT is a masculine domain and that there is a lack of role models for women in IT (Brooke et al., 2004; Downie et al., 2004; Morgan et al., 2004). One approach to combat these stereotypes and perceptions has been to actively promote math and science to girls at younger ages. For example, IBM has partnered with area schools to organize math and science summer camps for middle-school aged girls (Morgan et al., 2004, p. 14). Yet, even when women do enter engineering and computer programs they tend to gravitate towards the less 'technical' aspects of these disciplines or to leave the field altogether (Brooke et al., 2004; Downie et al., 2004). Again, this may speak to the gendered nature of the field but it may also stem from some of the structural barriers evident in the nature of IT work, in that the work environment tends to be less flexible (Downie et al., 2004; Platman, 2003).

Class/Education

Information on the class of origin of IT workers is not available. Therefore, in this investigation, the educational background and salaries of IT workers have been used to give some indication of their social status. High-skill workers in IT tend to have strong educational qualifications (Brooke et al., 2004; Freeman & Aspray, 1999; Morgan et al., 2004). As noted in the United States Digital Economy report (U.S. Department of Commerce, 2003), the majority of IT jobs require a high degree of skill based on education, training and/or work experience, and this strong skill requirement is in opposition to the majority of jobs in the labour force. Across the study countries, workers in IT occupations are better educated compared to the labour force in all industries. Over 75% of the Canadian IT workforce has a post-secondary education. In fact, "44% of IT workers had at least a bachelor's degree, more than double the proportion in all occupations (20%)"(Statistics Canada, 2003a). UK high-skill IT workers were also highly educated, particularly, in the

occupation of software engineers, as nearly 60% held academic degrees (OECD, 2002, p.166). Many IT workers have academic degrees based on general science, math and engineering backgrounds; however, graduates of computer science, engineering and IT programs do not make up the bulk of IT workers (Downie et al., 2004). In other words, the career trajectories of workers in IT tend to be non-linear and non-traditional compared to workers in other professions (e.g. many IT professionals have non-IT degrees) (Brooke et al., 2004; Downie et al., 2004).

Wages in the field of IT have increased exponentially over the past forty years in Canada, going from $5,132 in 1960 to $47,709 in 2000 (Gagnon, Jacobs, Vaillancourt & Vaillancourt, 2003; SHRC, 2003). Managers are at the top of the salary scale with 28% of Canadian managers earning more than $76,800 per year (Wolfson, 2003). It would be interesting to assess the impact that the downturn in IT has had on IT workers views on unionization and job security.

Race/Ethnicity/Nationality

Aside from the research done in the United States, there have been few investigations on the racial and ethnic make-up of the IT labour force. In the United States there is slightly more ethnic and racial diversity in the IT workforce compared to the total labour force, and this diversity is growing (7% ethnic minority compared to 5% in total labour force) (The IT Workforce Data Project, 2003; Morgan et al., 2004). According to the IT Workforce Data Project, in the IT boom period in the 1990's close to three-quarters of the IT workforce in the United States were native-born whites, while in 2002 the proportion of native-born whites in the IT workforce dropped to 66.9% (The IT Workforce Data Project, 2003, p. 4-5). Asians make up 15.1% of IT workers in the US. Only a small proportion of this group are Asian-Americans, as 85.3% of Asians working in IT were immigrants (The IT Workforce Data Project, 2003, p. 4-5). In contrast, African-Americans, Hispanic-Americans and Native-Americans were all under-represented in IT in comparison with their overall labour force representation (Morgan et al., 2004, p. 14). The research that has been done suggests that the IT workforce is predominantly white, with a comparatively larger component of foreign-born workers than in the total labour force (Morgan et al., 2004; Platman, 2003; Wolfson, 2003). For example, Canadian data showed that, in 2001, foreign-born workers made up 32.4% of the IT workforce in comparison to 21.3% of the foreign-born workers in the total labour force (Downie et al., 2004; Habtu, 2003; Wolfson, 2003).

Except for the US, the examination of the presence of foreign-born workers in the IT labour force is in fact where the bulk of research on the ethnic/racial backgrounds of IT workers has focussed (de Hoog et al., 2004; Downie et al., 2004). Many of the IT workers who emigrate to the study countries examined here come from Asian and Indian countries (Brooke et al., 2004; The IT Workforce Data Project, 2003; Morgan et al., 2004). The economic conditions of the technology boom in the late 1990's played a large role in the immigration of these IT workers, as almost half of this workforce emigrated in this time period (Downie et al., 2004; Habtu, 2003, p. 8).

The highest rate of foreign-born IT workers was in Australia, where 36% of IT workers were not native to Australia in 2001 (Brooke et al., 2004). In Australia, foreign workers tend to be clustered in IT occupations like software design (40%), and the majority of foreign-born workers originated from South East Asian countries (Brooke et al., 2004). A Canadian study also found that there were clusters of foreign-born workers in certain IT occupations (Habtu, 2003, p. 8). For example, foreign-born workers "made up almost half of software engineers, 40% of computer engineers and more than one-third of computer programmers." This is also the case in the UK, where ethnic minority workers are also clustered into certain IT occupations, with the highest representation in computer engineering (9%) and software engineering (8%) (Platman, 2003). Interestingly, the lowest representation is in management.

In the past, many of the study countries' policy initiatives had been concerned with easing the flow of migration of skilled IT workers between countries. There has been something of a shift or a 'backlash' to these efforts, as more recent policy moves in Australia and the United States has placed some barriers and curtailment of migration and offshore outsourcing (Brooke et al., 2004; Morgan et al., 2004). The United States has just prohibited government IT contracts from being offshored; however, analysts note that this limitation will have minimal impact on the offshoring phenomenon at large (The IT Workforce Data Project, 2003). Trends to greater outsourcing and offshoring have implications for older workers and the degree to which their working potential is likely to be integrated into the workforce of the 'new economy' (Brooke et al., 2004; Morgan et al., 2004). IT firms will be less likely to make long-term investments in employee training and retention if it is more economical and effective to ship the work overseas.

It is evident that the labour market for IT is a global market (OECD, 2002). The reliance on immigration to fulfill software engineering and analyst jobs is a trend across the study countries. These workers tend to be younger and more highly educated than domestic workers in IT (Downie et al., 2004; The IT Workforce Data Project, 2003; Morgan et al., 2004). Among corporations and governments, the sentiment is one of competition for the most talented and economical workers (OECD, 2002); however, increasingly the IT worker associations in the study countries (Australia, the UK, and the US in particular) are expressing concerns about the unemployment rates of domestic workers (Brooke et al., 2004; Morgan et al., 2004). The fact that "software development remains the core foundation of Software/IT jobs" (SHRC, 2003, p. 3), combined with the strong international presence of software engineers, suggests that there may be a conflict between investing in training and seeking cost-effective solutions by outsourcing specific skills and tasks. This trend has led to concern on the part of domestic IT workers, especially in the context of the downturn in IT. In the United States, more domestic IT workers lost their jobs in comparison to IT workers who emigrated, and the number of IT workers immigrating continued to rise throughout the technology 'bust' (The IT Workforce Data Project, 2003, p. 4-5).

Supply and Demand Issues

The Supply of IT Workers

IT workers are spread across several industries and even among the highly-skilled, skill sets are variable and must be updated continuously in some fields. These factors make it difficult to quantify supply and demand issues and to definitively label which/what skills are in short supply (Downie et al., 2004). Generally, the supply of IT workers is drawn from IT-related educational programs, work and occupational training, and from the immigration of IT professionals. Larger companies have also been increasingly able to 'outsource' and 'offshore' their IT needs to IT service firms specializing in contract/project work.

Student enrolments in IT-related disciplines increased markedly following the technology boom in the 1990s, although some of the increase shows a more targeted shift within the fields of science and math disciplines. For example, in Canada over the 1990's the number of computer science graduates increased by 27%, while math graduates dropped by 14% (Downie et al., 2004). In Canada, there was a pronounced shift, especially for men, to technology-related fields in post secondary education, including engineering and computer science in university programs and data-processing disciplines in colleges (Statistics Canada, 2003b, p. 5). Although the educational system in the UK struggled to implement timely IT programs, in Germany, schools reacted quickly and increased computer science enrolment spaces in order to meet the demand (Platman, 2003). Unfortunately, even though enrolments in Germany grew in the later half of the 1990s, the graduation rate of computer science degrees did not substantially increase, as high attrition rates and backlogs plagued the program (Platman, 2003). College degrees in IT-related fields have also grown in the US, going from 861,800 in 1999 to 998,100 in 2001 (The IT Workforce Data Project, 2003, p. 3). College and University programs in computer science and information technology related fields have expanded in response to the earlier 'boom' period in information technology but it is unclear (at least in the US and the UK) whether the new graduates will outstrip the decline in demand when competing with outsourcing and immigration of IT workers. There has been a recent decline in student enrolments in IT from the upsurge that followed the rise of technology (Brooke et al., 2004, p. 82). For example, in Australia, IT student enrolments have dropped 25% between 2001-2003 (Brooke et al., 2004, p. 32).

The non-linear path of most IT workers further complicates the issue of assessing whether or not there is a 'skill shortage' and to what extent (Downie et al., 2004), as we know that following educational paths is not an accurate indicator of how many IT qualified personnel will be available. Many IT professionals have higher education degrees but they are not in a related field, and experience and on-going training have played a strong role in skill development for many IT workers (Downie et al., 2004). IT workers do not typically emerge through the traditional 'professional' work trajectory of an educational degree resulting in a designated occupational category (de Hoog et al., 2004; Downie et al., 2004; Platman, 2003). For example, Platman

(2003, p. 12) notes that "60% of graduate intake into IT and Telecoms careers arrive with non-IT degrees." Most IT professionals achieved their degrees in non-IT but related scientific fields, like engineering (de Hoog et al., 2004; Downie et al., 2004; Morgan et al., 2004; Platman, 2003).

Educational programs have not been able to keep up to the pace of technological change and the skill sets needed in the marketplace (Brooke et al., 2004). In Australia, analysts recommend that IT education be focussed on building more general skills that students can enhance through their work experience (Brooke et al., 2004, p. 30-1). Since academia has had a difficult time keeping up with the pace of technology in IT fields, there has been an enrolment rise in the United States in computer-related skill certificates, where there was "400% growth in awards of less than one year granted in computer and information sciences between 1990-2000" (Morgan et al., 2004, p. 16). In Canada, there are some suggestions that the skills valued by academic IT programs are different than those desired by the businesses looking to hire IT professionals (Downie et al., 2004). Increasingly, there is a need for IT workers who have general business and organizational skills along with the more technical IT skills sets.

Training existing employees from within a firm has been shown to be an effective way to address IT skill gaps (Downie et al., 2004). On-the-job training and gaining skills through experience have been common routes into IT, especially for women (Brooke et al., 2004). A Canadian study of IT workers in a variety of industries found that as many as 42% of IT workers did not begin their career in an IT position (O'Grady, 2002, p. 25). One concern for these workers related to the pace of change in IT is that many lack an underlying IT educational basis upon which to build more and more complex technical skills (Platman, 2003). Some commentators have suggested that one important policy initiative should be providing IT educational backgrounds for IT professionals currently working in the field without an IT tertiary education (Platman, 2003, p.13). Another concern for workers stemming from employment-based training programs is whether or not the skills learned for their current workplace are transferable or are limited to the needs of the company alone (Platman, 2003).

In spite of the decline in federal funding for company training initiatives, IT workers are offered a number of training opportunities by their workplaces (Downie et al., 2004, p. 37). The most recent Canadian study on these issues found that more than half of IT employers offered both formal and informal training opportunities to their IT employees and only 5-10% of IT employers provided no training to IT workers (Downie et al., 2004, p. 21).

In addition, larger firms with more employees were found to offer greater supports and opportunities for both educational training and on-the-job training (Downie et al., 2004). This factor would put many IT firms at a disadvantage, as the prevalence of micro-businesses in IT suggests that these companies might be less likely to be able and willing to offer educational and training opportunities. The relatively high turnover rate among IT workers

also presents a potential roadblock to training, as the expectation that employees will not be with the company long-term may deter employers from investing large amounts of training on their staff (Downie et al., 2004). Whether or not employees choose to participate in training initiatives when they are offered is yet another consideration. The permanent and full-time work status so common in IT and the higher education levels of IT workers are both associated with employee participation in opportunities for further training (Downie et al., 2004). Still, some IT workers are more likely to get left behind in support for upgrading their skills. Casual and short-term employees in IT are less likely to receive training and these workers are also much more likely to be women and/or over the age of 55 (Brooke et al., 2004, p. 19-20).

There is a growing concern that the **migration** of IT workers and the phenomenon of offshore outsourcing constitute a threat for domestic IT workers, and that older workers in particular may be forced out of the profession in favour of younger and more highly educated foreign workers. Domestic IT workers are particularly vulnerable to being displaced by employers seeking to minimize labour costs. For example, in Australia employers are able to sponsor 457 (Temporary) visa holds and pay them less than what they would pay Australian workers (Brooke et al., 2004). In the Canadian Computer System Design and Related Services Industry, as many as 20% of IT workers said that their second last job was not in Canada (O'Grady, 2002, p. 26). Immigrants have been a key source of IT labour across the study countries. In Canada, the government has worked to expedite the entry of skilled IT immigrants possessing needed expertise, such as specialized software design occupations (Downie et al., 2004). Immigrants who intend to work in IT come with exceptional educational qualifications, compared both to the total Canadian workforce and to other non-IT immigrants (Downie et al., 2004). Canadian IT immigrants were also more successful in quickly landing secure jobs than other immigrants to the country (Downie et al., 2004, p. 23). One North Carolina study of IT employers (NCEITA, 2000 cited in Morgan et al., 2004) showed that, "over one-third of survey respondents had up to 10% of their employees on work visas (Morgan et al., 2004, p. 18). Employers justified this by citing the shortage in qualified IT personnel and emphasizing their goals of getting 'the best' person for the job."

In the United States, IT workers and their supporters have spoken out against the use of H-1B visas to ease the immigration of foreign IT workers into the United States (Morgan et al., 2004, p. 18-19). In the United States, IT workers who have immigrated through the H-1B are estimated at 10% of the IT workforce (Morgan et al., 2004, p.18). The cap for H1-B workers was raised to 195, 000 for 2001-2003; however, in the context of the downturn in IT this ceiling was lowered. Still, domestic IT workers are feeling the competition from immigration and offshoring, especially given the lower rates of pay and the higher education levels of foreign IT workers. US IT workers face competition, from all sides, including the migration of IT professionals from Canada and Mexico who work in US foreign affiliates and therefore have access to work in the United States

(Morgan et al., 2004, p. 19). The phenomenon of offshoring is another growing trend, especially by IT companies in the United States. According to the US Digital Economy Report (U.S. Department of Commerce, 2003, p. 32), "offshore outsourcing has become the fastest growing IT industry segment." The authors of the US Country Report (Morgan et al., 2004, p. 17) note that, "12% of IT companies have opened up overseas operations, with large IT companies being the most likely to make this move...in fact, 22% of large IT companies surveyed said they had already moved work offshore." Although the offshoring of IT work initially began with low-skill work, now the move has been to offshore high skill, software work and larger and more complex IT projects (U.S. Department of Commerce, 2003).

The Demand for IT Workers and the Question of Skill Shortages or 'Skill Gaps'

Issues of the demand for certain IT workers and skill sets are complex and must take into account the ongoing balance between finding, retaining and re-training staff, matching the existing educational backgrounds and experience of workers with current skill needs, and the agency of IT workers who may or may not choose to move locales and/or re-tool their skills (Downie et al., 2004, p. 24). It is difficult to reach consensus on whether there is a 'skills shortage' in IT, especially given the impact of the technology down turn. Formal educational qualifications relating directly to IT and business and communication skills are increasingly expected alongside of technical expertise and competence. Across the study countries, current demands for IT workers suggest that employers are seeking specific skills and skill set combinations. In this case, the 'demand' is more targeted and employers appear to have more leverage in the skills and qualifications that they want from their IT employees.

In terms of assessing a skills shortage, there are pitfalls in relying on one-to-one assumptions about the number of graduates from IT-related programs and the number of available IT professionals (Downie et al., 2004, p. 19-20). One reason for the diverse assessments of the reputed IT skills shortage is that reports and projections compiled at the end of the 1990's predicted dire shortages and skill gaps in IT (Downie et al., 2004). The US Bureau of Labor Statistics (BLS) projections were made before the downturn; however, the BLS feels that this sector will continue to grow, estimating an 86% growth rate in employment between 2000 and 2010 (Morgan et al., 2004, p. 11). In Canada, skills that were in demand included those associated with programming such as Java or C++ (Downie et al., 2004, p. 45). The overall boom in demand for IT workers at the close of the 1990s has been replaced by "pockets of demand for those with the right skills and experience, notably web designers and those with expertise in a few select languages/applications, such as Freehand, Smalltalk, OLAP and JDBC" (Platman, 2003, p. 17).

Other indicators that have been used to gauge the demand for IT workers have been charting the job advertisements and measuring the degree of salary increases

and decreases for various IT occupations (Brooke et al., 2004; Downie et al., 2004). The downward shift in the demand for IT workers across the board is evident in studies that document the fluctuation in IT salary levels (SHRC, 2003, p. 2). A Canadian study on salary fluctuations for IT occupations found that starting in the late 1990s and into the year 2001, IT workers at all levels saw large salary raises that were "often in the double digit range" (SHRC, 2003, p. 2). Once the downturn in IT hit, raises stagnated and some salaries declined for IT workers overall; however, the "highly technical skilled jobs seemed virtually unaffected" (SHRC, 2003, p. 2). For those highly skilled IT workers in software engineering, application development, and embedded software development with abilities in Java and C++, the market contraction had minimal effects (SHRC, 2003, p. 7). The time it takes for IT graduates to attain related employment has been another indicator of the demand for IT workers. An ITAC (2002) study in Canada, found that "68% of IT qualified graduates found an IT-related job in 90 days or fewer after graduation" (Downie et al., 2004, p. 25). In terms of job vacancies in general, high skill jobs tend to have higher vacancy rates than low skill, unionized jobs (Downie et al., 2004, p. 46). In one recent Canadian study, the vacancy rate for IT jobs across three industries was 12% (Downie et al., 2004, p. 25). One IT occupation that was in demand from 1999-2003 was that of technically skilled project managers (Downie et al., 2004, p. 26). Management skills and skill combinations of technical and business expertise are increasingly in demand among employers (Downie et al., 2004, p. 26).

Current outlooks for IT employment in the US are somewhat more grim than in the other study countries and commentators there see the trend toward relying on IT talent from immigrants and offshore contracts as a real threat to the investment in training IT workers presently in the field (The IT Workforce Data Projects, 2003, p. 5-6). The IT Workforce Data Project (2003, p. 5-6) argues that "it is not at all certain that the supply of high tech talent in the US is inadequate, nor is it clear that there will actually be future demand for a much larger S&E [Scientific and Engineering] workforce in the US...the long-run outlook is more problematic." Likewise, the US Digital Economy report (U.S. Department of Commerce, 2003, p. 35) notes that "after almost a decade of rapid job growth during the 1990s, demand for IT workers has fallen sharply during the past two years...recent job losses have been widespread across almost all IT-producing industries and IT-related occupations."

Australian reports tracking the number of job vacancies in IT found that the number of applicants per job vacancy rose and nearly all of the vacancies were filled between October 2002 and May 2003 (Brooke et al., 2004, p. 33). The lowering demand for IT professionals has made the current market a 'buyers one,' and employers are becoming more demanding in terms of applicants educational qualifications; however experts warn that this is a 'temporary' phenomenon (Brooke et al., 2004; de Hoog et al., 2004; Platman, 2003; SHRC, 2003). In the OECD's (2002, p.

163) discussion of potential skill/labour shortages in IT, they note that "a distinction should be made between a shortage of IT workers, for which there is little or no aggregate evidence, and a gap between the current skills of IT workers and those sought by firms." This provides further evidence for the notion that specific, highly technical IT skills remain highly sought after, even as the market contracts for those IT workers with less specialized skills.

Discussion and Conclusion

A number of implications arise from examining the context of IT employment relations and workforce aging in the study countries and these will be addressed in the second phase of WANE. In Phase II, we will be doing case study research in IT firms that will provide in depth analyses to many of the outstanding issues that are identified in this report. Among these issues are those summarized below.

The challenge for IT firms and government policy makers will be to diversify the IT workforce by re-tooling educational programs to appeal to a broader range of applicants, by retaining those skilled IT workers already in the workforce, and by encouraging aging workers to extend their working lives.

Across the study countries, the globalization of work is affecting highly skilled IT service workers in entirely new ways. There is a movement of IT work to regions with lower wages, both domestically and abroad. Ironically, the highly skilled IT jobs that are still in demand in the domestic labour markets are the very jobs that are increasingly being offshored and contracted out by the larger IT employers. This trend has been justified by businesses that point to domestic skill shortages and the significant cost savings that they achieve through offshoring. IT workers and groups challenge that the downturn has resulted in more domestic IT workers available who can be retrained and re-incorporated into the IT field. If companies resort to contracting out and offshoring all IT they also stand to lose out. They do not gain skilled and experienced employees who are knowledgeable about the firm and bring their experiences from the previous project to the next assignment.

IT employers also suggest that the workforce in IT is more ethnically diverse and therefore, perhaps more 'minority' friendly in comparison with other industries. But it is important to note that although foreign workers in IT tend to come from Asian or Indian countries, the ethnic and racial diversity within the study countries is not reflected in IT employment. In other words, domestic minority groups continue to be under-represented. Currently, in the study countries there is a vocal backlash evident in the media by spokespersons for IT workers against the trend to outsourcing high skill IT work. A concerning element of these protests is the tendency to 'racialize' the debate. In situations where there is competition between groups of workers (e.g. foreign and domestic workers), the companies and transnational corporations are often targeted less than those workers perceived to be 'taking away' jobs. The racialization of this debate could result in fractious work environments for foreign IT workers who are currently working in the study countries. This

possibility should be explored in the case studies, in order to assess whether there are racial and ethnic divisions in IT workplaces and whether the accelerating debate on the phenomenon of offshoring has contributed to racism and/or exclusive or unfair practices in the workplace or among employees themselves.

The experience of job insecurity for IT workers may have come as quite a shock for those who entered the field before the technology downturn, when IT seemed to offer one of the most secure and promising careers on the horizon. The technology downturn and the recent stabilization of the IT landscape presents a unique opportunity to get a sense from IT workers if their perspectives on job security, unionization and their career trajectory in IT have changed and if so, in what ways. Has this experience increased the importance of benefits and of accumulating seniority for IT workers relative to salaries and other compensation factors, such as stock options? For example, the experience of job insecurity may have implications for the rates of unionization among IT workers. Currently, the rate of unionization is quite low; however, it would be interesting to see whether this trend changes in the coming years. Perhaps professional associations will come to play a more dominant role in organizing IT professionals.

The frequent turnover in employees that has characterized IT work has been portrayed by employers as stemming from the desire of IT workers to seek out the most challenging and exciting work available. But for those workers who have experienced this market contraction, the appeal of better and brighter horizons may have dimmed. Highly skilled IT workers are also vulnerable to market contractions and the contingencies of demand. This is an area where knowledge about the social class of origin of IT professionals would also prove to be informative, in order to see if these experiences with employment and the contingencies of the market are wholly new and to examine to what extent (if any) attitudes vary on the basis of their social class background.

The country reports have indicated that there are differences in the areas of emphasis between academic programs and the skills that IT employers' desire. Some commentators have suggested that the fast-pace of change in the field of IT means that schools should focus on giving students a solid technological basis in conjunction with the business skills sought by IT firms. Given the prevalence of small-business and micro-enterprises in the IT industry, there is a unique opportunity for government to fund targeted apprenticeships through these micro-IT businesses in order to familiarize students with up-to-the-minute skills and company needs. This experience could also improve the IT and computer science program retention rates and would give students a better idea of what a career in IT entails. Apprenticeship programs have proved successful in Germany and have resulted in increasing numbers of young people entering the field.

The focus on the retention of students in IT-related programs is an important one, particularly as it relates to the retention of women and minority students who are taking educational routes into IT. Typically, initiatives aimed at increasing

the diversity of the IT profession have focussed on getting women into IT and engineering/computer science programs; however, more effort needs to be paid to retaining them. This would mean looking at what structural changes could to be made to IT-related programs to make them more inclusive and appealing to women and minority students. Future studies could examine student experiences within the program and look at who drops out and who stays with the program, at what point do these exits occur, and why.

We know that many, if not most IT workers enter the field via non-traditional routes. Women have been especially prone to enter the field in this way. The lack of an educational base upon which to build may push some IT workers out of the field. This may particularly be the case for women whose numbers in IT have been on the decline. In a tighter IT labour market, those workers who entered the field via a non-traditional route are more vulnerable as skill needs change. The tighter labour market in IT has allowed companies to become more demanding in terms of educational requirements and this could further reduce the numbers of women in IT in terms of 'who' is hired. The lack of a technical background could also explain the tendency for women in IT to cluster more often in those jobs with less prestige and lower salaries. Educational qualifications in IT-related fields could also be used as reasons for denying promotions and/or inhibiting career progress for women and some older workers (who tend to have fewer educational qualifications than younger workers). The implementation of programs to provide a technical IT-base upon which to build would help to lessen the vulnerability of those workers who lack this qualification. In this sense, IT-educational programs typically aimed at 'older' workers need to be re-tooled in order to address the needs of those workers who are already highly skilled in IT and who simply need to build upon and maintain their knowledge base.

Across the study countries, only a minority of IT workers were contract and/or non-permanent employees (Morgan et al., 2004; Platman, 2003; Wolfson, 2003). For example, in the European study countries, the vast majority of computer professionals (including associates) are permanent: 79% in Germany, 80% in the UK, and 87% in the Netherlands in 2002. Part-time work in IT is relatively uncommon even among women, in contrast to its prevalence among women in the labour force as a whole. For instance, 62% of female computer professionals (including associates) were full-time in the Netherlands in 2002, compared to only 28% of women across all occupations. A similar picture emerges in Germany, where 81% of women working as computer professionals were full-time compared to 60% of women in the labour force as a whole, and the UK (83% versus 56%). As Platman (2003, p. 4) notes, "IT jobs tend to be full-time and inflexible, creating difficulties for women returners, workers with caring responsibilities and those wishing for a less intensive transition into retirement." In the three European study countries, a very small minority of men in IT partake in the part-time work that does exist compared to the number of women, especially in the UK (de Hoog et al., 2004). Still, there is evidence to suggest that contract and flexible employment is increasing in IT and that there has been

some “erosion” in full-time employment prospects (de Hoog et al., 2004).

The ‘full-time’ and permanent status of most IT workers suggests that options for leave and benefits are available; however, there is less known about the opportunity to work flexible hours in IT. A work and employee study in Canada found that there was a correlation between employee education level and the opportunity to work flexible hours; however, this correlation does not seem to apply to the situation of IT workers (Statistics Canada, 1999). Similarly, an Australian Report found that in spite of full-time status, professional female workers were less likely to have access to leave entitlements and benefits than male workers (Brooke et al., 2004, p. 28). For example, over the ages of 35-54, 83% of men had access to leave, whereas, only 72% of women had the same level of access (Brooke et al., 2004, p. 28).

Protection against overtime work and compensation for this work is an area of concern (Brooke et al., 2004; Downie et al., 2004). An Australian industry surveyor noted that “because long hours are seen to be part of the nature of the IT industry, the provision is generally not considered breached unless patently excessive hours are demanded” (Brooke et al., 2004, p. 29). Similarly, a Canadian study found that IT workers are typically not paid for their overtime work (O’Grady, 2002). These requirements also may act to deter the implementation of flexible work hours. An industry level survey in Canada found that almost all IT occupations had 40 hour work-weeks and overtime was common, even though the amount of overtime was relatively low (e.g. 4-5 hours per week) (O’Grady, 2002, p. 30). Much more research is needed on how IT employees attempt to balance work and family life and the extent to which company policies are available to aid in the integration of these responsibilities. There remains a question over the extent to which ‘non-standard’ types of work, such as short-term contracts and short-hours employment, offers the IT industry the flexibility it needs to remain competitive and cost-effective. Equally, can such work attract and retain mature IT professionals as they enter different phases of their working lives, especially where individuals are looking to combine caring roles with work or to navigate a phased approach to retirement?

There is little research that directly examines the retirement and exit paths of IT workers in the study countries. Instead, much of the research is indirect and examines more general retirement rates of workers in different industries and the proportion of different aged workers in the IT labour force. There is variation among the study countries in age at retirement and within each of the study countries there is further variation among different occupations in the average age at retirement (Cooke, 2003; Kieran, 2001). For instance, workers in the United States tend to retire comparatively later in comparison to workers in the other study countries (Cooke, 2003). It will be important to assess ‘who’ is more likely to retire early or late and how these trends vary both across occupations and among the study countries. In Canada, the education and health sector are predicted to feel the most impact from early retirement (MacKenzie & Dryburgh, 2003). In the industry where most Canadian IT

professionals are located, the professional, scientific and technical industry, the median age of retirement has dropped from 66.1 years (1992-1996) to 65.1 years (1997-2001); however, this industry sector did not have one of the 'earlier' retirement rates overall (MacKenzie & Dryburgh, 2003, p. 7).

There is some ambiguity about the extent to which older workers in IT have been affected by the fluctuations in the technology labour market. Platman (2003, p. 10) notes that in Britain's e-skills quarterly report, they link the age of IT workers with their vulnerability to the effects of the downturn in technology, saying that "judging by the average age [of those laid off in the technology bust], a pipe and slippers could be a prerequisite for membership of this (redundant) group." For example, of the 162,000 people in the UK who had previously been working in ICT positions but were out-of-work during the last quarter, 50% were over 45 and 13% were of statutory retirement age" (e-skills, 2002, cited in Platman, 2003). Yet, more recent data suggests that these reports may be overrated, as younger and female workers were in fact more heavily affected by the market contractions from the downturn in IT (de Hoog et al., 2004). Indeed, Platman (2003) indicates that more older workers have been entering IT work than leaving it. In the Australian report, researchers found that older workers were more likely to have left the field from being "retrenched" as opposed to early retirement (Brooke et al., 2004).

The extent to which age bias exists in IT is another area that needs to be explored further. One area of importance will be assessing the degree to which stereotypes relating to the technical ability of older workers prevail. Are older IT professionals shuttled either subtly or overtly into management and analyst positions contrary to their own preferences? We know that there is diversity in the age composition of different IT occupations. Older workers in IT tend to be in higher paying, more tenured and more prestigious IT jobs. Unfortunately, there is very little concrete research on involuntary exits and retirement rates among IT professionals. This leaves many questions unanswered. The low proportions of IT workers between the ages of 55-64, and especially over the age of 65 compared to the total labour force, suggest that workers may feel less than welcome in IT as they age. There is a need to investigate the processes leading up to retirement for IT professionals and the factors that affect how and when retirement occurs for those in IT. Again, the context of the downturn in IT offers a unique opportunity to see whether or not IT workers and employers saw more retirements over this time period and whether they felt that older workers were pushed out during the market contraction. Older IT workers are among the fastest growing worker group in IT and that makes these issues extremely timely and relevant.

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