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Legacy Applications Trend Report – Final Report

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REPORT

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Executive Summary

'Legacy applications' comprise the IT backbone of many large organizations: hardware and software systems developed over thirty years ago by the baby boomers. Mainframe hardware has now been superseded by the PC and powerful languages have replaced early software.

While legacy systems still work, their details are lost in software's craft origins. Upgrading and maintaining them is increasingly problematic, complicated by the impending retirement of the baby boomers – with skills no longer taught and knowledge unrecorded in documentation: "[Legacy] systems have morphed over the years to become incredibly intricate and complicated...once you pull the wrong thread, the whole sweater can become undone."¹

There are some 600,000 Canadian ICT employees today. About 60,000 work with legacy systems – 20,000 of them baby boomers, part of the wave of births that began in 1947 after the return of armed forces personnel from World War II. The wave peaked in 1959 and ended in 1966. The first boomers are just now beginning to retire, peaking in about 2020 and ending around 2027. Without mitigating factors, this would create an average 'legacy skills gap' of about 1,700 workers per year. However, three factors are likely to largely eliminate any skills gap.

While the timing of boomer retirements is uncharted territory, it will likely be gradual and manageable. Moreover, legacy skills are being replenished. IBM in particular is taking a leading role in legacy skills development. For universities, they are providing direct access to industry technology experts, developing comprehensive curriculum materials that meet industry needs, and providing faculty training on the latest mainframe facilities. For students, they have developed an online repository where IBM Business Partners and customers worldwide can search for potential job candidates. Likewise, HP, Intel, and Oracle have announced a partnership to help legacy mainframe customers modernize their applications and provide a full suite of legacy services.

Advances in software are gradually compelling organizations to replace legacy systems: lack of agility and adaptability, increasing maintenance costs and system wide incompatibility are prime factors. Lack of qualified personnel is not. Furthermore, like the effort that averted potential Y2K problems, software solutions for legacy applications have been gaining ground for some time. For example, the Consortium for Software Engineering Research (CSER), a not-for-profit corporation established in 1996 with funding from NSERC, strong support from the software industrial sector, and NRC's Institute for Information Technology (IIT) continues to improve legacy solutions.

There is a significant and growing outsourcing industry to support legacy systems. Boomer retirees are already returning in part-time consulting roles to assist their old organizations. Forward-looking companies are organizing targeted programs to ensure that the skills needed to maintain critical applications are being developed in-house. For example, Public Works and Government Services Canada (PWGSC) does so with its pay systems group – a good example of why legacy systems persist: Pay is a critical ongoing function. The 'business rules' that are written into its software code reflect the special needs of many government departments and are the result of legislation governing many separate collective agreements.

In conclusion, the skills that are most likely to be in short supply are those required to develop comprehensive migration plans and present them to senior management in such a way as to attract the necessary conversion resources. At the operational level, there is a need for people who are skilled at using the sophisticated conversion tools that are now coming on the market.

While the baby boomer numbers discussed above may seem troublesome – 20,000 of the country's 60,000 legacy workers retiring – time and ongoing developments would still appear to be on the side of management.

¹ Can we close the gap? The Globe & Mail Update (Nov. 28, 2006).

1. Introduction

This Legacy Applications Trend Report is intended to assist the Information and Communications Technology Council in fulfilling its mandate as it relates to what are referred to as “legacy” systems. It will focus on labour market intelligence and skills requirements relative to the growing problem of maintaining aging hardware and software systems that date back to the early days of the IT revolution. In this report, legacy systems will be defined more precisely by their software generation (third or earlier) and the status of their hardware (no longer in production). They will have been developed and installed sometime prior to 1980.

Because many of the legacy systems in place today were implemented by people who were in age brackets that qualified them as “baby boomers”, and because many of them are now retiring, a special emphasis will be placed on exploring a possible skills gap related to the exit of these people from the IT skills pool in general and from the legacy skills pool in particular. The combination of the baby boomers’ retirement, the limited number of university and college courses teaching legacy skills, and the overall decline of enrollments in computer science-related degrees would appear to point to a disruption in IT skills that warrants the attention of ICTC.



2. The Stakeholders

The people who are likely to be the most affected by such a disruption are not just the users of these legacy systems but the people who maintain them. Because of the high level of outsourcing that occurs in the IT industry in general and in legacy systems maintenance in particular, it is necessary to survey both constituencies in order to gain an understanding of the above issues. While many of the systems were originally developed and implemented by personnel who were employed by the users, the responsibility for their ongoing maintenance has shifted heavily towards outside contractors who have developed expertise in legacy systems that complements their other IT skills. They are the people who are likely feeling the major impact of any skills shortage that does exist. They will be referred to as maintainers or suppliers in this report.

2.1 Quantifying the Stakeholders

Estimating the number of stakeholders in either the supply side or the demand side is difficult because none of the ICT statistics that have been gathered over the years make reference to anything that could be called a “legacy industry” and even if they did, that industry would likely not be applicable to the “baby boom” era, which is the focus of this report.

Industry Canada cites three major industry sub-sectors as comprising the ICT sector:

- **ICT Manufacturing** – 2005 employment of 89,900;
- **ICT Services** – 2005 employment of 422,907; and
- **ICT Wholesale, Rental and Leasing** – 2005 employment of 76,465.

They are aligned with the North American Industry Classification System (NAICS) and are confined to the supply side of the industry. The sum of the three figures (approximately 600,000) is frequently referred to in quantifying Canada’s ICT sector.

So far as the user side is concerned, ICTC has identified 21 software-related occupations using the National Occupational Classification (NOC) system and interestingly enough, the employment within those 21 occupations also adds up to approximately 600,000. However, the two figures refer to different entities. The NOC figure includes only software workers, but they are from both the supply side and the user side, while the NAICS figure includes all types of workers from the supply side (i.e. IT and non-IT roles).² These differences will be taken into account in



using the two systems to estimate the size of what would constitute a “legacy industry” as it might apply under the conditions laid out in this report.

On the supply side, the two most pertinent NAIC codes are:

- 511211 – Software Publishers – 41,300 employees in 2005;
- 54151 – Computer Systems Design & Related Services – 222,900 employees in 2005.

The bulk of the existing legacy system activity would be coming from these 264,200 employees. Based on the conversations that were held with both users and suppliers in the course of the interviews and our knowledge of what is referred to as the Applications Support and Maintenance (ASM) segment of the software industry, we assumed that

² ICTC Report, Current Snapshot of the Canadian ICT Labour Market – March 2007, Branham Group Inc.

10% of these employees, or 26,420 are currently employed in supply side legacy work as it is defined in this report. As for the user side, we are assuming that the ratio of supply side workers to demand side workers that applies to the ICT industry in total would apply in this case. There is a widespread opinion³ that the ratio is 50/50, which would mean that the demand side employment is also 26,420, bringing the total current legacy employment to 52,840. We will use a figure of 60,000 which is 10% of the 600,000 total ICT employment.

2.2 Quantifying the Baby Boomer Impact

In order to determine the relationship between the suppliers, the users, and the baby boomers, we must begin by defining a baby boomer. Professor David Foot, a University of Toronto demographer and economist, who is widely quoted on the subject, defines a baby boomer as anyone living in Canada (including immigrants) born between 1947 and 1966. The boom began later in Canada because Canadian soldiers were later in returning from Europe than their U.S. counterparts and it ended later because of the earlier adoption of the birth control pill in the U.S. The baby boom peaked in 1959 when 479,000 babies were born.⁴ A very small percentage is just now entering retirement and if current retirement trends hold, the 1959 peak will be reflected in a retirement peak in about 2020. (Canada's median retirement age was 64 in 1987 and fell to 61 in 1998 but is now on the rise again.⁵) The number of Canadians aged 55 to 64 – those most likely to be thinking about retirement – jumped by 28 percent in the past five years to 3.7 million.⁶

In order to assess the impact of baby boom retirement, it will be assumed that it is just now beginning and will end nineteen years from now (based on the boom lasting from 1947 to 1966) and that one third of the country's 32 million people are currently boomers. (Seventeen million of the 32 million are in the workforce.) This means that there are 5.6 million baby boomers in the workforce today (33% of 17 million). Assuming that the ratio of legacy workers to total workers is the same as it is for the ICT industry in total (that figure is 3.5%, or 600,000 divided by 17 million), then there are approximately 20,000 legacy workers who are also baby boomers and will be retiring over the next nineteen years – out of the total legacy workforce of 60,000. That would appear to be a manageable figure.



³ O'Grady, J. (2006), Outlook for Canadian IT Occupational Employment, ICTC & Prism Economics and Analysis, 2006.

⁴ The Globe & Mail, June 24, 2006. By Definition: Boom, Bust, X and Why by Tralee Pearce.

⁵ CBC News, Feb 11, 2005 In-Depth – Retirement, Peter Hadzipetros.

⁶ CBC News – July 17, 2007 Baby Boomers Swell Ranks of Retirement-aged Canadians.

⁷ Ibid.

3. Methodology

In order to investigate the scope of the skills shortage and its impact on the two classes of stakeholders defined above, two initiatives were undertaken:

- An extensive literature review; and
- A survey of users and suppliers.

The main purpose of the literature survey was to gain an appreciation of the challenges facing the legacy segment of the IT industry while the main purpose of the stakeholders' survey was to focus on the following issues:

a) Retirement of baby boomers and the legacy skills gap

(e.g. who will keep the systems running?; what is the availability of legacy training?)

b) Bridging the legacy skills gap

(e.g. how big is the gap?; what can be done to recruit and retain legacy skills?)

c) Evaluation of legacy applications

(e.g. why do firms continue running legacy systems?; what is the impact of new technologies that can replace legacy systems?)

A copy of the survey guide used in the interviews with users and suppliers is included as **Appendix I**. The list of survey respondents is included as **Appendix II**. The topics discussed in the next three sections are the result of the two surveys referred to above.



4. The Baby Boomer Issue – A Literature Review

4.1 Overview

A comprehensive literature review was conducted including a canvas of online periodicals, reports, databases, and corporate/organizational websites. While the legacy application problem receives a significant amount of attention in the literature, there is much less in terms of the “skills gap” created by it, or other human resources issues for that matter. It is evident from the review that there is a strong awareness of the problems posed by legacy applications from the technical community, but the HR issues surrounding them have not yet penetrated the C-suite⁸ to any significant degree.

As stated to us by Mr. Birket Foster, CEO of MB Foster Associates Inc., a Chesterville, Ontario firm specializing in supporting HP legacy systems and data migration, “people in the C-Suite don’t know they have a (HR) problem yet. Since they don’t perceive the problem, there are few HR initiatives for it”. This raises the interesting question as to why many HR managers have not yet identified ‘legacy skills gaps’ to their ‘C-suites’.

While there is extensive anecdotal evidence that the issue is a big one, there is nothing definitive in terms of estimates or studies on how large the problem may actually be. There are many estimates of various industry demographics (such as 80% of the people who work in mainframe support are 50 years of age or older⁹) but nothing in terms of the size or growth forecast for the legacy skills gap itself. Other examples of **industry demographics/skills issues** are the following:

- While there were more than 2.5 million Java developers working in 2001, there were only 90,000 COBOL programmers working in North America in 2001 and that number is expected to shrink 13% annually.¹⁰
- The average age of COBOL programmers in the U.S. is between 42 and 49.¹¹

- In response to the retirement plans of many COBOL programmers, IBM has set a goal of training 20,000 workers by 2010.¹²
- More than half of those who manage enterprise IT organizations in the U.S. are already over the age of 50.¹³
- There are significant legacy skills available in some Eastern European countries, particularly in the old Soviet bloc countries.¹⁴
- Significant COBOL programming skills reside in the Philippines.¹⁵
- The average annual salary in the U.S. for a mainframe systems administrator was \$65,500 in 2005 (compared to \$66,500 for UNIX administrators and \$58,000 for non-mainframe Windows server administrators).¹⁶
- “The ability to integrate COBOL (and other legacy code) with web-oriented development tools would be the skill to have in the future”.¹⁷

In terms of the **legacy application issue** itself, the literature review uncovered the following:

- The average Fortune 100 Company maintains 35 million lines of legacy code, and adds about 10% each year for enhancements and maintenance.¹⁸
- 490 companies of the Fortune 500 leverage CICS alone to process more than 30 billion transactions or \$1 trillion worth of business each and every day. CICS (Customer Information Control System) is a legacy transaction server that runs primarily on IBM mainframe systems (CICS first went on sale on July 8, 1969). It is used by many financial institutions such as banks and insurance companies.¹⁹
- Currently, there are more transactions processed by IBM CICS & IMS systems than by the Internet in its entirety.²⁰

⁸ C-suite – refers to the senior management team.

⁹ Plugging the Mainframe Brain Drain, CNET News, June 2007.

¹⁰ Gartner, 2001.

¹¹ Time to Bridge the Great Legacy Skills Gap, July 2005.

¹² IBM Announces a New Mainframe Strategy, IBM, October 2004.

¹³ Meta Group Study, 2003. \ 7 Ways to Protect Legacy Systems When Boomers Retire, Deborah Perelman, August 2007.

¹⁴ 7 Ways to Protect Legacy Systems When Boomers Retire, Deborah Perelman, August 2007.

¹⁵ Ian Archball, Micro Focus, Mainframe Programmers Wanted, InformationWeek, September 2005.

¹⁶ 2005 Enterprise Systems salary survey.

¹⁷ Ron Kizior, Assistant Professor, Loyola University Chicago School of Business, COBOL Skills needed in the Future.

¹⁸ R.C. Secord, Modernizing Legacy Systems (Boston: Addison-Wesley, 2003).

¹⁹ Legacy Application Competence Center, Ukrainian Software Consortium.

²⁰ Ibid.

- IT departments in large corporations manage over 50,000 CICS code modules written in COBOL, Assembler, or PL/I.²¹
- In total, there are well over 200 billion lines of COBOL code in use today – the largest percentage of code in corporate business systems.²²
- In total, five billion lines of COBOL code are added each year.²³
- Besides COBOL, other legacy technologies include IMS, IDMS, DB/2, Assembler, CICS, RPG, FORTRAN, ALGOL, PL/1, NATURAL, SAS, JCL, and DCL.
- 70% of the world’s data still resides in legacy systems.²⁴
- Legacy mainframes are the core of IT systems at PWGSC, CCRA, the Receiver General, and many other Canadian federal government departments.
- Mainframe systems are one of the most reliable computer technologies with up times far exceeding those of UNIX and Wintel systems. This is another reason why organizations are reluctant to move critical systems off them.
- Information stored in legacy systems is almost as likely to be current data files as historical data.²⁵
- There is a huge gap between the tools available for newer languages (such as Java) and those currently available for legacy applications.²⁶

4.2 Legacy Skills Gap Drivers

The sheer volume of examples and case studies is a clear indicator that legacy applications are a growing problem. Based on our analysis of these examples, there appears to be four major drivers to the ‘legacy skills gap’:

- **Demographics** – this includes an aging population, the retirement of older workers, and increased labour mobility in general;
- **Industry Dynamics** – this includes significant ongoing M&A activity in the software and systems sectors;
- **Technology Dynamics** – this includes technology obsolescence such as when a major vendor discontinues a chip set; and

- **Firm Dynamics** – this includes changing company needs and mandates. The result is that companies outgrow their system or discover that it no longer fits the business.

As stated previously, the focus of the published literature is on the last three drivers and not the first one. This is to be expected as much of the literature is from companies and organizations in the business of solving legacy application problems in industry and government. In fact, the number of outsourcing and consulting firms that offer niche services in this area is on the rise.²⁷ Moving data from old systems is a huge business opportunity for these firms. In fact, there are companies that acquire old systems for the express purpose of providing ongoing support to them. For example, Infor of Alpharetta, Georgia has acquired more than twenty outdated manufacturing systems from old or defunct companies. The literature review does reveal that legacy software skills such as COBOL and PASCAL are in particular demand since there are many legacy systems written in these languages (particularly payroll and transaction systems) in Canada. Increasingly, offshore resources have been tapped to deal with the issue.

In terms of the literature specifically addressing the ‘legacy skills gap’, it is interesting to note that very few are authored by HR organizations. This is another indication that the issue may not have the visibility that it should. The term ‘**legacy knowledge**’ has been accepted by many to refer to the skills and expertise needed to administer and maintain legacy applications/systems but there are no real numbers in the literature.

In addition to the ‘skills gap’ drivers, there are drivers prompting the modernization of legacy applications. Increasing agility and adaptability top the list of drivers cited in a 2004 Meta Group survey (see Figure 1). It is interesting to note that, in this survey, the ‘lack of support personnel’ only ranks in the middle of the group.

²¹ Ibid.

²² June 18, 2001 Computerworld.

²³ From the Dustbin, COBOL Rises, Stephanie Wilkinson, eWeek, May 28, 2001.

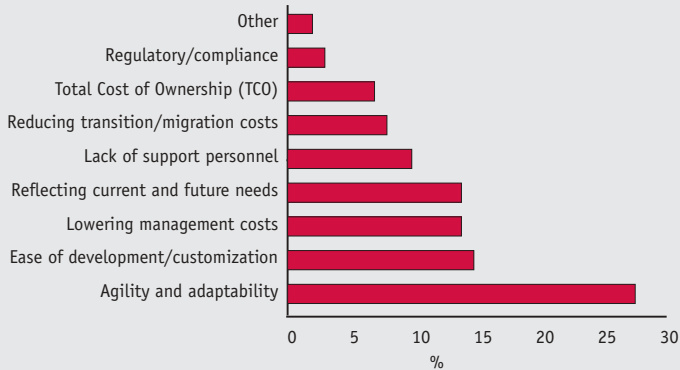
²⁴ <http://www.informationweek.com/747/legacy.htm> (Meta Group).

²⁵ Ibid.

²⁶ Computerworld.

²⁷ The Globe and Mail, Can we close the gap? November 28, 2006.

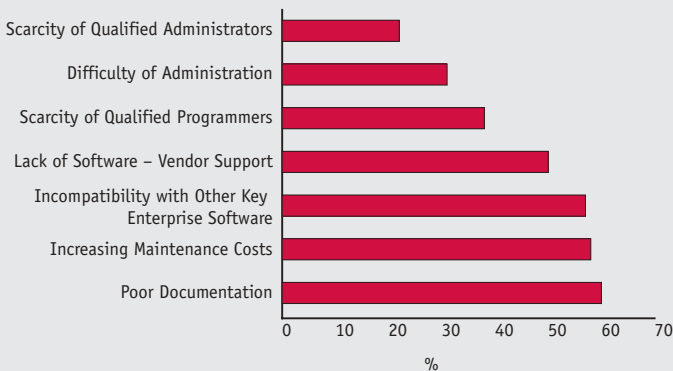
Figure 1:
Business Drivers Prompting Modernization of Legacy Systems²⁸



Source: Meta Group Survey, 2004.

Figure 2 presents results from a similar, but different, question. The question posed in this survey was “What are the most significant problems your company is encountering with its legacy applications?” Here, the focus is on what are the current problems, rather than what is driving the organization to migrate. Again, lack of qualified personnel is not at the top of the list. As will be explained later in this report, it is not surprising that ‘poor documentation’ ranks at the top of the list.

Figure 2: Current Problems with Legacy Applications²⁹



Source: Survey by InformationWeek.

²⁸ Meta Group Survey, 2004.

²⁹ Survey by InformationWeek.

³⁰ Capture Legacy Knowledge before it Retires, Info-Tech Research Group, October 3, 2003.

³¹ The Globe and Mail, Can we close the gap? November 28, 2006.

4.3 Today’s (and Tomorrow’s) Approaches to Addressing the Issue

An article appearing on the Human Resources Professionals Association of Ontario (HRPAO) knowledge centre website (entitled “Capture Legacy Knowledge before it Retires”) suggests that companies must develop an action plan now to address the pending skills gap:³⁰

- **Assess reliance on legacy systems** – build a list of all legacy systems;
- **Conduct a skills assessment of your IT staff** – use skills assessment templates to identify the skills needed;
- **Implement cross-generational training for all critical IT functions** – develop mentorship and incentive programs to encourage workers to add legacy knowledge to their skills (also consider external training and certifications to develop legacy knowledge);
- **Make legacy systems usable for non-legacy-literate workers** – use ‘legacy wrapping’ which encapsulates legacy code within newer code that can be maintained by IT workers; and
- **Manage departmental culture** – encourage teamwork, tap into peoples’ different skill sets, and reduce age-related tensions.

This article is one of the few that specifically identifies the pending retirement of baby boomers as a major driver for the legacy skills gap. Furthermore, it indicates that the average age of individuals in charge of enterprise IT shops is already over 50.

Based on our analysis of this, and other, action plans appearing in the literature, the typical response today is two-pronged: encourage retiring baby boomers to train the younger workers while at the same time creating incentives and programs to encourage the younger workers to acquire the legacy skills. Clearly, these steps are not enough (or were not implemented well enough) based on the fact that many firms and government bodies need to pull workers out of retirement and pay them consultancy fees to resolve legacy issues. One article even indicates that several Canadian firms have been luring Canadian IT retirees from Florida.³¹

One of the things holding back this ‘two-pronged approach’ is that younger workers typically have no mainframe skills as they are not commonly taught as part of typical computer science curriculums. Another impediment is that many organizational IT training budgets have been slashed in recent years.

Many believe that ‘web services’ will play an increasing role in filling the legacy skills gap.³² The concept is that hosted, web-based services on specific legacy applications and skills will evolve. Others believe the focus should still be on skills transfer, given that many of the baby boomers could still have a decade or more of regular employment ahead of them.³³ In Section 2.2, it was suggested that the baby boomer peak will not occur until 2020. However, there is consensus that the focus should not just be on replacing the boomers’ technical skills, but also on leveraging the business knowledge that they possess.

4.4 A Counter Position

An interesting article by Clabby Analytics argues that the projected mainframe skills shortages may never happen and that retiring baby boomers are not as big a problem as some believe.³⁴ Their literature review, like ours, found no published reports indicating what the legacy skills gap would be from retiring boomers. They argue that:

- Boomers will not all be retiring at the same time, but rather in phases with some not retiring at all;
- There are still many 35 to 50 year olds currently involved in managing mainframe environments. They maintain that this group represents a “second crop” of legacy skills already in the queue;
- Mainframes are becoming easier to operate and maintain.

With respect to the last point, they note that IBM is actively improving mainframe management (including a Windows-oriented user interface) and IBM expects this to appeal to the ‘next-generation of Windows-born-and-raised managers and administrators’. Clabby Analytics agrees that finding people with COBOL skills will be a challenge. New functionality will also ensure the mainframe’s longevity. Mainframes can now run Linux and other programs allowing them to drive a whole new generation of modern applications onto them. This means that organizations will be staffing for Java and Linux as much as trying to fill vacant COBOL positions.

Clabby Analytics agrees that some mainframe and legacy skills are in short supply but they do not see the problem as being that significant going forward. In fact, they believe that these skills shortages are pale in comparison to shortages of SQL Server DBAs, help desk administrators, and hardware engineers across the entire ICT industry.

4.5 Organizations Should Plan Now

One of the common themes in the literature is that an organization should undertake an enterprise-wide application/system audit now. By doing so, the organization will be able to identify which systems can be extended within their current environment and which ones will find new life, delivering greater value on a newer platform such as Windows, Linux, UNIX, etc. Only then will the organization be able to assess the degree to which it has (or will have) a legacy skills gap. Depending on one’s perspective, differing opinions surrounding such an assessment are likely masking or inflating the legacy skills issue.

³² Ibid.

³³ The Great Legacy Skills Debate, CNET News, July 25, 2005.

³⁴ Counterpoint – The Alleged Mainframe Skills Shortage, Clabby Analytics, March 2007.

5. Bridging the Legacy Skills Gap

5.1 Perspectives Need to Change

As indicated in the literature review, the solutions to the legacy skills gap fall into three major categories:

- The development of programs and techniques to encourage skills transfer from the baby boomers;
- The teaching of courses in legacy software and systems (including mainframes);
- The teaching of courses in the use of conversion tools (or the development of new approaches to solve the gap such as ‘web services’).

The interviews clearly indicated that changes to current perspectives will be required to address the skills gap.

That is, it will be necessary to convince today’s programmers that working with COBOL code (and other legacy code) is not the equivalent of mastering a dead language. While working with legacy applications may be a technically impressive task, it is not particularly exciting to many and is perceived not to be worth as much in the market as newer programming and system skills. As one respondent stated, employees are seeking career advancement, not just moving horizontally within an organization.

By their very nature, legacy applications create several challenges that lead to this less-than-glamorous perspective:

- *Tedious* – they often require line-by-line code analysis, which few IT people enjoy or have the technical competency to carry out.
- *Technologically unappealing* – they are based on technologies that few IT people are interested in maintaining.
- *Rigid* – they cannot be easily modified to embrace new user requirements.
- *Undocumented* – as the literature review indicated, these applications/systems often lack user or system documentation.
- *Cryptic* – they were developed in low-level programming languages that current IT people cannot easily understand.
- *Volatile* – they often produce unexpected results from small system changes.

- *Non-supported* – they often run on old hardware and software platforms which means that IT people spend a lot of time and resources identifying old vendors and finding alternatives.

These features of legacy applications need to be *managed* differently if more people are to be attracted to this area. They should be put into context as challenges with recognition given to those who can manage such a wide variety of factors and issues.

These perceptions and challenges were clearly on the mind of one IT manager who was interviewed. In order to counteract these issues, the organization has created a positive, pleasant, and supportive work environment with strong team dynamics. The intention is to provide recognition of the unique challenges legacy support work faces and provide staff an environment in which they enjoy coming to work and interacting with others.

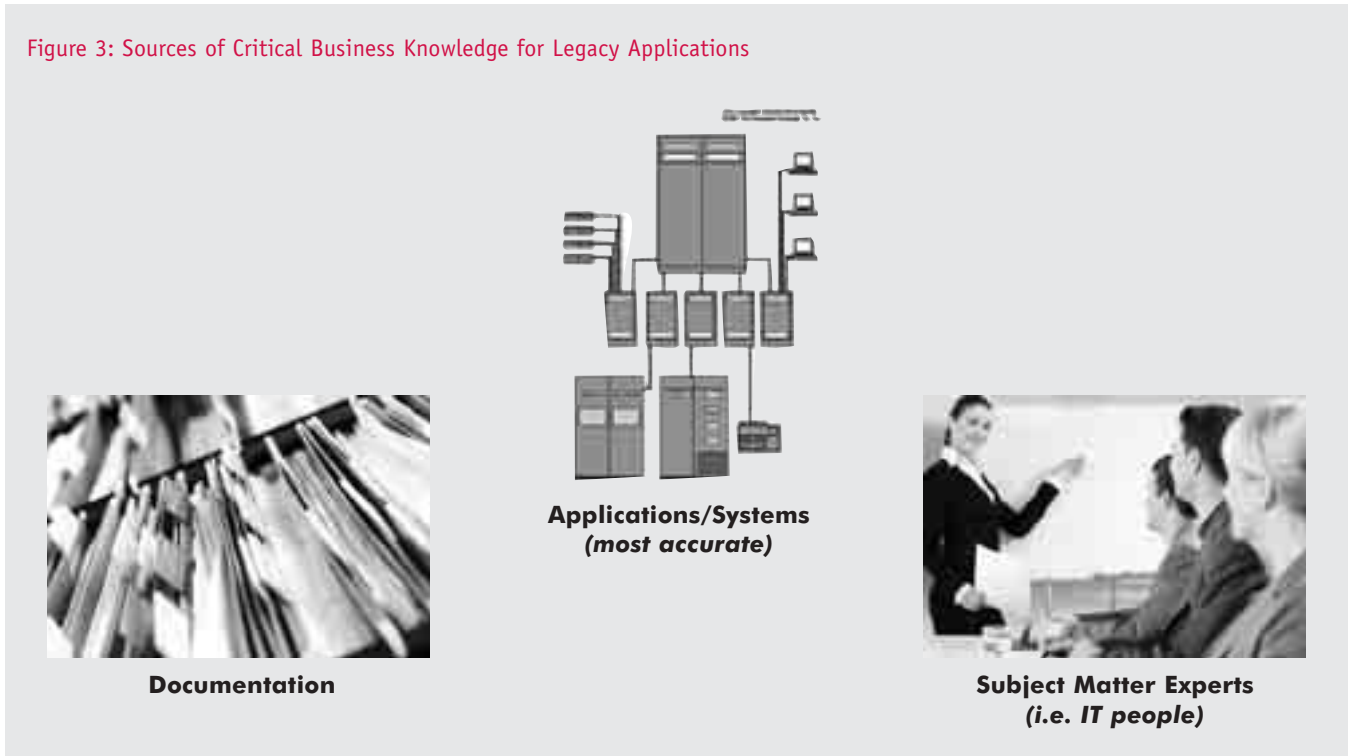
5.2 Retaining Corporate Knowledge through Maintenance and Support Activities

It is clear that relying on aging baby boomers to maintain and support legacy systems will not work forever. Other approaches will be needed. While mentorship and knowledge transfer to younger workers is occurring, this alone may not be enough (because of increasing competition for scarce resources). Several respondents believe that a much better job of documentation needs to be done. This is an immediate response that will help in an environment of increasing mobility of technical workers.

What is being called for is not simply the creation of a system manual, but rather a complete documentation of the workers’ business and technical knowledge. As shown in Figure 3, critical business knowledge is locked inside three sources of knowledge: the IT people, the documentation, and the applications. Although all three should be fully documented, this is rarely done. Increasingly, IT managers understand the importance of retaining corporate knowledge; however, maintaining and supporting existing systems while at the same time adding to their functionality demands most of their attention. They also face other issues which are far more subtle. Many legacy systems were created at a time when a lack of documentation (in whole or in part) was very common. Even today, a common characteristic of IT specialists and programmers is that they do not like to do documentation. As suggested by one respondent, in many cases this is intentional as technical workers seek to protect their position and skills in the competitive workplace of today.³⁵

³⁵ Based on personal interview (name withheld).

Figure 3: Sources of Critical Business Knowledge for Legacy Applications



In the case of many public sector legacy systems, outside consultants are often brought in to assist with documentation efforts, but since this is very expensive, it is usually not as up-to-date or as complete as it should be. Even many IT managers do not appreciate the value of documentation.³⁶

Based on the interviews, it is estimated that roughly 50% of the effort involved in maintaining and supporting large public sector systems is carried out by in-house employees with the other 50% performed by outside workers (these include recently retired employees who are now consultants as well as workers from external IT firms). While this is likely to vary widely between departments (and by size of department), it does suggest that external workers often play a key role in maintaining and supporting public sector legacy applications.

The most common answer to the question – *who will keep the legacy systems baby boomers built running* – appears to be ‘existing staff will, or so is the hope of many managers’. The following comment summarizes the current situation:

“Two weeks ago I received a call from my old department asking how to solve a legacy problem. This occurs every 4 months or so.”³⁷

One respondent’s comment echoes some of the research uncovered in the literature review, namely that organizations’ still have time on their side:

“2/3 of Canadians (non-public servants) have not saved sufficiently to retire fully. If this is true, then a larger number of people will continue working than was the case in the past. The problem will exist in terms of support, but the acuteness of it might not occur as soon as we might think. As such, hopefully many of the legacy applications will have been replaced (or adequate plans developed)”³⁸

³⁶ Based on personal interview with Mr. Birket Foster, CEO of MB Foster Associates Ltd., January 2008.

³⁷ Ibid.

³⁸ Based on interview with Mr. JP Soublière, President, Anderson Soublière inc.

5.3 Colleges and Universities are not seen as the Answer

All respondents said there were not enough university and college programs providing courses on legacy skills. Many of them understood why this was the case, echoing the legacy perceptions identified above. Others suggested that with the technology industry crash and reduced salaries in recent years, the decline in technical enrolment generally should not come as a surprise. Furthermore, many felt there would not be enough enrolments or graduates to meet the demand for legacy skills for the foreseeable future. In fact, the literature review indicated that U.S. colleges and universities have had a difficult time convincing their funding agencies that the legacy skills issue is one that should be funded.

Surprisingly, there was little consensus on which university and college programs would be the most relevant for bridging the gap. While computer science and systems engineering programs would be the obvious answers, respondents often did not have an answer to this question. This could reflect their view that many past coders and systems experts were self trained or have gained their skills through accreditation programs or on-the-job training rather than through formal degree programs at colleges and universities. No matter what the reason, it is clear that IT and HR managers do not expect universities and colleges to provide the resources any time soon. This perspective could also reflect the view that managers view the legacy skills gap as too customized for formal educational programs to address – at least in a direct way. These views are summarized by one respondent with the following:

“Most university students don’t have enough hands-on skills even for today’s software/hardware, let alone older legacy software/hardware.”³⁹

Respondents identified mainframe and technical courses offered by private sector companies, vendors, and associations as a key resource. Examples include IEEE, IBM, Oracle, HP, Microsoft, AFCOM, and WebEx Training (www.webex.com).

The interviews clearly indicated that COBOL and mainframe skills are no longer taught in many degree and diploma programs.

In terms of specific legacy knowledge, COBOL and mainframe skills are likely the most common requirements. However, they are by no means the only ones. Knowledge of languages such as ADSO, Natural, or IDEAL and expertise with databases such as ADABAS, IDMS, or Datacom were also identified. This knowledge is significantly more rare and expensive to obtain.

The interviews, like the literature review, indicate that COBOL and mainframe skills are no longer taught in many degree and diploma programs.

Besides the legacy software and systems skills, strong business analysis skills are much less common in Canada than many think, according to one respondent.⁴⁰ Two common measures used in assessing legacy systems are *business value assessment* and *technical quality assessment*. The first is a measure of an application’s importance to the business, and is determined by such things as contribution to profit, level of usage, user satisfaction, and the value of the information maintained by the system. Technical quality is a measure of the goodness of the application against a defined set of technical criteria, such as maintenance cost, language used, vendor support, training availability, and hardware required. The interviews suggest these assessments are not being done as frequently (and/or as adequately) as they should be.⁴¹

Another respondent indicated that while colleges and universities are good at teaching students how to write code, they are not nearly as good at teaching them how to test their code and designs. With interoperability and distributed systems key technical considerations today, this can be a shortcoming. It is also relevant to working with legacy applications.

Several respondents indicated that the colleges are much better than the universities in terms of providing more relevant courses and skills development – and much more responsive to industry needs. Programs at the University of Waterloo, Carleton University, as well as Algonquin College and St. Lawrence College were identified as helping to bridge the legacy skills gap.

³⁹ Based on personal interview (name withheld).

⁴⁰ Based on interviews with Mr. Birket Foster, CEO of MB Foster Associates Limited, January 2008.

⁴¹ Based on interviews with Mr. Garth Jones and Mr. Birket Foster, among others.

More hands-on experience (co-op), more openness to new ideas and approaches, and recognition of the continuing importance of legacy applications are other changes needed from Canada's college and university system.⁴² Co-op programs were singled out as crucial: students need to obtain real-world experience on specific vendor technologies (legacy and otherwise).

A few respondents felt that universities should not assume a direct role in legacy training. Instead, it is better for them to concentrate on other skills development (such as process management, change management, analytical thinking and assessment processes).

Colleges and other providers are better positioned to meet the specific legacy training issues.⁴³ Internship programs should be established prior to graduation allowing for a gradual familiarization with industry needs. They should consider partnerships with interested companies/organizations helping to offset program costs. They should also develop short-term certification programs which can provide the necessary skills and training, and they have a role to play in ensuring that new immigrants to Canada (many of whom have legacy skills) are ready to apply those skills.⁴⁴

5.4 Recruitment and Retention of Legacy Knowledge

The interviews clearly indicated that *recruitment* and *retention* are separate issues with respect to legacy applications. For example, some respondents indicated that they did not yet have a problem recruiting legacy skills but they did have a problem retaining them. Others stated that they had problems in both areas, while yet others had problems in recruitment but not in retention. However, there is widespread consensus that recruiting legacy knowledge is significantly more difficult than recruiting current knowledge.

The interviews clearly indicated that recruitment and retention are separate issues with respect to legacy applications.

While the retirement of baby boomers was frequently identified as a problem in terms of retention, the loss of IT people to outside consulting firms was also common. The belief is that IT people often leave for outside consulting firms because the pay may be better and the opportunity for professional and technical skills development much wider. This may open more career paths.

Those respondents who did not have a problem with recruitment of legacy knowledge at this time typically have some kind of specialized in-house program in place to help with skills development, or have taken other steps to bridge the skills gap. For example, at Public Works and Government Services Canada (PWGSC), they have developed a 3-year in-house apprenticeship program specifically to address their legacy knowledge needs both now and into the future.⁴⁵

PWGSC maintains the pay system for the entire federal government, among other legacy systems. They have noticed a legacy knowledge problem over the last several years and expect this problem to get worse over the next five to ten years. They estimate that the average age of an IT person in their organization is around 40 to 45. Unlike many organizations, PWGSC has conducted a comprehensive assessment on a position-by-position basis to identify where there is, or will be, a legacy skills gap. The apprenticeship program is headed by an in-house instructor who teaches several different courses to approximately 40 participants who are typically recent college or university graduates. It is interesting to note that the majority of these new graduates are from a non-IT background. For example, many have an accounting background, but others have backgrounds in the arts, or translation, or technical writing. In addition to courses, participants are provided with direct mentorship from retiring baby boomers.

While the availability of the resource itself is a major factor, the ability to recruit and retain talented staff depends on other factors as well – such as the organization's financial resources, its quality of work life, the perceived career opportunities it can provide, and the quality of its management and leadership teams. Organizations that are having problems with both recruitment and retention of legacy knowledge likely have several factors working

⁴² Ibid.

⁴³ Based on interviews with Ms. Gail Di Cinto (Larus Technologies), Mr. George Dinardo (Larus Technologies), and Mr. JP Soublière, President, Anderson Soublière inc.

⁴⁴ Based on interview with Ms. Gail Di Cinto, VP of Operations, Larus Technologies Corporation.

⁴⁵ Based on personal interviews with Ms. Kristine Renic and Ms. Diane St.-Denis, PWGSC, January 25, 2008.

against them. Nevertheless, the number one factor appears to be the organization's financial resources, as echoed in the following comments:

"Recruitment and retention are both difficult; because unless you are a \$5 million dollar (a year) company, outsourcing is very difficult to do.

SMEs are in a very difficult situation."⁴⁶

In terms of public sector legacy knowledge recruitment, it was noted that the government's own policies are making it more difficult for it to recruit appropriate IT people. Since they insist on hiring bilingual workers they are overlooking many highly qualified workers.⁴⁷

Interestingly, only one respondent mentioned immigration as a source for recruitment even though the literature review indicated that significant legacy skills exist in some Eastern European countries. Whether through immigration or outsourcing, it is clear that India and China cannot provide much help. While their IT workers have plenty of expertise in enterprise resource planning systems (and other newer technologies), they offer few legacy skills.⁴⁸

5.5 Approaches to Legacy Knowledge Training

There are many methods of ensuring proper training and knowledge transfer from the original architects of legacy applications. However, the very first step that should be taken (long before any training takes place) is to chart the age of all employees and assess the employee age threat. The goal is to determine when employees who deal with key systems are likely to retire. As stated by one respondent, planning is needed:

"This sort of last minute frantic effort to capture knowledge and processes should be absolutely unnecessary."⁴⁹

One of the most pro-active approaches identified in the interviews was PWGSC's 3-year in-house apprenticeship program. This succession planning approach is all about mentorship whereby the creators and/or maintainers of the

legacy applications work with younger workers to develop the operational, technical, and business knowledge to support the systems. Mentorship such as this can be an important key to job satisfaction for the younger generation.

It was noted that sometimes those doing the training do not necessarily know everything about the system they have inherited and cannot convey all the information that is required. For example, key items like why something was done the way it was rather than another way are often lost. This further emphasizes the need for complete and regular documentation and skills analysis. It also highlights the need to rotate employees between legacy system support roles and other IT activities.

Some respondents indicated that current IT staff are sometimes willing to learn legacy knowledge (in addition to performing their regular work) but are not given the opportunity due to budget constraints.

A phased retirement policy to retain experienced employees was viewed very favorably by a majority of respondents. It was believed that this would allow the newer staff to understand the system while removing some of the day-to-day operational stress from the retiring staff member. This would provide for one-on-one training which is considered key to knowledge transfer. This gives the organization a chance to plan for the attrition of the legacy knowledge. In this regard, organizations should try to make sure that key people do not retire all at the same time, although their ability to influence this is limited.

In addition to a formal phased retirement policy, organizations can simply elect to provide more flexibility to baby boomers involved in legacy knowledge. For example, they can be given flexibility in work schedules (i.e. job sharing or flex time) allowing them to alleviate some of the stress involved in working. It may even be possible to offer them telecommuting options if their presence is not needed onsite every day.

Employers will also need to develop new employment relationships to provide creative solutions to older workers' expensive severance, benefits, and health programs. Since government forces employers to pay out expensive severance packages, based on years of service, this can lead to companies retiring high cost employees.⁵⁰

⁴⁶ Based on interviews with Mr. Birket Foster, CEO of MB Foster Associates Limited, January 2008.

⁴⁷ Based on personal interview (name withheld).

⁴⁸ 7 Ways to Protect Legacy Systems When Boomers Retire, Deborah Perelman, August 2007.

⁴⁹ Based on interview with Mr. Mark Norton, February 11, 2008.

⁵⁰ Based on interview with Ms. Gail Di Cinto, VP of Operations, Larus Technologies Corporation.

Automating low-value work, wherever possible, and moving existing staff into higher value work was also viewed positively. Many seemed to consider it a requirement of IT and HR managers. Some of the new tools and technologies (when more mature) promise to make a positive impact here; however, as will be seen later in Sections 6.3 and 6.4, we are not yet there.

It is often the case that several different methods are needed to bridge the legacy skills gap. While most organizations can afford only one or two approaches, some large organizations can, and do, implement multiple methods. For example, a combination of on-the-job training, cross-training, web and video training sessions, and external training courses are employed at the same time.

It was recommended that managers and CIOs tap into vendor initiative programs. IBM, Micro Focus and other COBOL vendors have invested significant resources in their platforms and may be a resource.

For example, as indicated in the literature review, IBM is taking a leading role in mainframe and legacy skills development. Through its Academic Initiative, it has pledged to work with 325 schools to reach a target of 20,000 mainframe IT professionals by 2010. These programs are designed to assist universities, students, and corporate users directly. For universities, they are providing direct access to industry technology experts, developing comprehensive curriculum materials that meet industry needs, and are providing faculty training on the latest mainframe facilities. For students, they have developed an online repository where IBM Business Partners and customers worldwide can search for potential job candidates. They have also sponsored legacy and mainframe contests in North American colleges. For companies, they are providing access to qualified mainframe talent, and have developed targeted work-study programs.⁵¹ Many of these training approaches are the same as identified in the interviews – the difference here is that IBM has the resources to make it happen and is committed for the years ahead.

In 2005, IBM announced a new service whereby they would help organizations identify employees on the verge of retirement and obtain the critical legacy and business knowledge that they possess (the service employs cultural

anthropologists).⁵² Likewise, HP, Intel, and Oracle have announced a partnership to help legacy mainframe customers modernize their applications and provide a full suite of legacy services.⁵³

Outsourcing may be an option for some organizations. In fact, one approach to the problem may be to use outside contractors to document the systems while using the retiring boomers as support to the contractors (i.e. quality assurance) and to the new workers. The investment required to document as compared to trying to create new code, needs to be assessed on a case-by-case basis.⁵⁴

The comments from one respondent serve to highlight the general applicability of training programs as a solution (or partial solution) to the legacy skills gap:

“If someone does not have the aptitude for, and interest in, troubleshooting software and hardware, it is almost impossible to train or teach them.”⁵⁵

5.6 Developing the New IT Managers

Based on the interviews, the current legacy skills gap is at the technical/operational level, not at the managerial level. Nevertheless, as more and more baby boomers retire, respondents do acknowledge that more managers will be needed. One organization is actively seeking to recruit new managers from external IT consulting firms. Another organization is providing training so that technical/operational people can move into managerial roles in the future. Nevertheless, the focus of training and recruitment activities is with technical (rather than managerial) personnel at this time.

One respondent believed that more IT departments may have to be managed by two managers – one who is purely technical and one who is purely HR and budget-related. This would seem to indicate greater use of matrix organizational structures.

⁵¹ <http://www-03.ibm.com/systems/z/about/charter/skills.html>

⁵² http://searchdatacenter.techtarget.com/news/article/0,289142,sid80_gci1133766,00.html

⁵³ <http://www.hp.com/hpinfo/newsroom/press/2006/061024a.html>

⁵⁴ Based on interview with Mr. JP Soublière, President, Anderson Soublière inc.

⁵⁵ Based on personal interview with Mr. Garth Jones, CEO of Enhansoft Inc.

⁵⁶ Based on several interviews and an in-depth discussion with Mr. Birket Foster, CEO of MB Foster Associates Ltd.

In terms of specific types of training that IT managers' need, better project management (PM) skills were at the top of the list.⁵⁶ Given the pressure to deliver projects on time and on budget, PM skills help managers in all of their activities (whether legacy related or not). Managers also seek PM skills in their staff:

"Project management is more than an undervalued skill; it is the rarest of the IT skills."⁵⁷

IT managers should also understand the culture within the IT group. As one respondent indicated, different ages of workers bring different perspectives and strengths to the IT function. Some have tactical knowledge while others have business knowledge. The interviews revealed that organizations are starting to use teamwork dynamics to tap into the different skill sets while trying to reduce tensions that may be brought about by age.

Also, as was indicated earlier, IT managers need a better appreciation of the value of business analysis and documentation activities.

The issue of who is going to replace today's IT managers should also be addressed. While this is not a legacy specific issue, it will impact the legacy skills gap going forward. It has been stated that many Gen X-ers (ages 29 – 46) are more likely to want to work for themselves because they are dissatisfied with their current careers and do not see more responsibility as a way to resolve their problem. Ironically, this could mean that filling IT management positions going forward may be more difficult than many believe. It may also mean that legacy applications (and the skills gaps that they create) do not get the attention that they deserve.

In many ways, Gen X-ers have a completely different mindset to that of baby boomers that grew up believing career success equals personal success. This means that IT managers who develop skills in multi-generational team management will be in demand.

5.7 Wanted: More Diversity in Legacy Workers' Career Paths

It is obvious from the interviews that there is a general feeling among technical people that there is not much opportunity for career advancement within their current organizations. Furthermore, they tend to view these opportunities as being greater with external firms such as IT consulting firms. There appears to be a major issue with career paths for legacy workers (especially younger workers) at this time; many are not content with just 'moving across an organization', they want to move 'up'. This is occurring at a time when their managers cannot find other people to fill their positions.

The 'up and out' career path appears to be the most common one for legacy workers. A variation of this is the 'up and out and become a consultant' career path whereby the employee retires (or partially retires) from the organization and is subsequently hired back as a consultant on a part-time basis. As one respondent noted, many retirees like to come back to work as part-time consultants because the money is good for the amount of time involved.⁵⁸

If technical people wish to move up into managerial positions, they will have to develop a strong knowledge of budgets and other managerial tools and develop a strong proficiency in report writing.⁵⁹

It would appear that many IT workers (legacy and non-legacy) are wondering if traditional career paths for IT professionals are still feasible in the face of outsourcing, offshoring, and downsizing.

⁵⁷ Based on personal interview with Mr. Merv Perry, President of Immervation Multimedia Inc.

⁵⁸ bid.

⁵⁹ Based on interviews with Dr. James Bowen, CEO of CompEngServ (CES) Ltd. and Mr. Garth Jones, CEO of Enhansoft Inc.

5.8 Developing the New Skills Base for Legacy Workers

As indicated by the primary and secondary research, hardware/software/systems vendors (as well as the companies themselves) are driving efforts to fill the legacy void. In fact, vendors are way out in front of the colleges and universities in this regard, providing significant resources to the academic community on what industry needs are, providing them with facilities and systems, and even with complete curriculum materials. It has also been shown that organizations are seeking out assistance from vendors as well as tapping training resources from specialized providers and technical associations. By far, their most common approach is to leverage internal workers and documentation for knowledge transfer and skills development.

Many believe that if it were not for the huge amount of resources being provided by vendors and the private sector, the colleges and universities would be even further behind in addressing this issue. However, the skills development landscape is changing as more U.S. educational institutions are providing legacy training. The following are examples:

- *AFCOM* has been particularly active in seeking input from organizations on what are the legacy issues and how they can be addressed by academia. *AFCOM* is a U.S. trade association dedicated to providing education and resources for data centre managers.
- *Micro Focus* (a COBOL migration firm) has been working with educational institutions and government organizations in the U.K. to add legacy training to some Information Technology Management degree courses in the United Kingdom.

- *Marist College* in Poughkeepsie, New York is considered a leader in training legacy skills (in part because of IBM's Academic Initiative, which was described earlier). IBM's mainframe at this college can be accessed remotely by other schools in the U.S. and Canada allowing students hands-on mainframe experience as part of their Computer Science degrees.
- *IBM's Academic Initiative* continues to add colleges and universities to the program each year.

In terms of the actual skills needed for legacy work, this too is changing. As indicated earlier, COBOL and mainframe skills are the most common skills that have been needed. While they are definitely core building blocks, increasingly even these skills are not enough. More business analysis skills will be needed; and being able to understand how COBOL (and other legacy technologies) integrate with the newer technologies will be a key differentiator. For example, as indicated in the literature review, the ability to integrate COBOL with the new web-oriented development tools would be one of the best skills to have in the future.



6. Evaluation of Legacy Applications

This section will explore why industry and government continue to use legacy systems, how they determine whether these systems should be continued or replaced, and what pending technology solutions may be on the horizon.

6.1 Migrating Legacy Applications

The following are the major reasons given for why industry and government continue to use legacy systems:

- Moving the data is very expensive and error prone (also, there are privacy issues);⁶⁰
- The system(s) do work;⁶¹
- The people (or the contractors) are available to maintain them;
- Lack of vision or a strategic planning process;⁶²
- Lack of budget;
- System outputs are not critical to the organization.

Essentially, the most common reason given for retaining legacy systems is that the organization has already made a major investment in a system that does work so why change it (i.e. “if it is not broken, why fix it”).

The following are the major reasons given for why industry and government *migrate from legacy systems*:

- The hardware is no longer supported (e.g. chip sets become obsolete);
- The system becomes error prone;
- The system or applications no longer fit the business;
- Key in-house people retire or leave and replacements are difficult to recruit and/or train (including contractors);
- There is a ‘herd mentality’ in a particular industry toward a new technology solution;⁶³
- Senior management becomes concerned about the risks involved.

Essentially, the most common reason for migrating is that organizations are forced to do so. They can no longer maintain them or support them, or the risks involved in doing so are just too great.

As stated by one respondent, most firms in highly competitive sectors are not dependent on unsupportable legacy systems; it tends to happen more in government or mature sectors of the economy (i.e. the banks).⁶⁴ For many other firms, continuous migration is required to stay competitive.

6.2 Assessing Legacy Applications

There are many methods used in determining which legacy systems to keep and which to discard. In larger organizations that have a formal CIO organization, the CEO typically has a strategic plan for the IT function that projects requirements ahead for three to five years. In smaller organizations, it is the CFO who projects such requirements but IT (and therefore legacy systems) rarely gets the attention they deserve. In other words, in large organizations, legacy systems are a strategic issue that gets addressed as part of the planning process, while in small organizations they are typically a tactical issue that gets addressed when there is a problem.

The most common method for assessing legacy applications is to determine **the business risks of application failure**. As one interviewee put it, if the system generates one report every year at the end of the year, then upgrading or replacing is likely not critical to the business⁶⁵. On the other hand, if the system is a key component of the enterprise’s production apparatus (e.g. an airline reservation system), then the cost of application failure is significant (and quantifiable). A major factor in this assessment is the frequency with which data is required by the organization.

Every organization has a priority list (whether it knows it or not) in assessing business risks – a failure on the plant floor is more catastrophic than a delay in publishing the employers’ newsletter. These priorities are usually reflected in the attention that a legacy system might get. Again, the size of the enterprise has a major influence – the larger ones have formal risk management programs in place and legacy systems are part of the risk.

Legacy payroll and pension systems in large Canadian companies and governments are receiving significant attention at this time. The ‘business risk of application failure’ in these cases can be high. However, as one

⁶⁰ Interview with Mr. Lee Cary, President of Outsource Oasis Ltd. (and based on several other interviews).

⁶¹ Ibid (and based on several other interviews).

⁶² Interview with Mr. Glenn Thomsen, Senior Product Manager, Omnitrol Networks Inc.

⁶³ Interview with Mr. Ron Seybold, 3000 NewsWire.

⁶⁴ Interview with Mr. Mark Norton, February 11, 2008.

⁶⁵ Based on interview with Mr. Garth Jones, CEO of Enhansoft Inc., Ottawa.

interviewee noted, a major government legacy system (with millions of lines of code) has been operating for over 30 years and has been remarkably stable over that time.⁶⁶

Another method of assessing legacy applications is to determine **the business value of an application**. Very few organizations, large or small, relate business value to the reliability of their information systems, whether they are legacy systems or conventional systems. When they do tend to deal with it is when they are considering implementing the delivery of a new product or service. If the new business unit must rely on a legacy system, it tends to be a huge barrier because the people who will be managing the new business unit are typically not familiar with legacy systems and are not prepared to take on the added risk.

As one interviewee stated:

"I have yet to see this done properly (assessing business value of an application). The valuation is either seriously inflated or seriously deflated with the later being true 99% of the time".⁶⁷

Ideally, migration should enhance business value while reducing risk. Although it is difficult to place a value on a successful migration, it is usually easy to measure the cost of not doing it. The trouble is that it is usually done "after the fact". For example, there is the well publicized case of WestJet Airlines having to write off \$32.1 million in July 2007 as a result of a failed reservation system⁶⁸. Even though the system was still "doing the job" (WestJet had just set a record for single day ticket sales of \$10.6 million in bookings on the old system), sound business management dictated that the system had to be discarded because the supplier was terminating support for the system within two years.

Most legacy users get an early warning about migration through the rising cost of outside consulting services, and these are often driven by the changes of ownership of the companies maintaining the systems. In cases where the systems are part of the production process, the early warning is reduced efficiency of the business units delivering the products or services.

Determining if migration enhances business value while reducing risk is a difficult task. Interviewees identified several factors that should be considered in the evaluation, including:

- Maintenance cost;
- Upgrade cost;
- Security of data;
- Security of the system;
- Supportability of the system;
- Staff knowledge;
- Usefulness of the system;
- Disaster recovery of the full system.

The literature review indicated that a major driver for migration is industry's movement toward new Internet-based platforms, such as .NET and J2EE. The desire is to web-enable the organization's IT systems.

6.3 Replacing Legacy Applications – Current Challenges and Pending Solutions

The literature review revealed that technical solutions are expected to provide at least a partial solution to the legacy knowledge issue going forward. A major problem with legacy applications is that the 'business rules' of the organization are embedded inside the code of the program, which means that as people leave or retire, knowledge of the business rules is lost. It also means that if the code is changed by someone new, they can unknowingly change those business rules.

Another common problem, especially in the case of large organizations, is that the application or system changes over time as new code is added to the original design. This means that 'bugs' and other defects can arise and change the architecture of the original system. Also, documentation is often lacking, which is particularly problematic with increasing employee turnover and retirement.

One interviewee stated that many of these applications were written in the 1970s and early 80s, a time when software engineering was new and documentation was not developed as frequently (or as completely) as today⁶⁹. This is because software was considered largely an art and not a true engineering discipline with rules and procedures to follow. Even today, software cannot be considered a true science for

⁶⁶ Based on interview with Mr. Anatol Kark, Group Leader, Software Engineering Group, National Research Council Canada – Institute for Information Technology (NRC-IIT), Ottawa.

⁶⁷ Based on interview with Mr. Garth Jones, CEO of Enhansoft Inc. Ottawa.

⁶⁸ http://3000newswire.blogs.com/3000_newswire/2008/01/the-migration-s.html

⁶⁹ Ibid.

the same reasons. In the case where documentation was done properly, it is frequently out-of-date or inaccurate because the system has been in production for some time and has seen numerous upgrades and patches.

Even when there is legacy knowledge inside the organization, it is often the case that developers maintaining the code are only familiar with parts of it – those they interact with on a daily basis – and there are often dark areas.

While it is forecast that technology will be able to help in the future, the reality is that we are not there yet; there does not seem to be a single answer on the horizon to solve the problem because legacy applications are so customized. The hope is that someday it will be possible to take, for example, the COBOL code from the legacy system, extract the business rules from it, and then use this as input to a COTS (commercial off-the-shelf) product. COTS products are designed to be easily installed and to interoperate with existing system components. COTS software is mass-produced and is available at relatively low cost. Many already have the skills required to operate and maintain them. The trend in industry is toward COTS products where possible.⁷⁰

While many support this scenario, others do not see it as the single solution because many of the larger legacy systems have been so highly customized. Having COBOL skills may not be enough because legacy systems have grown over time (i.e. with 'home-grown code') and are no longer pure systems. This is especially true for several Canadian government pay and pension systems. As the literature review indicated, Canadian banks and insurance companies face similar issues.

Developing tools to extract the source code and/or business rules is very complex. Simply extracting the source code itself can be problematic. The system is often spread across a multitude of small programs, embedded in database procedures, built into GUIs, and is generally extremely difficult to disentangle. This problem is made worse by the fact that the system is often written in an obsolete language for which it is hard to recruit good developers.

There are many other issues and challenges with legacy applications and they can vary by sector. However, many are common across sectors – such as financial resources (i.e. budgets), timelines, and staffing. No matter if legacy applications were in the financial sector, or government, or the primary industries, these issues were frequently

identified in the interviews. An emerging issue in Canada is security. Security considerations can determine if and how systems (particularly legacy systems) are upgraded. For example, some Canadian legacy systems have the names of those in the witness protection program embedded inside the code of the program (more secure than external databases). This presents a significant security challenge in terms of upgrading (or replacing) the system.

National Research Council Canada's Institute for Information Technology (NRC-IIT) has conducted considerable research in the area of legacy applications with specific interest in the new business rule extraction tools. NRC scientists and researchers do not believe that the legacy problem will go away on its own⁷¹; thus, they have been helping a few small Canadian companies active in this area. One such firm is KDM Analytics of Ottawa (www.kdmanalytics.com); it is active in the development of Knowledge Discovery Metamodel (KDM) tools and services.

KDM is a publicly available specification from the Object Management Group (OMG). It is a metamodel for knowledge discovery in software, defining a common vocabulary of knowledge related to software engineering, regardless of the implementation programming language and runtime platform. The development of the KDM specification was started in 2003 by a consortium of companies interested in architecture-driven modernization and knowledge discovery in software engineering. KDM specifications and tools can be considered the first step towards the development of the robust tools mentioned earlier and have been embraced by many in the software modernization community.

It is expected that Canadian companies and researchers will play an increasingly important role in the development of future technology solutions for legacy applications. The reason for this is that Canada is already a world leader in reverse engineering and has significant expertise in data migration⁷². Furthermore, NRC-IIT's Consortium for Software Engineering Research (CSER) has been successful in bringing together industry and academia. With the involvement of industrial and academic partners, CSER has been successful in carrying out directed research for industry which is subsequently fed back into the Canadian higher education community.

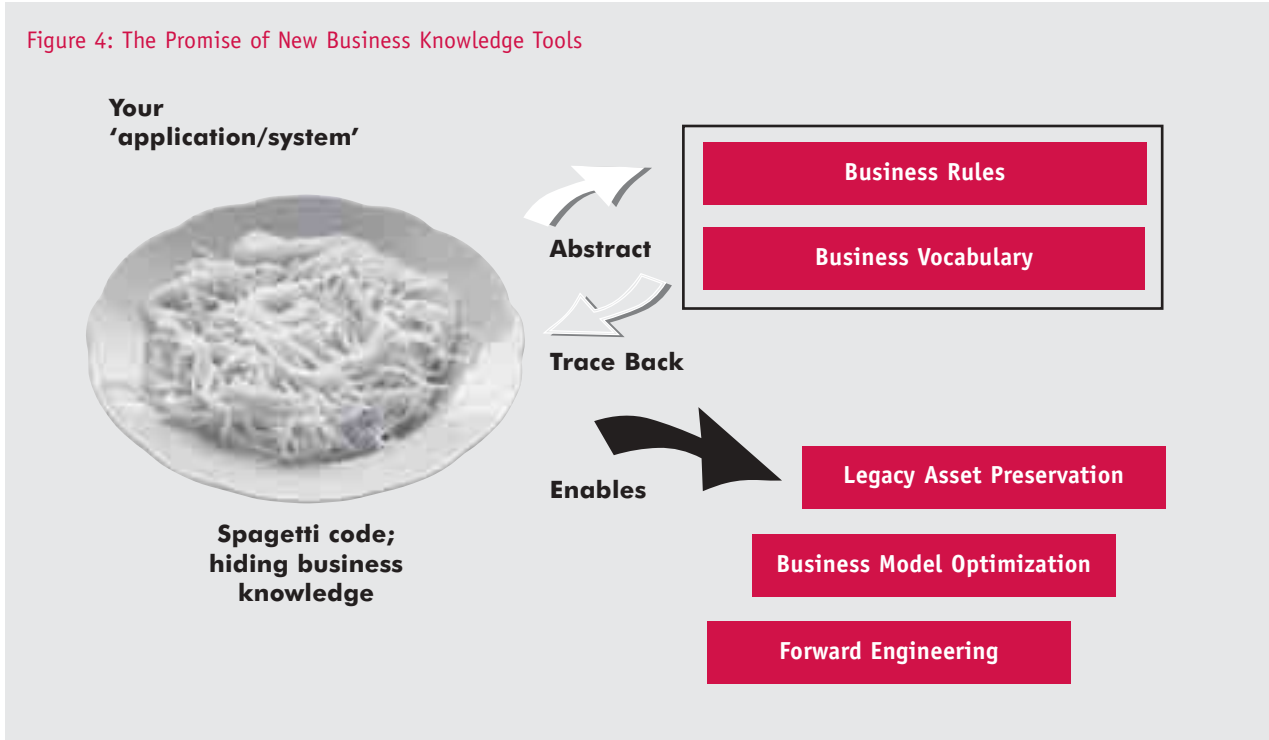
With a clear trend toward more 'open' systems, the business logic trapped within the 'closed' legacy systems

⁷⁰ Interview with Mr. Ravi Maithel, CEO of CLEVOR Technologies.

⁷¹ Ibid.

⁷² Ibid.

Figure 4: The Promise of New Business Knowledge Tools



will potentially have enormous value, if only it could be unlocked and made available to the rest of the enterprise. Also, separating the business logic from the technology will facilitate the ease of future evolutionary change for an organization's applications.

As a summary to the preceding discussion, Figure 4 indicates the promise of advanced business rule extraction tools. It will lead to forward engineering which will positively impact the organization's IT function going forward.

There is actually a third option available in addition to the 'replace it' and 'live with it' options; it is the 'wrap it' option. That is, an organization can decide to wrap the existing legacy application in a modern interface. These interfaces allow for the use of a more flexible service-oriented architecture approach. This can allow the legacy system to be used by other systems. It can also allow it to be modularized and thus parts of it may be replaced on a piecemeal basis. For the organization, this can mean less up front cost and lower risk, but maintenance costs and functionality may not be any better. It is not known what

impact the 'wrap-it' option will have on the legacy skills gap going forward, but it is another variable to be considered.

Even in the case of outright migration, there are many approaches available, each representing a different level of risk to the organization. For example, 'migration from the platform' is probably the least invasive migration strategy. There are many products and services that allow client companies to move their application (typically COBOL) from a mainframe platform to a Windows/Intel, UNIX, or Linux platform. 'Migrating from the language' is significantly more risky since it involves not one but three migrations: from the language, as well as from the platform, and from the DBMS.

Gartner has frequently segmented mainframe markets based on MIPS (million instructions per second), with the three general segments being: (1) under 500 MIPS, (2) between 500 and 1,000 MIPS, and (3) greater than 1,000 MIPS. Their research suggests that organizations with fewer than 500 MIPS are the ones most likely to successfully migrate completely from a mainframe to a Windows or

UNIX platform. The larger environments face significantly greater and more complex challenges, making it unlikely that they will leave the platform.⁷³

6.4 The New Emulation Tools

The emerging emulation tools promise to help with the skills gap (see Figure 5). Known as hardware emulators, these are actually hardware and software solutions that replicate the functionality of specific legacy hardware while running on modern computer systems. This means that an organization does not have to discard its legacy applications just because their underlying hardware is wearing out. While this can be of obvious value in itself, moving to an emulator confers other benefits. These include a reduction in hardware maintenance costs, reduction in infrastructure costs (such as space and power consumption), consolidation on a common hardware platform and improved reliability.⁷⁴

While these tools promise to assist organizations, it remains to be seen what impact they will have on the legacy skills gap issue itself. Software support is still needed for the legacy O/S and applications. There seems to be a widespread perception that, by deploying an emulator, a reduction in software support costs can be realized. This is often not the case; the applications still require the retention of legacy skills and knowledge.

6.5 Legacy Applications in the Financial Industry

As stated previously, legacy applications are particularly prevalent in the financial and insurance sectors of the economy. The size, complexity, stability, and cost of these systems are major drivers for their continued use, as is the fact that many are based on specific technologies tailored to the needs of their sector.

Figure 5: New Hardware and Software Emulators

Commercial Hardware-Based Emulators:

Product	System Emulated	Supplier
Hawk	Data General: Nova, Eclipse	Strobe Data
Kestrel	HP: HP 1000	Strobe data
NuVAX & Future VAX	DEC & Compaq: VAX	Emulators International / Logical Company
Osprey	DEC: PDP-11	Strobe Data

Commercial Software-Based Emulators:

Product	System Emulated	Supplier
CHARON-AXP & VirtualAlpha	DEC & Compaq: Alpha	Emulators International
CHARON-VAX	DEC & Compaq: VAX	Software Resources International

⁷³ Vecchio, Dale CIO Update: The Future of the Changing IBM Mainframe Ecosystem Gartner, 24 March 2004.

⁷⁴ Strobe Data Inc. (www.strobedata.com).

It would seem that with many of the largest applications the assessment (in terms of risk and value to the organization) took place some time ago and the decision was made to keep them. As one respondent stated:

“this (decision) was made with the hope and expectation that new systems would ‘soon’ be required, that the system was solid enough as long as major changes were not needed, and replacements would occur naturally.”⁷⁵

What does seem to be happening now is that organizations are hearing more and more debate about the legacy skills and baby boomer retirement issues and this may be causing them to revisit those decisions. However, based on the literature review, it is also clear that many organizations will continue to use legacy applications because the threshold to replace them remains “sufficiently difficult to surpass”.⁷⁶

As one respondent stated, many CIOs and IT managers are wary of suggesting replacement of core legacy systems because of the risk of ending their own careers should the project fail.⁷⁷ This is especially true in the financial sector where institutions are typically risk averse and managed very conservatively.

The following are some findings from the literature review with respect to legacy systems in the financial sector:

- Wachovia Corporation, a large regional bank in the eastern United States, spends \$1.4 billion a year on IT, with 65% to 70% spent on legacy systems, compared with 30% to 35% on new development (2003 data).⁷⁸

- Many financial institutions became very concerned after the 9-11 terrorist attacks, realizing the inherent risk in having outside consultants maintaining their legacy code.⁷⁹ Auditors to the banks have been highlighting these risks.
- European financial institutions have historically relied on in-house software and system development rather than on COT systems.⁸⁰
- Canadian financial institutions (including insurance companies) remain a major user of legacy systems. There has been an ‘insourcing trend’ going on for some time, whereby legacy code maintenance has been taken in-house to cut costs and mitigate risks.
- Financial institutions have been very conservative about offshoring their legacy support and maintenance.
- Globally, mergers and acquisitions in the sector have replaced or eliminated several legacy systems.



⁷⁵ Based on interview with Mr. JP Soublière, President, Anderson Soublière inc.

⁷⁶ Ibid.

⁷⁷ Based on interview with Mr. Merv Perry, President of Immervation Multimedia Inc.

⁷⁸ <http://www.informationweek.com/story/showArticle.jhtml?articleID=15200151>

⁷⁹ Wachovia insources mainframe code maintenance, Datacenter.com, 10 Oct 2006.

⁸⁰ <http://software.silicon.com/applications/0,39024653,39150482,00.htm>

7. Conclusion

The way in which legacy applications/systems are managed and evaluated inside an organization is not fundamentally different from the way in which conventional IT systems are managed and evaluated. The two major factors are the size of the organization and the role that the systems play inside it. Larger organizations usually have some form of strategic planning process in place that forces a planning discipline on every unit within the enterprise and this usually gives visibility to the problems and opportunities associated with IT systems in general and legacy systems in particular. As for the risk factor, IT systems that are integral to the delivery of the products and services of the enterprise will receive more attention than those that merely provide supporting services to the production apparatus.

The planning discipline allows IT managers (in fact forces them) to take a strategic approach to the migration of legacy systems. They are typically required to prepare an annually updated strategic plan that forecasts the costs of their operations for the next three to five years. Such forecasts are typically accompanied by operational plans that will reveal the cost of operating their systems.

In smaller organizations, even if there is a strategic planning system in place, it will typically not provide the IT manager (or whoever plays the role) with the same opportunity to bring his or her issues to the attention of senior management. The result is that IT (and legacy) decisions tend to be tactical (or reactive) in nature rather than strategic.

The following is a summary of key findings from the primary and secondary research:

- Legacy Knowledge refers to the skills and expertise needed to administer and maintain legacy applications/systems.
- While there are many studies and estimates of various demographic characteristics of the IT workforce, the literature review did not uncover any study quantifying the legacy skills gap (either now, or in the future).
- We estimate that there are approximately 20,000 legacy workers in Canada who are also baby boomers and will be retiring over the next nineteen years – out of the total legacy workforce of 60,000.
- From a macro perspective, demographics are a major driver of the legacy skills gap; but it is not the only one. Industry, technology, and company dynamics are also drivers.
- Currently, a lack of skilled people is not the primary reason why organizations seek to modernize, or replace, or migrate from their legacy systems.
- Current perspectives need to change if the legacy skills gap is to be addressed.
- Legacy applications and legacy work, by their very nature, create several challenges and perceptions which need to be properly managed by IT managers and HR personnel.
- Many approaches to retaining legacy knowledge are being taken by Canadian organizations; however, there is no solution that fits all situations. In fact, there are not even documented best practices to follow.
- Documentation of the legacy application and the business knowledge embedded therein is rarely done as completely or as effectively as required.
- In terms of who will keep the legacy systems running, the most common answer is: existing staff will (or so is the hope of current management).
- Colleges and universities are not seen as the current or future answer to the skills gap.
- The potential for colleges to fill this gap going forward is seen as significantly greater than for the universities.
- Nevertheless, universities can and should play a role in ensuring that IT people have process and change management skills, analytical reasoning and assessment capabilities.
- Colleges should develop close partnerships with companies seeking legacy knowledge.
- Colleges should develop short-term certification programs and programs to train new immigrants in legacy skills.
- Few Canadian organizations appear to be using immigration or outsourcing as a way to obtain their legacy knowledge.
- Significant legacy knowledge exists in some Eastern European countries.
- Currently, the primary sources of legacy knowledge development are consultants, vendors, technical and trade associations, with the primary one being the companies themselves.
- COBOL and mainframe skills are the most common legacy knowledge needed, but they are not the only ones. Knowledge of languages such as ADSO, Natural, or IDEAL and expertise with databases such as ADABAS, IDMS, or Datacom is also needed. This knowledge is significantly more rare and expensive to obtain.

- COBOL and mainframe skills are no longer taught in many degree and diploma programs.
- Mentorship and specific training programs appear to be effective means to transfer legacy knowledge; however, they are very expensive and time consuming to implement. Also, they tend to be much more effective if they are done on a one-on-one basis.
- A phased retirement policy gives the organization a chance to plan for the attrition of the legacy knowledge.
- New employment relationships need to be developed by companies. Creative solutions to older workers' expensive severance, benefits, and health programs need to be developed. Since government forces employers to pay out expensive severance packages, based on years of service, this can lead to companies having to retire high cost employees.
- CIOs and IT managers should tap vendor training resources.
- Increasingly, outsourcing of the entire legacy knowledge problem is becoming a possible solution for some organizations in specific situations.
- Increasingly, CIOs and IT managers will need new and better skills, not just to address the legacy issue, but to address other issues in their departments. These skills include better report writing and business analysis, comprehensive project management abilities, and inter-generational team management skills.
- Many CIOs and IT managers are wary of suggesting replacement of core legacy systems because of the risk of ending their own careers should the project fail.
- More diversity is needed in the career paths of legacy workers. The 'up and out' career path appears to be the most common. A variation of this is the 'up and out and become a consultant' career path whereby the employee retires from the organization and is subsequently hired back as a consultant on a part-time basis.
- Many IT workers are not content with just 'moving across' an organization; they want to move 'up'. This is occurring at a time when their managers cannot find other people to fill their positions.
- Many IT workers (legacy and non-legacy) are wondering if traditional career paths for IT professionals are still feasible in the face of outsourcing, offshoring, and downsizing.

- The actual skills needed for legacy work is changing. Knowing COBOL and having mainframe capabilities is often no longer enough. Being able to understand how COBOL (and other legacy languages) integrates with the newer technologies will become a key differentiator. The ability to integrate COBOL with the new web-oriented development tools will be one of the best skills to have in the future.
- There are few IT people who can properly assess the business risks of application failure or the business value of an application. These assessments are not as common as they should be and even when they are done they are often seriously inflated or seriously deflated.
- There are many proprietary products and processes that large vendors and consulting firms have developed to help with the legacy knowledge issue. More powerful tools are expected to be developed in the future, with more flexibility across applications and sectors.
- The emerging hardware emulation tools will be a definite help to organizations; however, the degree to which they help with legacy skills shortages is open to debate.

Feedback from the Expert Panel

We conclude this exploratory study on legacy applications by considering the thoughts and experience of the ICTC Expert Panel (EP) that reviewed a draft of this report. Those comments can be categorized into two major areas.

The first is that skills issues surrounding legacy applications are impacted by the age of the workforce involved. As we have noted several times in the report, there is no single 'wave' of retirees who will all retire in the same year (or even over a few years). In fact, as Clabby Analytics has determined (see literature review), there are two distinct waves of retirees and perhaps more, depending on how long some seniors plan to stay in the workforce. Add to this an increasing desire for part-time work in the retirement years and it becomes very difficult to predict the magnitude of the skills gap. We were reminded by one interviewee that about two thirds of non-public sector workers in Canada have not saved sufficiently for retirement and that full retirement will continue to be pushed back. Furthermore, as the EP identified, the postponement of retirement is being facilitated by Canadian seniors living much longer⁸¹.

⁸¹ Canada is in the top four or five countries in the world for longevity, according to Statistics Canada.

The age of the workforce is an issue that can be examined at the macro level (i.e. for Canada as a whole) and at the micro level (i.e. for an individual firm or government department). The comments above apply mainly at the macro level. That is, an individual firm's workforce age profile may not look anything like that of Canada overall, or even like that of other companies in its sector.

Startup technology companies typically do not have legacy skills issues because they are using modern IT systems. Large banks and insurance companies, many of which have been around for many years (and have a strong track record of employee loyalty), tend to have legacy systems in place. In fact, if a study were done on this issue it would probably show that there is a direct correlation between the age of the company/organization (i.e. years in existence) and the existence of legacy systems. One interviewee had a somewhat extreme view of legacy systems, namely that the only reason they even exist today is because of past bad management. This may be a somewhat harsh assessment since there are often many good reasons why such systems can, and should, continue to exist. But this comment does serve to remind us that there are many companies (and many sectors of the Canadian economy) that have no significant legacy skills gap.

Many government departments and agencies face real legacy skills issues – in part because of the age profile of its workforce. That is, they tend to have a higher proportion of workers nearing retirement. But, even in the case of government, the legacy skills gap is being fueled by more than just the older age profile of its workforce. Very attractive pensions (especially compared to the private sector) are causing many workers to retire as expected.⁸²

The second area of comment from the EP was related to the HR techniques that might be used for maintaining legacy skills. Since the above discussion has indicated (as did the literature review) that there is still the interest and the need on the part of older legacy workers to be engaged, the question becomes: "What are the most appropriate HR techniques to facilitate that engagement?" Our interviews identified many techniques such as phased retirement programs, flex time, telecommuting, apprenticeship and/or mentorship programs. As stated earlier, there are no best practices as to which techniques or approaches to use in a given situation. Organizations have elected to use what works best for them. However, the primary and secondary research does suggest that one-on-one mentorship programs have been very successful and that HR policies and practices should reflect their importance in transferring legacy knowledge. These programs are costly to implement in themselves, and even more costly if HR programs are changed to accommodate them (i.e. increased worker compensation, etc.).

The EP asked about how HR policies can be adapted to keep legacy skills in an organization. HR policies and practices are in a constant state of flux and many of these changes are aimed at older workers; however, it is the compensation practices that will need more attention going forward. This report has identified several techniques for retaining legacy knowledge; however, since the issue will be much more acute in some organizations (and some sectors) than in others, multiple approaches will have to be implemented. A common theme of good HR management is flexibility and flexibility is even more important when it comes to legacy workers.

⁸² According to Statistics Canada, the average Canadian earns \$38,000 per year while most government employees retire with incomes in excess of \$60,000 per year (including CPP, OAS and pensions).

Appendix I – Legacy Applications Survey Guide

Legacy Applications Trend Report

SURVEY GUIDE

Our firm is conducting a research project for the **Information and Communications Technology Council (ICTC)** on the human resource and technical issues related to the maintenance of legacy systems, with an emphasis on systems that were implemented more than twenty years ago. Your organization has been identified as being either a **user of such systems or a supplier** of development, applications, and maintenance services to such users. The following questions are intended for guidance only in an interview that we hope you will grant to us.

Our study for ICTC concerns the growing problem of maintaining ageing hardware and software systems that date from the early days of the IT Revolution (“legacy applications”). We define legacy systems more precisely by their software generation (3rd or earlier) and the status of their hardware (no longer in production).

For more information on ICTC and its mandate to help Canada’s Information and Communications Technology (ICT) industry, please visit www.ictc-ctic.ca

Interviewee: _____

Title: _____

Firm/Organization & Website: _____

Email & Telephone: _____

Issues to Investigate:

1) Retirement of baby boomers and the “legacy” skills gap:

- What is the impact on firms of the impending retirement of baby boomers?
 - Who will keep the systems they built running?
 - Are there enough university/college programs providing courses on legacy skills?
 - Are there enough enrolments and graduates from such programs to meet the demand for such skills?

- What are the methods of ensuring proper training and knowledge transfer from the original architects of legacy applications? E.g.:
 - Programs for succession planning that could be tied into HR
 - Interviewing of key employees before they retire, and creating documents on how everything works (not only with respect to technical knowledge, but also with respect to business knowledge)
 - Phased retirement policies to keep the experienced employees around
 - Mentoring/training programs
 - Etc.

2) Bridging the legacy skills gap:

- How many new jobs will be created by the legacy skills gap?
 - How many legacy applications specialists will be required – What is the real magnitude of this issue?
- Are firms able to recruit and retain the talented staff required to bridge the gap?
- What university/college programs are the most relevant for bridging the gap?
- Are there enough enrollments/graduates in such programs?
- What kind of training will be required to develop new managers?
- Should firms look into automating low-value work, and look into obtaining staff that will handle high-end work instead of training new replacement workers to handle the grunt work?
- What kinds of career paths and professional developments are possible for new application maintenance workers to ensure their skills are kept current? What alterations are required by colleges and universities to ensure a supply of legacy workers?

Other issues to investigate:

3) Evaluation of legacy applications:

- Why firms continue using legacy systems
- Why firms migrate from legacy systems
- What methods are typically used in determining which legacy systems to keep and which to discard? E.g.:
 - Assessing business risks of application failure
 - Determining business value of an application
 - Migration should enhance business value while reducing risk: how can this be evaluated? (e.g. enterprise-wide application audits, evaluating the cost vs. value performance of applications, etc.).
- Which new technologies can be used to replace legacy systems, and what are the challenges with this?
- What are the major issues and challenges with respect to legacy applications in sectors such as finance, government, primary industries, etc.?

Appendix II – List of Survey Respondents

Interviewee	Title & Organization	Coordinates
1. Mr. Birket Foster (in-person and telephone interviews) (HP legacy system specialist, data migration and related consulting)	CEO, MB Foster Associates Limited	82 Main Street South Chesterville, Ontario, K0C 1H0 T: 613.448.2333 F: 613.448.2588 Birket@mbfoster.com
2. Mr. Garth Jones (in-person and telephone interviews) (IT management and support experience and related consulting activities)	CEO, Enhansoft Inc.	1 Wheeler Street Ottawa, Ontario, K2J 3C2 T: 613.297.0245 F: 613.226.5747 garth@enhansoft.com
3. Dr. James Bowen (telephone interview) (management consultant with IT and system project experience)	CEO, CompEngServ (CES) Ltd.	1510 Riverside Drive, Suite 407 Ottawa, Ontario, K1G 4X5 T: 613.830.5465 jbowen@ces.on.ca
4. Dr. Anatol Kark (in-person interview) (software engineering and legacy systems – technical and research specialist)	Group Leader, Software Engineering Group, National Research Council Canada, Institute for Information Technology (NRC-IIT)	1200 Montreal Road, Building M-50 Ottawa, Ontario, K1A 0R6 T: 613.991.6973 F: 613.952.7151 Anatol.kark@nrc-cnrc.gc.ca
5. Mr. Glenn Thomsen (in-person interview)	Senior Product Manager, Omnitrol Networks Inc.	260 Hearst Way, Suite 504 Ottawa, Ontario, K2L 3H1 T: 613.270.9601 x203 F: 613.270.9729 gthomsen@omnitrol.com
6. Ms. Kristine Renic (in-person interview) (large user & manager of legacy systems – federal government)	Director, Compensation System Management and Development Directorate, Public Works and Government Services Canada	16A1, Portage III Gatineau, Québec, K1A 0S5 T: 819.956.4941 F: 819.956.5584 Kristine.renic@pwgsc.gc.ca
7. Ms. Diane St.-Denis (in-person interview) (large user & manager of legacy systems – federal government)	Manager of Public Service Pay Systems, Public Works and Government Services Canada	16A1, Portage III Gatineau, Québec, K1A 0S5 T: 819.956.2443 F: 819.956.2418 diane.st-denis@pwgsc.gc.ca
8. Mr. Mark Norton (in-person interview) (former user of legacy systems; founder of Norpak)	President, Pakenham Holdings Ltd. (founder and investor, various technology companies)	marknorton@storm.ca

Interviewee	Title & Organization	Coordinates
9. Mr. Lee Cary (in-person interview) (former user/developer of legacy systems)	President, Outsource Oasis Ltd. & Director of Sales, Circumference www.3000newswire.blogs.com	T: 613.227.1243 outsourceoasis@sympatico.ca
10. Mr. Ronald Seybold (phone interview) (operator of website and blog addressing HP legacy systems)	Editor In Chief, The 3000 NewsWire www.3000newswire.blogs.com	T: 512.331.0075 rseybold@sbcglobal.net
11. Mr. Merv Perry (in-person interview) (former user and supporter of legacy systems)	President, Immervation Multimedia Inc. www.immervation.com	67 Felix Leclerc Gatineau, Quebec T: 819.775.9620 immervyn@aol.com
12. Mr. JP Soublière (email survey) (former firm was involved in legacy systems products and consulting; extensive business and government background)	Ex CEO, Systemhouse Ltd. President, Anderson Soublière inc.	jp@soubliere.com
13. Mr. George Dinardo (telephone and email survey) (extensive background in legacy systems use and consulting; former software engineer in the federal government)	President, Larus Technologies Corporation www.larus.com	58 Antares Drive, Unit 1B Ottawa, Ontario K2E 7W6 T: 613.244.8916 george.dinardo@larus.com
14. Mr. Ravi Maithel (telephone and email survey)	Founder & CEO, CLEVOR Technologies Inc. www.clevor.com	302 – 111 Research Drive Saskatoon, Saskatchewan S7N 3R2 T: 306.955.5772 F: 306.955.1493 Ravi.maithel@clevor.com
15. Ms. Gail Di Cintio (telephone and email survey) (extensive HR background, head of HR services and consulting division at Larus, former VP of Employee Development at Fujitsu Consulting)	Vice-President of Operations (and Human Resources), Larus Technologies Corporation	58 Antares Drive, Unit 1B Ottawa, Ontario K2E 7W6 T: 613.224.8916 gail.dicintio@larus.com

The Information and Communications Technology

Council (ICTC) is a non-profit sectoral council dedicated to creating a strong, prepared and highly educated Canadian ICT industry and workforce. ICTC is a catalyst for change, pushing for innovations that will provide labour market intelligence, life-long professional development and quality education and training for the Canadian ICT industry, educators, governments and the ICT workforce. We forge partnerships that help develop the quantity and quality of ICT professionals needed to improve Canada's position as a leader in the global marketplace.

To achieve its goals, ICTC focuses on four areas that are proven building blocks of a healthy, forward-looking sector:

- **Skills Definition** – defining the skills required to be a professional in the ICT sector.
- **Labour Market Intelligence** – providing up-to-date statistics and analyses of human resource developments in the ICT sector.
- **Career Awareness** – providing programs and tools to explore the career possibilities in Canada's ICT sector.
- **Professional Development** – dedicated to continuous learning for ICT workers so they can maintain and improve their skills sets and increase their opportunities within the sector.

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