# INFORMATION TECHNOLOGY SKILLS WORKPLACE ASSESSMENT

# INDUSTRIAL-COMMERCIAL-INSTITUTIONAL CONSTRUCTION INDUSTRY OF NOVA SCOTIA


PREPARED FOR:

NOVA SCOTIA CONSTRUCTION SECTOR COUNCIL—ICI

PREPARED BY:

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## Executive Summary

The Nova Scotia Construction Sector Council (NSCSC-ICI) is a not-for-profit organization that partners with industry, federal and provincial government departments and agencies, and other stakeholders to identify present and future skill and labour issues. Through cooperation and research, the NSCSC-ICI provides solutions to challenges and opportunities in the Industrial, Commercial and Institutional (ICI) construction industry.

The NSCSC–ICI's mandate is to communicate and consult with founding Member Organizations to identify areas of concern related to human resource planning and skills development within the sector.

The NSCSC-ICI's founding members include:

- Cape Breton Island Building & Construction Trades Council;
- Construction Management Bureau; and
- Mainland Nova Scotia Building & Construction Trades Council.

Working in partnership with member organizations, NSCSC-ICI directors and staff

> provide human resource and labour market information to industry partners including Service Canada, Province of Nova Scotia departments and agencies, national Construction Sector Council, public and private training institutions, associations, organizations, groups and individual Nova Scotians.

The Sector Council's objective is:

> …to contribute research and labour market information that will:
>
> - Identify imminent and future skills required by sector employees;
> - Identify current worker skills and qualifications;
> - Identify the demand for additional skills development;
> - Identify current and future essential skills and new technology; and
> - Promote this industry as a professional career choice.

The information supports short, medium and long term improvements and solutions, focusing on the sector's human resource capacity.

The NSCSC-ICI's goal is "To complement the work of labour and management organizations, government departments and other industry associations and organizations and work to ensure industry and government investment is managed to benefit the sector."

In fulfillment of their mandate, the NSCSC-ICI issued a call for proposal with the primary objectives to:

- Conduct an **Information Technology (IT) Workplace Skills Assessment** of the ICI construction industry; and
- Provide recommendations that will support the industry and the NSCSC-ICI in the development of strategies to address IT skills requirements.

This study responds to the call for proposals by:

- Profiling current and anticipated demand for IT skills and technologies within the ICI sector; and
- Making recommendations that support the NSCSC-ICI's efforts to fulfill its mandate to prepare the workforce for anticipated technological sophistication in the ICI construction industry.

## Study Objective

The NSCSC-ICI commissioned Jozsa Management & Economics (JM&E) to undertake a study to:

> Create an industry profile through the collection and examination of data on the current and anticipated demand for IT (Information Technology) Skills and Technologies within the Industrial, Commercial and Institutional sector. [1]

The report provides findings and recommendations that support the Nova Scotia construction industry as it develops initiatives and strategies to:

- Ensure that a framework is in place to address IT skills requirements; and
- Prepare the workforce for anticipated technological sophistication in the ICI construction industry.

## Methodology

JM&E used a direct consultative process (surveys and interviews) with business owners, union managers, non-union representatives, and other ICI stakeholders to collect primary source information. Augmented with secondary research, our methodology followed "multiple lines of evidence" to respond to the research objectives.

For the purposes of this study, IT includes:

1. **Software that enables** communication, analysis and management of information related to the ICI construction industry; and
2. **Hardware that enables** these functions. Hardware includes computers, communication devices, sensors, monitors, meters and trades-specific construction tools that now employ digital electronics and require some level of IT training to operate and maintain.

The research program was conducted concurrently with a research project wherein the principal consultants were conducting a labour market and demographic study commissioned by the NSCSC-ICI. The IT skills consulting team for this study was able to use IT related information gathered during the labour market assessment.

## Worker Survey Conclusion

Workers are:

- Very likely to have had some exposure to IT;
  - However, they are, for the most part, novices or below at using computers;
- Very likely to have home Internet access;
- Anticipating that IT will remain a part, or become an increasing part, of the sector;
- Not likely to have participated in e-learning but very likely to be willing to do so; and
- Very likely to be willing to take computer training necessary to allow them to participate in e-learning.

## Employer Survey Findings

Employers generally have a limited view of the technological innovations that ICT (Information and Communications Technology) makes possible and are more likely to be focused on current "in the field" communications options (e.g., cell phone, fax, etc.), rather than on longer term benefits

[1] From the request for proposal, "Invitation for Proposal to Conduct an Information Technology (IT) Skills for the Workplace Assessment," January 18, 2006

of better information management (e.g., unit cost control). Most employers do not look for ICT competencies in their industry workers and do not expect that this will be a requirement. The survey results, in combination with the findings of the personal interviews, suggested that some employers are leaders in ICT innovation in the sector. The prevailing sentiment among employers is that "IT will come and it will be the norm", if through no other means than the natural increase in new entrants with ICT skills.

### Union Manager Survey Findings

The typical union manager's view of IT is similar to that of employers who participated in the survey. IT is seen as an 'end' to which the industry is naturally progressing, but at the moment, industry workers are not typically expected to have IT skills and union managers are not receiving requests from employers for industry workers with IT related skills. The view of IT at the job site is limited to more obvious and immediate benefits of information management in areas such as time sheets and other paper-based activities. As one union manager put it, *"We have [computer] programmers working in the field and this capability provides no particular advantage."*

We find that workers are not likely to drive IT, but rather requirements of general contractors' and/or customers' service requirements will be such that contractors will be pushed to use IT to improve their service offerings. Furthermore, there are actions that the NSCSC-ICI can take to support the accelerated adoption of IT among sector participants, giving rise to the conclusions and recommendations outlined below.

### Conclusion and Recommendations

The national Construction Sector Council's 2004 report, *The Impact of Technology in the Construction Labour Market*, summarized the adoption of innovation in general by saying, "Overall the industry is pretty conservative. Technology needs to prove itself before it will be adopted. Designers need to be convinced that they will not suffer any liability."

People who do not understand the costs and time expectations will hesitate. Encouraging adoption of technology is a change management issue that must deal with different risk thresholds and attitudes and skill sets that often differ by age groups. With respect to the adoption of innovations, people in construction are similar to those in other occupations and economic sectors—if IT brings value and efficiency to their day-to-day jobs they will be more likely to "buy into" it.

Barriers to IT usage must also be directly addressed. For some people, the barrier may be related to literacy issues and possible fear that their limitations will be exposed by a system that forces users to write. Emerging (and improving) voice-to-text software may bridge this gap, but in any case, IT will cause these issues to surface and plans must be in place to deal with them when they do. Others view IT with fear and seem to regard it as being more complicated than it actually is.

Support for increased use of IT must also come from the industry. Are their peers using IT, and if so, how? What are the benefits? What are the usability issues on site? Stories of success and reward will provide incentive for foremen and managers. Companies may also choose to make IT a requirement, but they must lead, as well as follow, by example and experience.

The implementation of these recommendations and adoption of IT within an organization (firm or otherwise) needs champions. The NSCSC-ICI must carefully consider:

- its role as a champion; and
- who else has the level of respect, knowledge, and expertise in the industry that enables them to take on the role of champion and partner with the NSCSC-ICI to help ensure that the benefits of ICT pervade the industry in Nova Scotia.

## Acknowledgements

Jozsa Management & Economics thanks Service Canada, the Nova Scotia ICI Construction industry, and the Nova Scotia Construction Sector Council (NSCSC-ICI) for their combined support. Special thanks are due to NSCSC-ICI's Steering Committee:

- Catharine Otto, Executive Director, Nova Scotia Construction Sector Council – ICI
- Trent Soholt, Project Manager, Nova Scotia Construction Sector Council - ICI
- Allan Stapleton, Construction Management Bureau
- John Furneaux, Rideau Construction Inc
- Doug Holstead, Sayers and Associates
- Tim Swinamer, International Brotherhood of Electrical Workers Local 625

The committee's guidance, support and insightful comments strengthened the final report.

Our appreciation is also extended to the many individuals who invested their time providing responses to our research questions.

– The Consulting Team –

John Jozsa

Thomas McGuire

David Sable

Michael Curri

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[2] The opinions and interpretations in this publication are those of the authors and do not necessarily reflect those of the Government of Canada.

## TABLE OF CONTENTS

## 1. BACKGROUND

The Nova Scotia Construction Sector Council (NSCSC-ICI) is a not-for-profit organization that partners with industry, federal and provincial government departments and agencies, and other stakeholders to identify present and future skill and labour issues. Through cooperation and research, the NSCSC-ICI provides solutions to challenges and opportunities in the Industrial, Commercial and Institutional (ICI) construction industry.

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This study responds to the call for proposals by:

- Profiling current and anticipated demand for IT skills and technologies within the ICI sector; and

- Making recommendations that support the NSCSC-ICI's efforts to fulfill its mandate to prepare the workforce for anticipated technological sophistication in the ICI construction industry.

### 1.1. STUDY OBJECTIVES

"Create an industry profile of Nova Scotia through the collection and examination of data on the current and anticipated construction demand for IT Skills and Technologies within the Industrial, Commercial and Institutional sector."[3]

The study meets the overriding objective by identifying:

- Current and anticipated IT skills requirements;
- Current IT Skills and abilities of the workforce;
- Imbalances and gaps between required and available IT Skills;
- Specific IT-based occupations, tasks and responsibilities emerging within the industry;
- IT skills that are and will be needed to transition older and displaced workers, expand employees' employment options and/or lengthen employees' careers within the industry,
- IT skills that will be demanded by the industry in general to meet the requirement of technological changes impacting the industry;
- IT skills that are and will be needed to retain the existing workforce and effectively recruit new entrants;
- IT trends and standards for the construction industry;
- Market requirements;
- Recommendations for the ICI construction industry of Nova Scotia to consider in response to the findings of this study; and
- Costs and benefit of implementing each IT skills recommendation and opportunity to improve the use of IT.[4]

This report's findings and recommendations are key elements needed by the Nova Scotia construction industry to:

- Support develop initiatives and strategies;
- Ensure a framework is in place to address IT Skills requirements; and
- Prepare the workforce for anticipated technological sophistication in the ICI construction industry.

The consultants used a direct consultative process (surveys and interviews) with labour supply stakeholders (including union and non-union representatives) to collect information. Referencing existing information ("off-the-shelf" documentation) was secondary.

[3] From the request for proposal, "Invitation for Proposal to Conduct an Information Technology (IT) Skills for the Workplace Assessment," January 18, 2006.

[4] Costs are estimated based on our assessment of the scope and level of effort to implement the recommendations. Benefits stem from the efficiencies and productivity gains. The benefits are addressed in a qualitative discussion of each recommendation.

### 1.2. APPROACH AND METHODOLOGY

Jozsa Management & Economics was selected by a competitive proposal process. Our methodology followed multiple lines of evidence to develop the response to the research objectives specified in the request for proposals (RFP).

Our methodology included the following research and consultation steps.

- **Interviews**—We conducted more than 30 interviews with union managers, employers, and industry stakeholders.
- **Surveys**—These included 13 employers, 15 union managers, and more than 219 workers[5].
- **Desk-top research**—This included more than 25 documents sourced during the literature and best practices research.
- **Case studies**—These profiled existing research on projects where IT had been used to improve project management at the work site.

The research program was conducted concurrently with a research project wherein the principal consultants were conducting a labour market and demographic study commissioned by the NSCSC-ICI. The IT skills consulting team for this study was able to use IT related information gathered during the labour market assessment.

The conclusions in this document are based on more than 30 detailed interviews, over 200 survey returns, and extensive background research.

### 1.3. STUDY WORK STEPS

The research and fieldwork took place during the spring and summer of 2006 and consisted of the following steps:

1. **Matrix of Study Topic and Stakeholder Targets**—A matrix of research topics (i.e., the RFP objectives) was developed from the perspective of industry stakeholders and reviewed with them to:
   a. Confirm that the stakeholders saw the topics as relevant;
   b. Identify stakeholders who could best provide input to the RFP objectives;
   c. Help focus attention on the research objectives and the required primary (and secondary) information sources; and
   d. Most efficiently use the time taken by industry stakeholders to participate in the consultation process.
2. **Survey Questions—**IT related questions were incorporated into the concurrent Labour Market Study of the ICI Sector. As a result, the IT survey coverage included employers, business managers and individual workers.
3. **Fieldwork Implementation—**The fieldwork implemented the primary and secondary research steps. These steps emphasised:
   a. Developing on-line surveys (worker, employer and business manager);
   b. Making downloadable PDF documents available on NSCSC-ICI's web site;
   c. Providing hard copy at union halls for pickup by workers and/or for direct mail to workers selected by union managers;

[5] At the time of writing (October 27th, 2006) 219 surveys had been processed. The final report will include an analysis of all worker surveys available at that time.

d. Conducting personal interviews with employers, union managers, and other stakeholders;
e. Providing surveys to employers for inclusion in direct mailers and pay cheques;
f. Visiting construction sites to promote awareness of the study and circulate the survey to construction industry workers; and
g. Making a series of public survey announcements to bolster industry awareness of the ongoing study process.

4. **Interview Guide Development and Interviews**—The development of a high-level interview guide used throughout the interviewing process.
5. **Ongoing Data Collection, Entry and Audit—**The mechanics of data entry, confirmation and analysis.

The project was governed by a Steering Committee of industry representatives and the NSCSC-ICI. This committee, through its Project Manager, was kept apprised of the team's study progress though a weekly reporting meeting and regular e-mail and telephone updates.

Primary data, collected through direct interviews conducted by the consultants and surveys of industry and workers, formed the basis for our findings.

### 1.4. REPORT ORGANIZATION

The balance of this report is organized as follows:

- **Section 2** provides a **Literature Review**. This section provides an industry overview based on existing information. It shows a snapshot of the ICT[6] trends in the industry, the IT skill needs, and options for providing those skills based on observed trends in recent years.
- **Section 3** presents **Study Findings**, including summaries of interviews and survey responses. We also discuss what they mean and what can be done to address what was revealed. This section highlights current IT demands and looks forward to discuss what trends may affect the workplace in terms of IT skill requirements of the ICI construction sector.
- **Section 4** provides a **Profile of IT in the ICI Sector** based on our primary research. The section also offers qualitative and quantitative discussion of ICT trends in the industry and forthcoming IT skill needs.
- **Section 5** provides a **Summary of Recommendations and Actions**.
- **Appendix A** provides a bibliography**.**
- **Appendix B** lists the interview participants.
- **Appendix C** provides our interview findings**.**

[6] Throughout this report we refer to "ICT" (Information and Communications Technology) interchangeably with "IT" (Information Technology) depending on the sources we refer to. Our definition of IT covers digital communications technology.

## 2. LITERATURE REVIEW

Relatively little research has focused specifically on the impacts of IT on the ICI construction industry in Canada. Most relevant research described trends and anticipated skill requirements. The results of the literature review were corroborated by our local primary research; there are more advanced uses of IT outside Atlantic Canada, but even in these jurisdictions, IT usage in ICI construction is growing slowly.

Our research confirmed that despite this, stakeholders at all levels do expect to see increasing use of IT and the consequent need for more IT skills.

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- **Software that enables** communication, analysis and management of information related to the ICI construction industry; and
- **Hardware that enables** these functions. Hardware includes computers, communication devices, sensors, monitors, meters and trades-specific construction tools that now employ digital electronics and require some level of IT training to operate and maintain.

One report reviewed for this study documented IT trends within companies and divided IT application and usage into three categories:[7]

- **Inside the company office** for communication—document preparation, scheduling, design productivity, drafting, information storage and retrieval, etc. **"**Inside the company office" refers to construction administration functions, which include preparing:
  - Organizational charts;
  - Meeting minutes;
  - Progress photos;
  - Weekly/monthly status reports;
  - Punch lists;
  - Commissioning documents; and
  - Operating and other manuals.
- **Outside the company office *with foremen or job supervisors***[8] on job sites for voice and data communication, document sharing, etc. Functions that occurred between the company office and job sites included:
  - Inventory requirements/management of the site, including human resources and tools;
  - Specifications and blueprint drawings, revisions;
  - Progress updates, oral and visual;
  - Timesheets; and
  - Purchase orders.
- **Outside the company office *with other companies*** for voice and data communication, document sharing, marketing, information gathering, etc. This category includes many of the items listed above under communications with foremen/job supervisors.

[7] Lane, Kent. *Consulting Engineering Perspective on the use of Internet Based Technology* http://ctca.unb.ca/CTCA/connections/e-construction/KentLane.pdf

[8] We use the terms "foremen" and "job supervisors" to describe individuals on a job site who are most likely to have the field management role of the firm for whom they work.

### 2.1. OUTSIDE THE COMPANY

"Outside the company" use of IT is most relevant to the objectives of this study. We expand on this level of communications in the following section. The general trend in large-scale businesses is toward enterprise software—i.e., **software that meets a requirement across divisions of an enterprise or project**. Microsoft, SAP, and Oracle produce enterprise software that permits customization and information flow to accomplish enterprise-wide purposes. There are now industry-specific enterprise software applications, including applications in the construction sector. The ICI construction industry in Atlantic Canada reported the following improvements in efficiency, productivity and competitiveness associated with information sharing within an enterprise:[9]

- Improving communication abilities;
- Overcoming challenges in coordinating work between multiple locations;
- Minimizing time and effort;
- Maximizing productivity and momentum;
- Accessing project information in real time as projects progress;
- Lowering project costs and compressing project schedules;
- Improving workflow;
- Enhancing project data quality;
- Improving efficiency for the entire building life-cycle;
- Strengthening commitment by the team to the project; and
- Increasing community involvement.

#### 2.1.1. MIGRATION TO INTERNET-BASED PROJECT COLLABORATION SOFTWARE

The integration of IT between companies working on a project is occurring at the highest level of the ICI construction industry.

In Atlantic Canada, trends in the use of enterprise software have been researched and carried forward by the **Construction Technology Centre Atlantic** (CTCA)**,** based in Fredericton, New Brunswick, and the Interactive Collaboration Lab at the University of New Brunswick.[10] The CTCA promotes technology development by bridging the gap between researchers (and research and development organizations) and industry participants (SMEs and larger industry organizations).

Over the past four years, the CTCA has been involved in developing web-based applications that support several phases of the construction process, including pre-tender and execution. The CTCA developed a web-based system for the management of construction quality, safety, environmental and operational information for the $650 million Fredericton-Moncton Highway Project. This web-based system was further developed into a prototype that allows interaction with the web-based system using wireless handheld solutions. The CTCA has also developed custom software for Atlantic Canadian organizations.

There is a consensus on the potential of enterprise software to make consortia and partnerships more competitive. For example, in the food industry, where, arguably, suppliers are in a more stable relationship with distributors and retailers, electronic data interchange (EDI) has become the

[9] *e-Construction Symposium—Examples from a contractor*, PCL Constructors Inc. (2002) (http://ctca.unb.ca/CTCA/connections/e-construction/JoeWatson.pdf)

[10] http://ctca.unb.ca/

industry standard. Agricultural producers' and processors' ability to enter the supply chain is restricted unless they can participate in web-enabled transactions with wholesale distributors.

The application of enterprise software is not as pervasive in ICI construction as it is in other industries. This may be because, in contrast with other industry sectors, there are many players that come together for only a limited time, with many different players (construction companies) mobilised to address a specific construction project for a specific duration. The next construction project will likely involve a different set of players working on another fixed term assignment.

In more stable and highly functioning enterprise-wide IT environments there are also "extra" requests and expectations of access to information by clients. Although the technical problems of communicating across different software platforms and applications are gradually being overcome, there are legal, trust and privacy issues about sharing information. Because there is more tracking and accountability, there can also be more accurate, "finger pointing". We were told that the potential for this is not welcomed by contractors and acts as a deterrent to the uptake of IT in the ICI sector:

> The resistance has to do with what information gets used and shared—a common platform for integrating job specifications and change orders is appealing—a platform that makes available work loads and schedules is more of an issue for some of the suppliers…. So it comes to a task-by-task basis when employers are considering the uses of IT…[11]

Concerns for finger-pointing are most often found in situations and organisations that have yet to appreciate that collaborative work processes are not meant to target blame accurately but rather to avoid errors and deal with issues before they become contentious. In collaborative work environments, information sharing promotes group ownership, responsibility, and focus on problem solving versus blame avoidance.

Driven by major project owners, the trend is growing and slowly overcoming these obstacles. The trend in Atlantic Canada is positive but moving slowly and will likely continue that way until legal and trust issues can be overcome.[12] Thus, there is a balancing act. For "outside the office" information sharing to be meaningfully integrated, it must not jeopardize an organization's confidential information and at the same time, it must be substantive enough that it contributes to productivity gains and other benefits that stem from IT usage.

### 2.2. OTHER TRENDS

There is a trend toward the construction of "smart buildings" that include a variety of digitally controlled systems—from HVAC to security to remote sensing. In many cases, the sophistication of HVAC systems is such that the manufacturer sends an agent to work alongside the installers and tradespeople. These agents program and commission the system and provide the monitoring and maintenance codes to controllers.

The code information is provided to local staff that may monitor and maintain these systems. In other cases, monitoring can be done remotely. The construction of "smart buildings" requires growing communication, planning, and knowledge related to IT on the part of foremen/supervisors. Our primary research indicated few IT requirements for the tradespeople directly responsible for installing infrastructure. However, as "smart buildings" become "smarter" and more common, it is

[11] Interview with Carol MacCulloch, President, Construction Association of Nova Scotia, July 19, 2006.

[12] Interviews with CTCA officers and Carol MacCulloch, July 19, 2006.

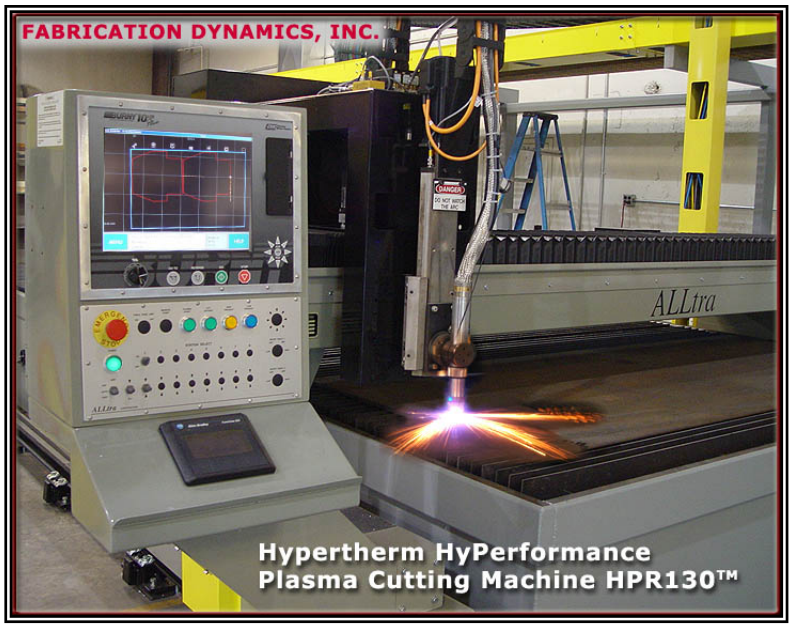
reasonable to assume that tradespeople will need more orientation on installation and operational requirements of the digital systems involved:

> As building automation systems (BAS) that control heat, air conditioning, lighting and other building systems get smarter, they're converging with traditional IT infrastructures.[13]

The trend is for more integration and more sophistication. In the same way you change the thermostat to match heat preferences, you will program entire facilities to optimize the operation of every system they contain:

> The long-term vision is that you'll be able to physically control everything based on preferences, criteria and business rules.[14]

The tools of construction work are also becoming more sophisticated and require knowledge of IT and digital electronics. For example, plasma cutters in the mechanical trades are now directly tied to design software and Nova Scotia companies are using this technology. Computer numerically controlled (CNC) plasma cutters fully automate the shape production process. Today's CNC units use either computers made specifically to run burning machines or modified personal computers.




Monitoring and control systems are increasingly being designed for and installed in buildings that could be subject to catastrophic events. While earthquake proofing is not new, enhancements to mitigate loss due to catastrophic events such as terrorism are. Newer buildings are being designed with features to protect against terrorism, specifically larger buildings and/or those that builders and project proponents believe will become iconic. New features include “safe floors”, which may have completely independent HVAC systems that are remotely monitored and specific to the particular floor (not linked into the rest of the facility) and elevators that are designed to access only the “safe floors” during evacuation. As these trends continue, even tenants will need to elevate their knowledge of their buildings.

The issue for the trades is that if end clients and tenants are demanding the sophistication of “smart facilities” with IT enabled building, should the trades be more knowledgeable of these areas so that they can create the required structures?

With all the uses of digital electronics and information technology in ICI construction, the national Construction Sector Council produced a report in 2004 entitled *The Impact of Technology in the*

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[13] *The Rise of Smart Buildings*, Robert Mitchell, Computerworld, www.computerworld.com/networkingtopics/networking/story/0,10801,100318,00.html, Downloaded October 6, 2006.
[14] Ibid.

*Construction Labour Market* that hardly referred to IT.[15] Their focus, and the focus of the National Research Council Construction Research branch, has been on the adoption of advanced construction materials and methods, rather than on IT.

### 2.3. OTHER DOCUMENTS REVIEWED

Although our main objective with the document review was to determine best practices from other jurisdictions, we also sourced material published by the NSCSC-ICI so that we could place the information from other jurisdictions in a Nova Scotia context.

We reviewed:

- Essential Skills—Construction Related (NSCSC–ICI, April 2005); and
- Foreman Skills—Trade Specific (NSCSC–ICI) (April 2005).

This "Essential Skills" study examined skills as they related to the non-residential construction sector by drawing on information from a survey of industry practitioners. The discussion of essential skills centred on the "basic enabling skills" identified by "HRSDC Essential Skills", listed as:

- Reading text;
- Document use;
- Numeracy;
- Oral communication;
- Working with others;
- Thinking skills;
- Computer use; and
- Continuous learning.

The Essential Skills survey was administered to "the NSCSC-ICI directors and sub committee members and to management and labour industry representatives"[16]. The results focused on 15 construction occupations and identified the following essential skills:

- Reading;
- Numeracy;
- Communication;
- Problem solving;
- Decision making;
- Job task planning and organizing;
- Significant use of memory;
- Finding information;
- Working with others; and
- Computer use.

The study found a need for Essential Skills upgrading for most occupations in ICI construction and makes specific mention of roles for foremen and supervisors as mentors. Further comment from the

[15] The National Construction Sector Council's web site reports three technology-based programs that are "currently underway or in development". These include the Computer-based Safety Training for Pipeline Construction, E-learning Gold Seal Program and Skills Data Card Initiative.

[16] The survey achieved a 71% response rate.

survey participants highlighted the role of the education system in training and the need for the system to better match its training to industry requirements to remain competitive. Management and labour indicated that lack of essential skills limits success in the workplace and the capacity of the labour force to participate successfully in occupation-specific training.

The solution to improving the level of essential skills focused on the:

- Development of best practices for Essential Skills in the workplace;
- Participation of employers in the development of course material (in modular form) that would suit their needs; and
- Engagement of employers in implementing this solution.

The "Essential Skills" study determined that the NSCSC-ICI should develop a plan to "**further assess the need for skills relating to information technology requirements in the institutional, commercial and industrial construction industry.**" This IT study is an outgrowth of that determination.

"Foreman Skills" looked at the role of the foreman and found that "Skilled foremen are essential to a company's success; the jobsite foreman is typically the first line of supervision within the management structure of a construction company."

The study surveyed foremen and other industry stakeholders to understand the current and changing role of foremen and the relationship to the projects they manage. The study described the role of the foreman as the person who:[17]

- Gives instruction to the job site tradespeople, and
- Ensures the work is completed in a timely manner."

The study also looked at attributes of today's foremen and found them to have the ability to:[18]

- Deliver clear and understandable instruction;
- Maximize worker output;
- Problem solve and make informed decisions;
- Mentor apprentices and assist inexperienced tradespeople;
- Be very aware of OH&S regulations;
- Have knowledge of new technology in order to give clear direction; and
- Record and report timely and accurate information to management using the latest technology.

The last attribute, and its relationship to the other abilities, explains why IT is relevant to the "tool kit" that foremen need to perform their jobs. Foremen are increasingly required to perform administrative activities on site and communicate increasingly complex information to suppliers, project managers, architects, engineers and other contractors. The challenge for the sector is to help foremen progress from "old school" approaches to more technologically intensive and effective ICT methods.

[17] *Foreman Skills – Trade Specific*, Nova Scotia Construction Sector Council (NSCSC–ICI, April 2005, p. 23.
[18] Ibid.

## 3. SUMMARY OF FINDINGS

In this section, we present:

- A summary of interview results;
- Two detailed interview summaries; and
- A summary of survey responses to date.

### 3.1. KEY INFORMANT INTERVIEWS

The key informant interviews were conducted with the aid of the interview guide shown in **Figure 1**. This guide was structured to address the RFP points and approved by the Project Steering Committee.

**Figure 1 Interview Guide: Information Technology (IT) Skills Assessment**

1. What are the current and **anticipated IT skill requirements** in your company? Are there gaps between current IT capabilities and the IT skills needed in your company (at job sites and in the home office)? If so, what are they?
2. What are the **new technologies** (products and applications) and trends in IT usage (e.g., the use of hand held electronic scheduling and reporting products)?
3. Specifically, can you identify IT skills that will assist in the development of **employment retention and expansion** opportunities for older workers in managerial, supervisory and mentoring positions? If so, what are they?
4. Identify what **methods of training** are preferred to enhance IT skills (e.g., workplace training, classroom, distance learning, etc.).
5. The potential **benefits of increasing information technology** in the construction sector lead to increased productivity through improved communications, access to information on the job site, better billing data, better job costing information, better resource deployment, etc. Should the ICI Construction Sector Council support the uptake and transition to these enhanced work methods? If so, how?
   a. **What would employers need?**
   b. **What would workers need?**

   Do the employers see value in working with CTCA for their applied IT demonstrations and simulations, or would something centred in Halifax and Sydney work better?

   Would they see a program where IT take-up is subsidized by government, possibly by subsidies for training and/or tax incentives for equipment investments?

   Would they find value in communication programs that emphasize the productivity and efficiency value of IT in the workplace—such as a speaker series of case studies where manufacturers and industry participants tell about their advanced technology solutions?

#### 3.1.1. SUMMARY OF INTERVIEWS[19]

More than 30 interviews were conducted with industry stakeholders that included employers, union managers, and other industry representatives and stakeholders. The following provides a summary of the interview findings.

##### 3.1.1.1. IT NEEDS IN THE CONSTRUCTION SECTOR

- There is a need for more familiarity and ease of use with IT systems.

[19] More detail on the responses to the Information Technology (IT) Skills Assessment interview guide is provided in Appendix C.

- There needs to be more general education about IT. Many people have a perception that IT means programming or some level of complexity that is beyond the average person's comprehension. (Potential IT users need to understand that using IT is, by analogy, like driving a car. One does not need to know how to build a car to drive it. Likewise, one can use a computer without being a programmer.)
- In terms of where IT education should be targeted, the first stage would address supervisors, foremen and project managers.
- Tradespeople perform best when they are actually doing their trade and should not be distracted from their trade by IT requirements.

#### 3.1.1.2. Information Management on the Job Site

- This will become an important function of the foreman. It might also become a function of the workers, but not at the same level as the foreman/job supervisor. Workers may operate at the level of sending in timesheets and basic information pertaining to their trade. The foreman/job supervisor will be expected to be more involved in planning and management roles enabled through IT. The uses of IT may include:
  - Submitting timesheets—Keyed in and e-mailed;
  - Coordinating drawings/interface drawings—Not an on-site CAD station, but electronic drawings made available;[20]
  - Sharing shop drawings—A shift in project management away from sharing binders of shop drawings to digital storage so that they are available to everybody on line, which also reduces printing and storage costs;
  - Keeping job journals—Maintained up-to-date on site and submitted;
  - Materials tracking—Tools and building materials tracked and monitored for condition/maintenance and availability; and
  - Task tracking—To be able to say what percentage of a job is completed and what remains to be done.

  All of these management functions are being performed; however, for many companies they are not being done electronically.
- **Level of IT on the Job**—One view was expressed very strongly about the level at which IT should reach on a job site. This interviewee said that it is important to consider the role of workers on a job site. These people are there because they know a trade and can apply that trade with a high degree of skill. They are there because project managers and owners want that skill brought to their job sites. These people are not there because they know how to use a computer (although they may well know this). They are not there because they are particularly adept at managing information technology (although they may well know this). However, the workers do need the benefits of the management tools that IT provides. Workers need clear information about what is expected, when it is expected, and where it is expected. They need to know that materials will be available and tools in working condition will be there for them.

  Seen from this perspective, the real force of IT on a job site derives from its use by foremen, supervisors and project managers. Their jobs are to make sure that workers can fulfill their duties as efficiently and effectively as possible. Site managers, foremen and

[20] On-Site CAD stations do exist, however, this would be found more often with the general contractor (not for the sub-trades) on larger jobs mainly because of the costs associated with that equipment and risk of damage or theft while on-site.

project supervisors generally make or break a job. Tradespersons' first priority should probably not be "pushing buttons on the computer", although this may be necessary to apply certain techniques and tools of their trade. They should be working with the tools of their trade.

- **Scale of jobs—**The larger the job, the obvious greater need for more organization. Conversely, smaller/shorter jobs are expected to benefit less from IT.

  On larger jobs, one would also expect to find a wider range of tools being used for the information management on the job site.

  The largest jobs can become almost self-contained, with entire engineering offices located on site and the prevalence of IT based tools equal to that at the head office.
- **Reluctance to Adopt IT—**Most interviewees noted that younger workers—individuals who have grown up with IT/using computers—would be more receptive to IT at the job site. Interviewees said that older workers might be somewhat reluctant to learn and use IT because older workers' exposure to IT has not been as extensive as younger people's. However, some believe that at the level IT would need to be targeted (toward the foreman/job supervisor) and there would not be a great reluctance to learn IT in the ICI trades.
- **Perceptions of Costs**—There was universal recognition that the adoption of IT would incur costs for software and hardware, for training individuals to use the technology, and for training time spent away from the job site.
- **Experience With the Need for IT—**The employers we spoke with indicated that they had some experience with IT (indeed, most were selected to be interviewed because they use IT), but acknowledge a need for more sophisticated project management on more complicated jobs. Most firms we spoke to are handling project management through project management software at the office, using data collected manually at the job site. They use the information and software to evaluate the status of the job elements, their relationship to the schedule (percent completed/not completed), and what might be holding up a job. No one indicated using the data to improve unit costing in subsequent tenders.
- **IT Specific Skill**—Few of the interviewees identified occasions when a job site required tradespeople to have specific IT skills. Where IT specialties are needed by tradespeople and contractors today is in the area of digitally controlled trade-specific equipment, such as plasma cutters. These workers need PCs tied to the web to commission mechanical components. We heard that most other trades are "rough" and interviewees do not see workers in the near term lugging computers. In the longer term, they believe that there will be an evolution to some form of hand-held device (e.g., PDAs) to assist with what they perceive as a growing trend toward information management at the worker level.
- **Durability**—During the course of the study, durability was mentioned as an issue for computers, PDAs and other electronic devices not specifically designed for use on the job site. We tested the concern over durability and found that most believed that the issue of design depended on who is using computers. For example, computers would be unlikely to stand up to workers in the field who are working on staging or around pipe and other obstacles. Today's computers are, however, more than adequate for use by a foreman/job supervisor sitting at a desk in a trailer on site.
- **IT Skills Gap**—Newer, younger workers are exposed to IT; it has been part of their education and their daily lives, so it is natural that they would use it as part of their jobs. Because of younger workers' exposure to IT, interviewees expect that they would be more

receptive IT as part of their work environment. Among older workers in general, however, there is a perception that there would not be so much interest.

We discussed with interviewees the options for using technology to support skills transfer, providing several examples of potential applications. Among these was the possibility of web cams being used by experienced workers, who may be unable to work on a job site but could be available through the web cam to assist in installation, answer questions or demonstrate what needs to be done. As technology becomes more affordable, using web cams to support on-site Q&As will become more practical. Responses to this example revealed that a lot of thought had been given consideration to this possibility.

- **Training**—We asked about roles for the Council and how it might be involved in providing IT related training. Presumably, some of the larger firms would be able to internalize IT capacity and piggyback job-site IT needs with IT services that are already being provided at the firm level (management). Small firms, however, are unlikely to have their own dedicated IT person and may benefit from the Sector Council taking an active role in ongoing IT support. This can come in the form of an IT consultant available by phone or e-mail so that workers in the field can ask a technical question when it arises. In addition, if, for example, a company decides to switch their foreman/job supervisor to computer-based job reporting (e.g., reporting of timesheets, purchase orders, materials inventory, etc.), they may, as part of the change, implement classroom training. After the classroom training (which may also be provided through the NSCSC-ICI), ongoing support will be required.
- **Benefits of IT**—Interviewees saw the benefits of IT in how it could help job sites become more organized, which could lower costs. **The benefits of increased efficiencies needs to be weighed against the cost of the training, training time spent away from the job, and software and hardware expenses**.

### 3.1.2. INTERVIEW PERCEPTION OF IT TARGETS/LEVELS OF IT

Interviewees identified two levels of IT in the construction sector and characterised them as management use and site use, similar to the "in office" and "out of office" uses described earlier. Management use consisted of human resource functions, accounting, financial management, recordkeeping, etc. This level of IT is likely fairly strong and has been the standard for several years.

Site use is essentially the same as "out of office" use. **Even with advances in portable technology, however, IT does not seem to have penetrated the job site to a great degree**.

The absence of a basic familiarity with IT technology raises barriers to its adoption. In addition, individuals who may be less proficient in essential skills could be more reluctant to adopt a tool that forces them to write. For example, many foremen prefer to report on site activity using the phone—is this because of a lack of comfort with writing or simply a preference? The question remains how they would react to the option of using IT to complete the same task.

Given research findings on "Essential Skills", individuals may be less comfortable writing because they fear exposing a limited capacity; or it may also be a preference formed out of habit to phone in job information and have administrative staff enter the information on computer.

In cases where the practice is to handwrite and fax information, these individuals may be far more receptive to using e-mail and electronic correspondence to accomplish the same tasks.

Interviewees point out that the benefit-cost of implementing IT would need to look at any additional burden information management creates and which options best use the company's higher value time. For example, is it better to have administrative personnel entering data phoned

in by a foreman/job supervisor, or would it be preferable to have a foreman/job supervisor at a higher hourly rate working with a keyboard?

The benefit-cost analysis would need to cover the full scope of benefits and costs. For example, an assessment of the cost of a foreman's time compared to administrative time must also consider the new value that the data, if used properly, could bring in the form of better unit costing, which can make a company more competitive. More sophisticated approaches to IT in the field can also help companies demonstrate their commitment to quality and management and thereby help them win contracts from customers who understand the inherent value of improved information management.

**Recommendations:**

**Conduct Research on the Functional Information Needs of Foremen/Supervisors.** More research is needed on the functional information needs of foremen/supervisors in particular for several reasons: 1) Foremen/supervisors will need to understand the direct benefits of ICT to job site productivity and 2) they need to understand the changes to the way work will be done by any workers using new technology. How can ICT benefit foremen/supervisors in terms of current, basic administrative tasks such as reporting time on tasks, materials used, and materials to order?

**Introduce Foremen/Supervisors to the Benefits of ICT.** There is an emerging need to educate and train foremen/supervisors and selected tradespeople in the benefits and requirements of IT. This is the case because IT has direct pertinence to the changing infrastructure and tools in their industry. For example, the foreman overseeing implementation new technology such as a new plasma cutter will also need to understand what the expected benefit of the machine is to productivity and also what will be required of the operator in terms of time, skills, support, and access to information. Presentations, seminars and workshops for foremen/supervisors must "personalize the return on investment" so that participants see clearly how this will benefit them on a routine basis.

**Develop and Deliver Follow-up Modules for Foremen/Supervisors.** The NSCSC–ICI should arrange access to basic IT training sessions for foremen in tasks that they perform on a regular basis. Scheduling should be arranged during off-season or slow periods for ICI construction. This could be done with the Nova Scotia Community College (NSCC) or other training providers.

### 3.2. WHY FORCE IT ADOPTION?

Several interview respondents noted that IT is destined to arrive at the job site through a natural evolution, particularly since many young workers will arrive with well established IT skills. If this is the case, why force or try to accelerate the update of IT? The answer lies, in part, in the:

- constant need to increase productivity in a sector that is facing potential labour shortages;
- increasing complexity of the job site reflected in the growing complexity of trades and their integration on the job site; and
- need to stay ahead of the competition.

These trends are discussed in the section below that describes the future of IT in the ICI sector.

### 3.3. EXPANDED STRATEGIC INTERVIEW SUMMARIES

The following profile of the "Electrical Technology Programs at NSCC" and interview with "Construction Technology Centre Atlantic" are presented in detail because they provide information that is particularly relevant to understanding the future of IT in the ICI sector.

### 3.3.1. STRATEGIC INTERVIEW: ELECTRICAL TECHNOLOGY PROGRAMS AT NSCC

Gordie MacNeil, Academic Chair for Electrical Technology Programs, NSCC (July 19, 2006) provided the following information on NSCC's electrical technology programs.

There are approximately 44 students entering the one-year certificate program at the Halifax campuses that offer electrical construction and industrial electrical programs. Upon graduation, some will move directly into the ICI sector, but most will start in residential construction as apprentices. This includes electronic technician and engineering students.

The engineering technology programs have about 24 students. Upon graduation, they generally go to work with engineering firms, utilities, manufacturers, the Department of National Defence, the Coast Guard and hospitals.

There are about 250 apprentices at the Leeds campus in Halifax. Apprentices have been employed between one and four years and all come through at least one year of NSCC education. Apprenticeship includes students who come back to school from employers.

There is a wait list in Halifax of about 100 students for electrical programs at the Leeds campus, sometimes rising to as many as 200. Some try for two or three years to get in; some go elsewhere. According to Professor MacNeil, it is "safe to say this is the most in demand program in the province."

At the Kingstec Campus, comparable programs take in 60 students per year. The campuses in Shelburne take in 20, Lunenburg 20, and the Strait Area 40. Approximately 180 are entering electrical construction and industrial electrical programs per year at the NSCC.

The table below provides some specifics on NSCC's Electrical–Construction & Industrial Certificate and Diploma programs. Electrical Construction (compulsory certification) and Industrial Electrical are apprenticeable trades in Nova Scotia.

| | |
|---|---|
| Start Date: | September |
| Length: | 1 Year(s) |
| Credential: | Certificate |
| Location: | Institute of Technology Campus<br>Kingstec Campus<br>Lunenburg Campus<br>Shelburne Campus<br>Strait Area Campus |

| | |
|---|---|
| Start Date: | September |
| Length: | 1 Year(s) |
| Credential: | Diploma |
| Location: | Strait Area Campus |

Placement rates are very good. Industry recruiters take graduating students directly from the classroom. Recruitment directly to industry is facilitated by the program's five-week work experience component, which provides an opportunity for employers and students to get to know each other. Many graduates continue with their work experience employer.

#### 3.3.1.1. How Rapidly is the Technology Itself Changing? How Does IT Fit In?

Each graduate must take courses in communications, mathematics, computer applications (spreadsheet applications for creating work orders, project budget management), along with wiring and DC theory, etc. More students each year are comfortable with computers when they arrive on campus.[21]

Since IT plays a role in many digital systems that go into construction, such as fire alarm systems, security systems, sensors and wireless technology in general, IT **is essential learning for the related trades as well as the electrical trades themselves**. Students are, at a minimum, exposed to Internet hubs for integrated HVAC controls, etc.

However, NSCC apprenticeship training does not involve a lot of hands-on work; "We do the theory end and that's maybe only 15 percent of the training. About 85 percent is happening on the job." The NSCC would like to do more hands-on training, but would need a laboratory or shop to do so. Manufacturers sometimes come in with hands-on demonstrations to help fill the gap.

**Recommendation:**

**Solicit Industry Support for Hands-On Learning.** The Sector Council should help attract funding from industry for more hands-on learning within the NSCC programs. There is precedent for industry funding; for example, the Electrical Federation of Canada has contributed.

### 3.3.2. Professional Development (PD)

Seven faculty have been on PhD leaves in the past four years for as long as a year doing research, working in the field, taking advanced courses, and/or networking with the business community. Faculty who wish to go on professional development leave provide proposals for future presentations and workshops they will lead upon their return. The proposals are reviewed by an internal panel.

There are also short courses in-house for professional development. For example, the Apprenticeship faculty participate in a weeklong PD session on construction sites and attend seminars presented by industry experts.

### 3.3.3. Future Plans

On October 19th and 20, 2006, the Atlantic Provinces Community College Consortium (APCCC) met in Halifax to discuss the current and projected state of the ICT sector in Atlantic Canada and investigate the role that public colleges should play to help the industry meet its current and projected human resource needs.

There will be more follow-up specialty programs for graduates, especially in industrial/commercial applications (e.g., new controllers, building envelope issues). NSCC is exploring different delivery modes—a certain amount could be online, including some hybrid demonstration components of new technologies. The blended learning approach (e-learning and classroom based) seems to be growing.

Students who want to go on to the higher levels can take advantage of articulation agreements with universities, where NSCC has established specific course agreements that enable transfer students to receive credit for their academic programs. Arrangements exist with Dalhousie University, Cape

[21] NSCC does not teach industry-specific software, such as enterprise software aimed at the construction sector, but does teach computer-assisted design (CAD).

Breton University and universities in Ontario. NSCC graduates can finish an engineering degree in less time than new students.

Digital technology will eventually dominate trades-specific technology—e.g., software based controllers, wireless systems, etc.—so that there will be increasing integration of technologies across the trades. This implies that the lines between trades are blurring—for example, sensor technology is used by both plumbers and elevator technicians. The trend to technology integration among the trades will have profound impacts on future programs.

**Recommendation:**

**Advise NSCC and Other Training Providers on ICT-Related Content and Delivery to the Construction Sector.** As more firms develop IT implementation plans, the NSCSC–ICI should solicit their participation in discussion with the NSCC ICT program advisory and construction trades committees. These committees should be encouraged to work together to ensure that sector needs will be met. Input given to NSCC should be shared with other training providers, including unions that may set up their own ICT-intensive training. In general, the NSCSC–ICI should support blended learning models (combining hands-on learning, e-learning, and technical support on the job). There is a longstanding precedent for this in apprenticeship programs.

### 3.4. STRATEGIC INTERVIEW: CONSTRUCTION TECHNOLOGY CENTRE ATLANTIC (CTCA)

The following information was collected during an interview with:

- Jeff Rankin, PhD, P.Eng; and
- M. Patrick Gillin, Chair in Construction Engineering and Management; Associate Professor, Department of Civil Engineering, University of New Brunswick; Current Advisor to the Board, Construction Technology Centre Atlantic (CTCA).

CTCA is a technology transfer organization linked to research groups at the University of New Brunswick (UNB), Fredericton and the National Research Council (NRC) IT branch. It focuses on adoption and implementation of communication technology by the architectural, engineering and construction sectors. CTCA is responsible for the Construction Information Network (CINet), an electronic service designed to allow access to construction tender information, including drawings, specifications, and addenda, via the Internet. CINet is currently in operation via CTCA within New Brunswick. (Nova Scotia now uses its own system.)

Another recently completed project focused on extending current functionality offered by web-based construction information and management tools by determining the most appropriate scenario for the application of handheld technologies in the construction industry. Collaborative web-based applications were extended beyond the desktop to portable wireless handheld computers, providing instant access to real-time construction information.

The CTCA has interactive, collaborative IT workspaces in a laboratory-meeting environment where multi-disciplinary teams can try new technologies. Dr. Rankin's research investigates application of IT in the ICI industry and the factors that influence technology adoption: "We are finding the right use for them, making them fit, or finding out why they don't fit."

Dr. Rankin says these IT technologies are "mature with respect to their development but not in terms of implementation." The existing problems are solvable on the technical side, but significant implementation issues remain because there is no common agreement on standards among stakeholders.

Larger companies can dictate the use of specific tools, but there is "no specific push in that direction" for this industry in Atlantic Canada. The focus is short-term—simply getting the work done, rather than getting everyone using a common system and ironing out the problems. Few web-based applications are actually being used. Professor Rankin believes progress will be driven more by site owners than general contractors.

Certain specific technologies incur usability issues. For example, developers of digital cameras, handheld computers and other mobile technologies have not addressed usability in rugged job site conditions.

Nobody is really looking at the entire IT management cycle from the job site to a central database and back to the site. Sometimes people need better one-to-one voice communication, but other times better data transfer is required, such as retrieving drawing specifications and video images—"There are not really great tools yet that combine all those scenarios in one efficient solution." Most project managers have access to BlackBerrys and digital cameras, but they are not combined efficiently. In Fredericton, CTCA researchers are now evaluating BlackBerry and digital camera technology for application to playground, road, culvert and building inspection. Is the condition too noisy, inside/outside, is there bad or good lighting, etc.? Which technologies match all these potential circumstances?

Companies in the construction industry rarely have longstanding supply chain relationships such as exist, for example, in the food supply chain. Therefore, cooperation among stakeholders is a much larger challenge in the construction industry. According to Professor Rankin, "Where it really has to happen is on regional basis; the supply chain is mostly regional—consultants, contractors, subcontractors."

CTCA is trying to increase awareness and lead pilot projects. They introduce new IT tools as well as the methods to analyze and evaluate the new technology. CTCA needs more construction industry representation on its Board of Directors to help support applied research: "We don't do the white coat lab research, it is not pure research, it is applied research."

CTCA is an innovation broker for researchers, developers, contractors, suppliers and construction work practitioners. The CTCA aim is to support innovation to the point of becoming standard practice. "Here's a technology that actually works and here's a scenario where it's being used; here are the advantages and disadvantages—best practices."

**Recommendation:**

**Partner with CTCA on Research Initiatives.** The NSCSC–ICI should invite manufacturer representatives to visit ICI job sites in Nova Scotia to conduct formative research and field test new versions of their ICT. Several employers interviewed appeared to be open to cooperation and possible partnerships with IT equipment manufacturers. The CTCA and the NRC IT branch could cosponsor research.

### 3.5. SUMMARY OF SURVEY RESPONSES

In this section, we present the summary highlights of IT related questions contained in the following surveys:

- 2006 ICI Worker Survey;
- 2006 ICI Business Manager Survey Comments; and
- 2006 ICI Employer Survey Comments**.**

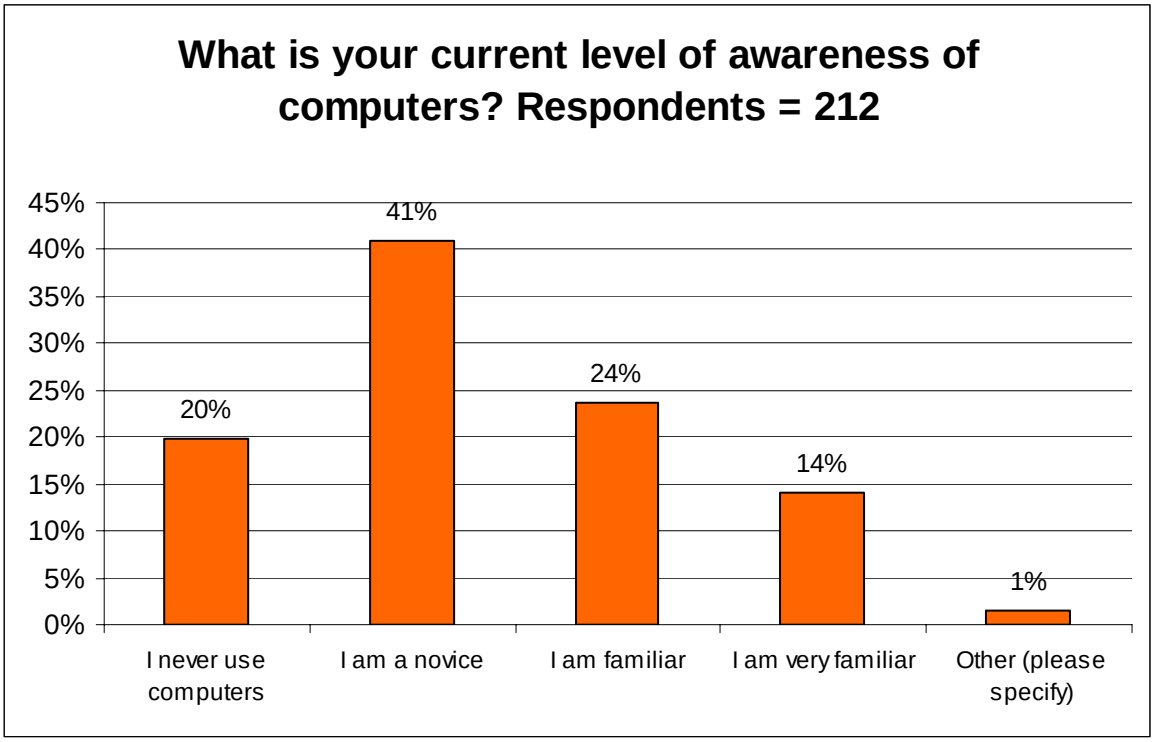
### 3.5.1. WORKER SURVEY

The following is a summary of IT related survey responses was drawn from the concurrent labour market and demographic study. The data are current as of October 27, 2006.

**Section E—Use of Information Technology for Information Management**

[Please complete all questions in this section.]

| | |
|---|---|
| What is your current level of awareness of computers? ***[select only one]*** | ○ I **never** use computers<br>○ I am a **novice;** I can use basic e-mail and search the Internet<br>○ I am **familiar;** I use computers for word processing, spreadsheets, Internet access, sending and receiving documents and pictures, etc.<br>○ I am **very familiar**; I use computers regularly for many functions.<br>○ **Other** (Please specify)<br>_____<br>_____ |

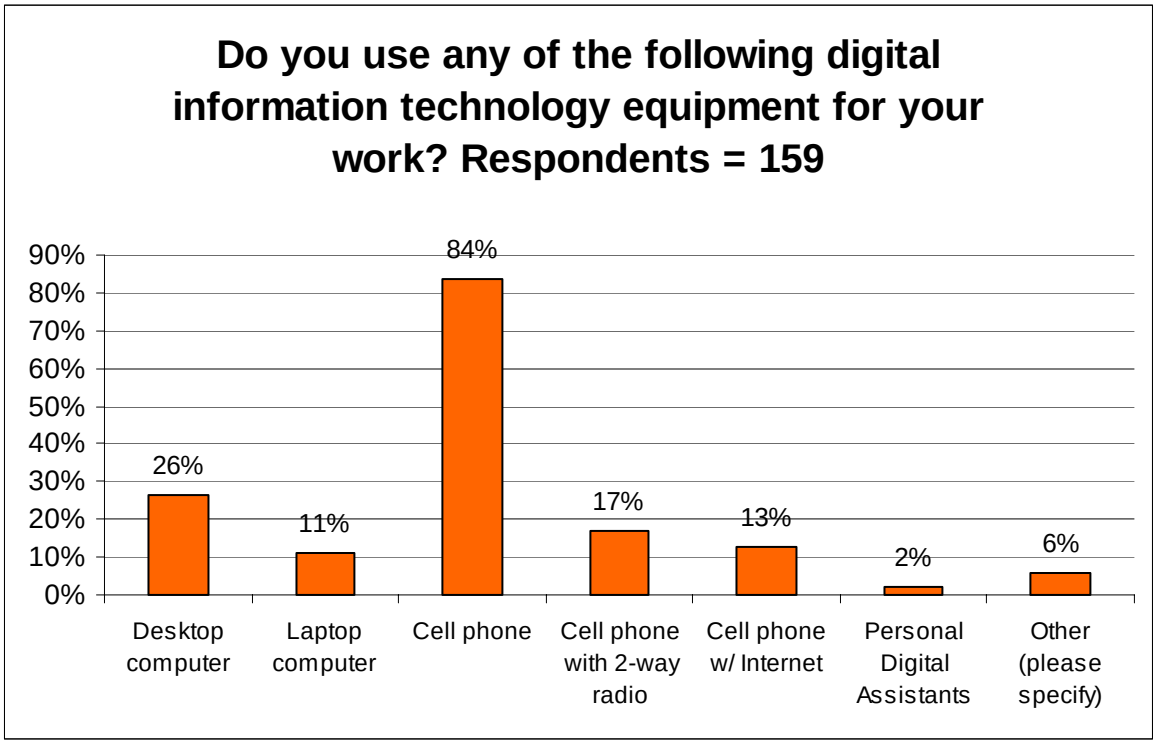



About 38% of respondents indicated some level of higher familiarity (24% are familiar and 14% are very familiar) while 41% indicated they were "a novice" and 20% said they never use computers. No open ended comments were received for this question.

In further research, it will be useful to correlate this result with age and trade, as interview respondents postulated that greater IT skills would be found among specialty trades and/or younger workers.

| | |
|---|---|
| Do you use any of the following digital information technology equipment for your work? ***[select all that apply]*** | ○ Desktop computer<br>○ Laptop computer<br>○ Cell phone<br>○ Cell phone with two-way radio capability |

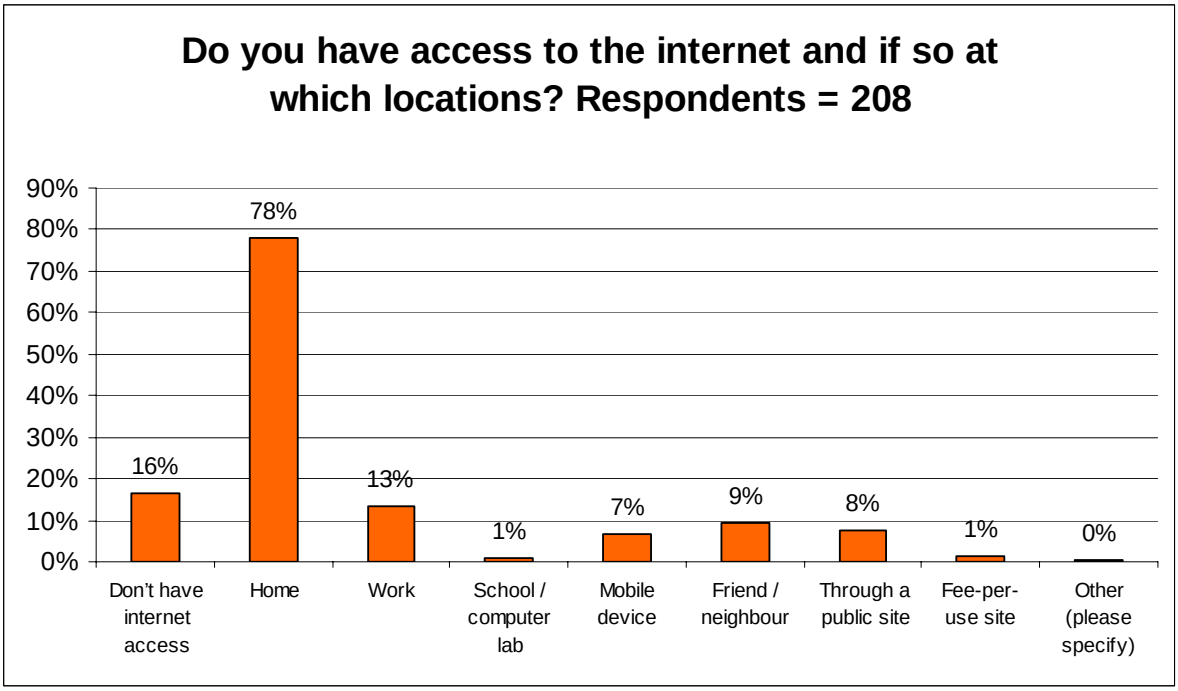
| | |
|---|---|
| | ○ Cell phone with Internet capability<br>○ Personal Digital Assistants (e.g. BlackBerry, palm pilots)<br>○ Other (Please specify)<br>_____<br>_____ |




The majority of respondents (84%) use cell phones while the next largest group (26%) indicated they used desktop computers. On average, respondents used 1.58 types of IT equipment—meaning several respondents selected multiple categories. "Other" IT equipment included:

- Air monitors
- CNC Controller
- Digital Camera
- Fax, photocopier
- Hand-Hold Service tools (2)
- Pager

| | |
|---|---|
| Do you have access to the Internet and if so at which locations? ***[please check all that apply]*** | ○ Don't have Internet access<br>○ At home<br>○ At place of work<br>○ At school/computer lab<br>○ Through a mobile device<br>○ Through a friend/neighbour<br>○ Through a public site (e.g. library)<br>○ Through a fee-per-use site (e.g. Internet café)<br>○ Other (Please specify)<br>_____<br>_____ |

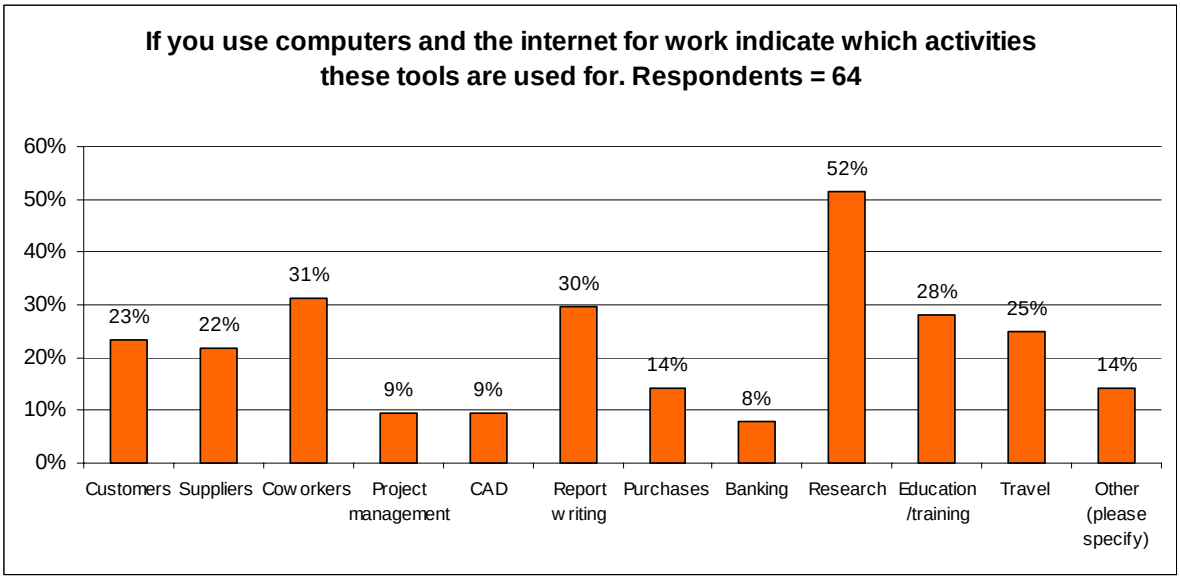



The majority of respondents (78%) indicated they have Internet access at home. Sixteen percent of respondents do not have Internet access, 13% have Internet access through work, and fewer have access through the other means such as a mobile device, neighbour, public site, or fee per use.

There were no open ended comments.

Statistics Canada's survey of household Internet use, by location of access, indicated in 2003 that 52.7% of Nova Scotians had home access. The provincial average for work is 35%. The construction trades appear to be ahead of the curve in this regard; however, the responses of the construction industry survey came from areas centred on Halifax and are less representative of rural populations, which may have lower access levels.

| | |
|---|---|
| If you use computers and the Internet for work, indicate which activities these tools are used for. ***[select all that apply]*** | ○ Communicating with customers (e.g. e-mail)<br>○ Communicating with suppliers<br>○ Communicating with co-workers<br>○ Project management<br>○ Computer-assisted design<br>○ Report writing<br>○ Buying product (e.g. on-line purchases)<br>○ Business administration (e.g. business banking)<br>○ Research/Information gathering<br>○ Education/training<br>○ Travel information/arrangements<br>○ Other Internet services (Please specify)<br>_____<br>_____ |

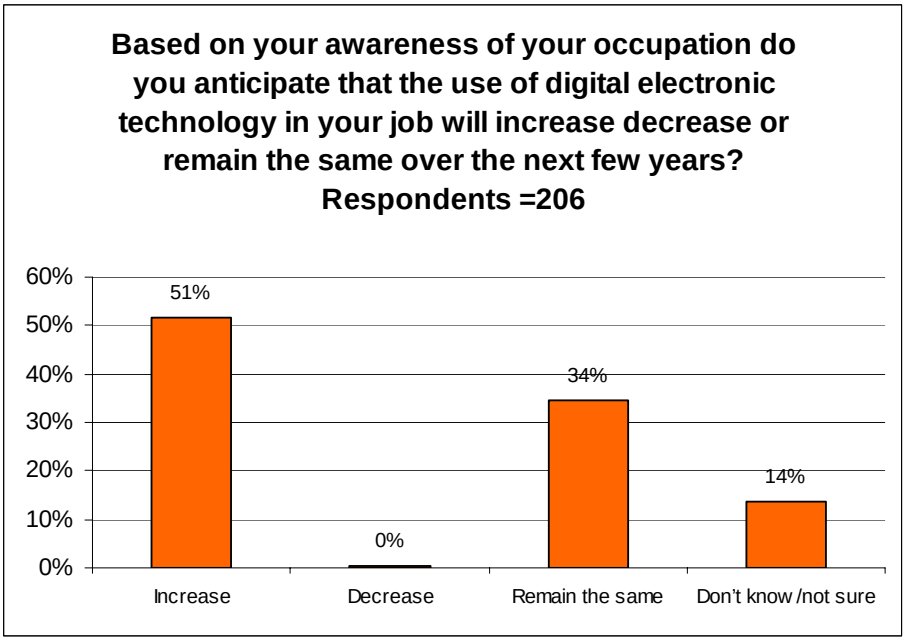



Sixty-four respondents using their computers and the Internet for work identified 170 activities for which these tools are used. Fifty-two percent said they use the computer for research, 31% for communications with co-workers, 22% for communications with suppliers, and 23% for communications with customers. Other relatively prominent uses included education and training (28%) and travel research/planning (25%).

Comments around other uses included:

- Don't use a computer at all
- E-mail
- Fax only
- Nothing special [standard activities]
- Programming building controls
- Weather—shower prediction

| | |
|---|---|
| Based on your awareness of your occupation, do you anticipate that the use of digital electronic technology in your job will increase, decrease, or remain the same over the next few years? ***[select only one]*** | ○ Increase<br>○ Decrease<br>○ Remain the same<br>○ Don't know/not sure |




Slightly more that half of the 206 respondents (51%) expects that the use of digital electronic technology will increase, while 34% believe it will remain the same. Fourteen per cent are unsure of the direction the usage of digital electronics will take in their jobs, while 1% believes IT use will decrease.

With the responses to date the sample size is too small to draw many conclusions from the split between "increase" and "remain the same". The exception thinks use of digital electronic technology will decrease.

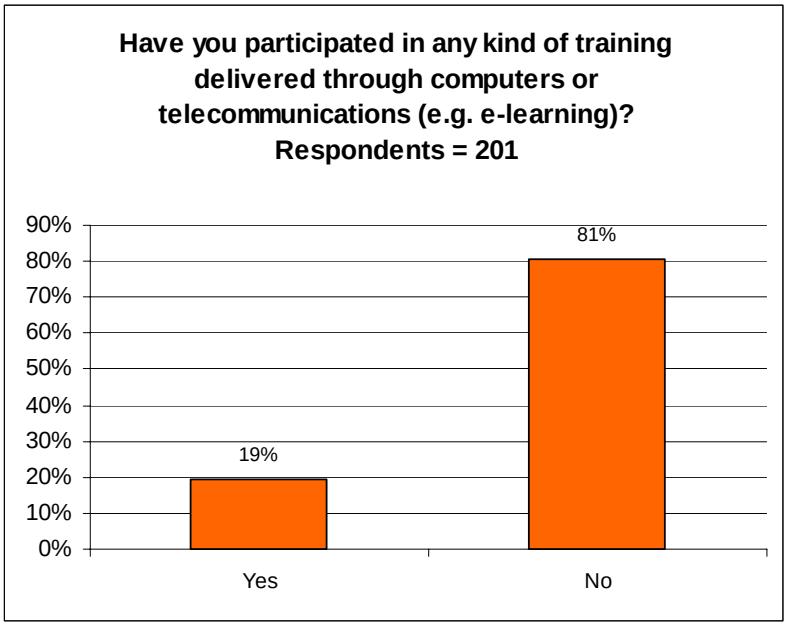
| | |
|---|---|
| What new technology (hardware and software) do you think you will be using within the next few years? ***[please explain]*** | _____<br>_____<br>_____<br>_____<br>_____<br>_____<br>_____<br>_____<br>_____<br>_____ |

## What new technology (hardware and software) do you think you will be using within the next few years?

A total of 39 respondents offered comment on the hardware and software they expect to see in the construction work place. These comments include:

- All workers may be linked on the work crew by wireless communication directly to their foreman.
- BlackBerrys to respond to e-mail when working from remote sites (2)
- Blueprints
- CAD (3)
- Laser technology
- Survey equipment
- Cell phone (2)
- Computers for work progress reports/Computer (3)
- Digital camera (2)
- Elevators are already heavily computer controlled. I expect controls that are more advanced.
- Laptops for plans (3)
- Digital survey equipment
- Microsoft Windows
- More advanced software
- More blueprints on computer
- More estimating and supply ordering online involvement
- New HVAC program Duct coil technology
- None—I am almost computer illiterate/None (4)
- Don't know (6)
- PDA (3)
- Programmable logic controls (3)
- Totally go wireless, emails, fax

| | |
|---|---|
| Have you participated in any kind of training delivered through computers or telecommunications (e.g. e-learning)? | ○ Yes<br>○ No |



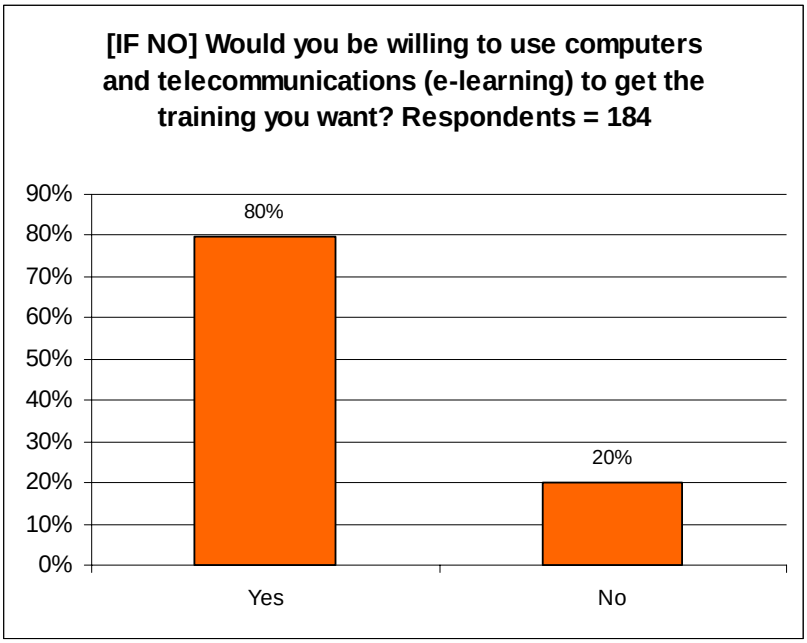
Of 201 respondents to this question, most (81%) indicated they had not participated in any kind of training delivered through computers or telecommunications. The high proportion that has not participated in e-learning is not surprising, given the structure of the skills development in the industry, which is largely hands on, on-the-job, and class based.

| | |
|---|---|
| [IF YES] Please list the three most recent courses taken and the kind of equipment used (e.g. project budgeting via a home computer)? ***[please list]*** | _____<br>_____<br>_____ |

Eighteen respondents offered comment as to the courses they had taken and the software used. These comments included:

- Basic computer introduction
- Communications (Trade School)
- Computer based safety training
- CS TS (2)
- Information technology network administration
- Structured cable
- WHIMIS (6)/Safety (3)
- AUTOCAD

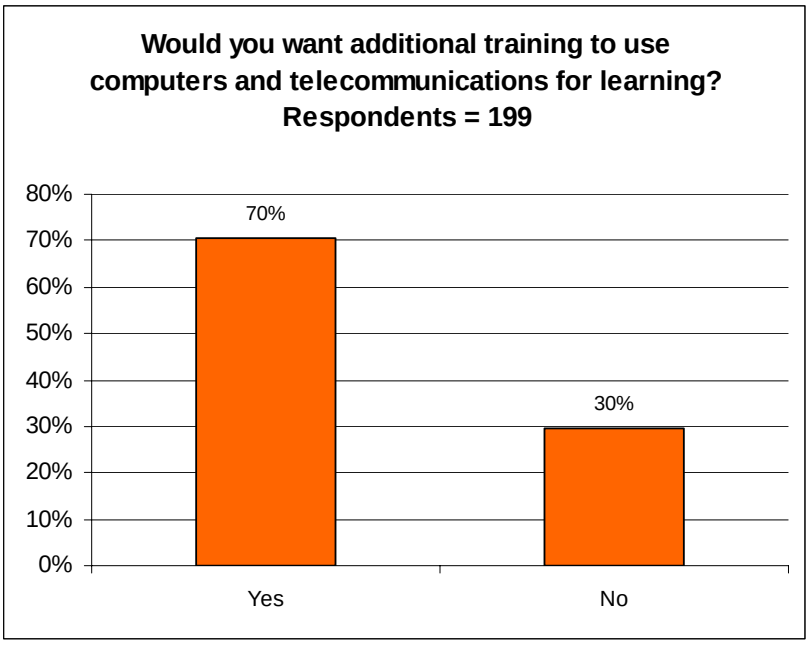
| | |
|---|---|
| [IF NO] Would you be willing to use computers and telecommunications (e-learning) to get the training you want? | ○ Yes<br>○ No |




Of the 184 respondents to this question, a strong majority (80%) indicated willingness to use computers and e-learning to get the training they want.

Taken in combination, the results of this question and the previous one show that just over 84% of respondents had participated in e-learning or were willing to use computers and telecommunications to get training. This result indicates that a broad cross-section, not just the younger members, of the labour force is ready, or willing to get ready, for e-learning.

| | |
|---|---|
| Would you want additional training to use computers and telecommunications for learning? | ○ Yes<br>○ No |




Most of the 199 respondents to this question (70%) indicated they would want additional training to use computers and telecommunications for e-learning.

#### 3.5.1.1. WORKER SURVEY CONCLUSION

Workers are:

- Very likely to have had some exposure to IT;
  - However, they are, for the most part, novices or below at using computers;
- Very likely to have Internet access in their homes;
- Anticipating that IT will remain a part, or become an increasing part, of the sector;
- Not likely to have participated in e-learning but very likely to be willing to do so; and
- Very likely to be willing to take computer training necessary to allow them to participate in e-learning.

### 3.5.2. FROM THE EMPLOYER SURVEY

The employer survey provided an opportunity to ask 15 employers four open ended questions on their perceptions of IT. The data are current as of October 27, 2006. The table below summarises the responses.

| **What new information technologies will be needed by the industry over the next several years? (e.g., BlackBerrys, palm pilot, handheld computers, new software]?** |
|---|
| • None [no new technology]<br>• New technology associated with the gas industry (Gas technology)<br>• [There will] not be a need [for technology] in our industry. The work to be done is manual labour. It is a requirement to be able to read and understand rebar placing drawings and converse with others in regards to work related problems.<br>• [There will be a need for] new software to keep more efficient—Microsoft Project, etc. [There will be a need for] BlackBerrys for communicating, etc.<br>• [we will] not [need] a lot — cell phones and faxes<br>• I imagine at some point everyone will need to know how to use computer design and modeling, for example<br>• [The technology need is] closer to the front than it is to the backend—cell phones and have computers and have faxes cell phones—e-mail is used for communications—we try to avoid travel back and forth to the office |
| **What specific information technology based activities and responsibilities are emerging within the industry (e.g., voice and data communications with home office, project management, cost estimating)?** |
| • None/Don't know (2)<br>• All of the above [those items listed in the question] for a more efficient workplace<br>• Modeling software, software for the machine shop, shot models—we need to keep it in front-end |
| **What are the baseline competencies for information technology in the trades in your organization?** |
| • Don't know/not sure.<br>• Personal exposure/community college<br>• Cell phones for 24/7 communication high speed internet.<br>• [Baseline IT skills] are not applicable<br>• Only restricted to IT as a resource to produce cost information... [There is] IT in other regions but not here...<br>• We do not look for any [Baseline IT skills/competency].<br>• We'll look for this at the start—but it is more of a natural outcome [the industry will increase IT usage over time as younger workers who have this skill are absorbed into the sector] |

| **What will these baseline IT competencies look like over the next several years?** |
|---|
| • Don't know/Not sure<br>• Personal exposure/community college<br>• [IT will be] faster, higher tech, etc.<br>• Pyramid building … [but] not applicable—technology has been maintained.<br>• IT will come and it will be the norm [in the trades]—[workers] use [computers] at home now anyway. |

#### 3.5.2.1. EMPLOYER SURVEY CONCLUSION

Employers generally have a limited view of the technological innovations that ICT makes possible. They tended to focus on current practices in relation to communications options (cell phone, fax, etc.) in the field. Most employers will not look for ICT competencies in their industry workers and most do not expect that this will become a requirement. Based on the survey and personal interview results, we find some employers who, in contrast to the norm, are leaders in ICT application. It appears the prevailing sentiment is "IT will come and it will be the norm" if through no other means than the natural increase in new entrants with ICT skills.

### 3.5.3. FROM THE UNION BUSINESS MANAGER SURVEY

The survey of union business managers used three open ended questions to collect perceptions of IT in the ICI construction industry. The data, provided in the ***Table, following,*** are current as of October 27, 2006.

| **What new information technologies will be needed by the industry over the next several years? (e.g., BlackBerrys, handheld computers, new software)** |
|---|
| • Do not see the need [for new information technology] to any great degree.<br>• Common sense—will see computers in schooling for trade. [We] will see IT such as cell phones, voice commands—[overall] improved technology.<br>• [Don't believe there is a significant need]—fax machines<br>• [Project] supervision will need IT access to [connect] office/inventory/communications—linking to wholesalers and distributors.<br>• The industry is using IT now but not so much here [in Nova Scotia]—this is more for bigger centres.<br>• [We will see] AutoCAD training, supervision, welding of exotic materials, estimated and takeoff training, new software.<br>• Foremen are going to be using a high-tech [IT] more so than the worker but more upgrading and computer-based activities will be associated with the ICI trades [overall].<br>• There is a little [IT] now [but there will not be much more]—program logic control—start-ups—the twist is the PLCs (programmable logic controller) and walkie-talkies.<br>• IT will be with the [workers] in the crew who grew up with IT. I don't see a need [for IT] in general but IT would be [a useful skill] on some job reports… but if there is a need [getting IT] won't be an issue. |

| **What specific information technology based activities and responsibilities are emerging within the industry (e.g., voice and data communications with home office, project management, cost estimating). [please explain]** |
|---|
| • [Those in] project Management—on site foreman—shop persons.<br>• Don't know/note sure.<br>• Site levelling tools.<br>• [IT services are] normally performed at the management level within the company<br>• [We will see more] Laptops—in process controls—energy management etc. timesheets, etc.<br>• [IT based responsibilities are emerging in] hazardous waste—you should talk to our training director [#######].<br>• Functions in payroll hour reporting, cost control, material procurement, estimating in takeoffs, drawing and specification transfers.<br>• Planning is the latest [IT based activity] available online.<br>• Not really<br>• The younger crowd all will have enough IT |
| **What are the baseline competencies for information technology in the trades you work with now? What will they be over the next several years?** |
| • [There are none] really, timesheets are manual and send via fax<br>• Younger people will have the skills anyway—don't know if we need to burden them with making this a requirement [of their current training programs]<br>• We don't look for any<br>• [It would be a] bonus if they [have IT skills]—our main requirement is can you write? [There is] no particular market advantage [to a trades person with IT skills]...We have [computer] programmers [in our midst], but it is not an asset to their construction work.<br>• We don't look for IT—it is good if they have IT—and [IT] may be a question the future...[something we may look for in our workers]<br>• [There are some] contractor specific programs—AutoCAD—that might require IT<br>• IT is not a requirement and if an employer looking is for a foreman and one has AutoCAD capabilities and one does not, the one with an AutoCAD capacity may be preferred.<br>• Apprentices now have IT but there's not a lot of opportunity to bring in journeymen<br>• Some people will be employed for IT skills but not [our] workers—those that are under 25 can use IT anyway |

#### 3.5.3.1. UNION BUSINESS MANAGER SURVEY CONCLUSION

The typical union manager's view of IT is similar to an employer's. In general, IT is seen as an end to which the industry is naturally progressing, but at the moment, industry workers are not typically expected to have IT skills and union managers are not receiving requests from employers for industry workers with IT related skills. The view of IT at the job site is limited to more obvious and immediate benefits of information management in areas such as time-sheets and other paper based activities. As one union manager put it, *we have programmers working in the field and this capability provides no particular advantage.*

The consultants conclude that workers are not likely to drive IT but rather general contractors and/or customers whose service requirements are such that contractors are pushed to use IT to improve their service offerings.

### 3.6. SYNTHESIS: A PROFILE OF IT IN THE ICI SECTOR

The following points provide a profile of IT in Nova Scotia's ICI construction sector.

- Employers are interested in how IT can bring about efficiencies—e.g., the capacity of IT to provide job specifications on the job site through mobile communications and laptops is already an obvious benefit among early IT adopters in the field.

**Recommendation**:

**Develop and Deliver Best Practice Seminars for All Stakeholders in ICI Construction.** The Sector Council should work at communicating the benefits of information technology to the ICI trades through a comprehensive look at the benefits and costs on a firm level basis. One delivery option is to have companies at a local and regional level speak to the industry about their use of IT and what benefits they have realised. Alternatively, the NSCSC–ICI could collect and present local case studies of IT users to demonstrate its benefits to peers in non-competitive relationships (with assurance of confidentiality regarding proprietary information).

Interviewees also asked for:

- "Lessons learned" including the "downside" of implementing IT solutions (e.g., Does IT invite "micromanagement" by agents not familiar with the practicalities of the job site?).
- Access to demonstrations of IT solutions specific to the construction sector and research findings from the CTCA (by remote video and/or events conducted in Nova Scotia).

While employers of all sizes and stripes should be encouraged, we recommend special encouragement of SMEs because they have more limited resources than large firms to identify IT technologies and assess their value to their firms.

- Employers and unions know that more IT is coming, but do not see skills upgrading or hiring as a pressing need.
- Among early adopters leading the way in IT usage, some skill needs in specific niches are still unmet. For example, engineering and design firms have some need for more advanced CAD drafters.
- When employers are seeking IT skills, they generally look for basic skill sets—ability to use e-mail and send in time sheets, for example. They are interested in having foremen use at least basic IT skills to manage and report data.
- The overriding need is to optimize the tradesperson's productivity, leaving job administration and IT to the foreman/supervisor.
- Among unions, business managers do not typically require or seek IT skills. For example, they do not see a time where a framer is going to use IT, but they appreciate the evolution of the younger generation coming in with IT skills in any case. They believe there is a level of work where the craft or tradesperson needs to focus entirely on the manual effort and not be distracted by looking at a laptop screen or pressing buttons on a BlackBerry.

  There are some exceptions, such as in mechanical trades, where skills in digital controls and instrumentation require knowledge of digital technology and IT in general.

- Other stakeholders have some views that contrast with the unions'. The head of electrical trades at NSCC and the international representative for sheet metal workers recognized that knowledge of multiple trades is becoming more necessary as the construction sector produces more "smart" buildings through IT. IT will help tradespeople anticipate problems on site and respond on a timely basis during construction and ongoing operation and maintenance.

  To other industry stakeholders[22]: the scale of the project influences the application of IT. The larger the project, the more likely the project will be managed using ICT, involving the general contractor and all or some of the sub-trades sharing project related data through an extranet. Large projects are also more likely involve owners who are more technologically sophisticated. Research shows the use of ICT is demanded by clients so that:
  - They are kept up-to-date on project progress; and
  - The project is run more smoothly with less disruption for existing tenants working in the facility.

### 3.6.1. BARRIERS AND OBSTACLES TO THE ADOPTION OF IT

A minority of employers and IT stakeholders believe that reluctance to adopt IT at all levels of the industry will work itself out over time, while others believe something needs to be done, particularly at the foreman/supervisor level, or competitiveness will suffer.

Adoption of IT will require a cultural shift. The construction industry's experience with the adoption of safety practices provides an instructive example. Today the industry has a good safety culture. However, it took a good deal of effort to convince the industry that using safety devices was important—thinking needed to shift to be able to accept that using safety devices and practices was a sign of good judgment rather than of fear, and that the personal and financial benefits to individuals and companies outweigh the costs.

### 3.6.2. CONFIDENTIALITY

Section 2.3 describes the technical, legal and trust matters that are slowing the integration of IT across companies and project stakeholders. The resistance has much to do with concerns about what information is used and with whom it is shared, even though having a common platform for integrating job specifications and change orders is appealing to many contractors and suppliers. For example, a platform that makes available workloads and schedules is more of an issue for suppliers.

### 3.6.3. BARRIERS ON THE JOB SITE

There are different issues on the job site.

There is some general reluctance, particularly among older workers, to take up IT because it is unfamiliar. Workers who are unfamiliar with IT may feel that it would be a challenge to learn and/or a distraction from getting their work done. Younger workers are generally computer literate and they can and do help others with IT related tasks.

Concerns for usability equal the barrier presented by lack of familiarity with IT processes. These concerns include:

- Noise and other factors on the job site render some communications technology almost useless.

[22] Doug Colwell, Construction Technology Centre Atlantic; Carol MacCulloch, Construction Association of Nova Scotia.

- Mobile technologies such as BlackBerrys have screens that are far too small to display blueprints and drawings.
- Internet connections at many job sites are unstable or nonexistent.
- Under rugged conditions, IT equipment must be able to withstand dust, moisture, and physical shocks.
- No technology integrates all needs (data transfer and good quality voice, for example). Consequently, different devices are needed for related tasks. Are more multi-function technologies coming?

Manufacturers have not adequately tested their generic mobile technologies in construction environments or designed versions that are adequate to the conditions and needs on many construction job sites.[23] These problems tend to reinforce any existing reluctance to use IT on the job site.

However, the precedent exists for manufacturers to address usability issues with trades-specific technologies, such as laser and sensor guided tools.

### 3.6.4. CURRENT IT SKILLS REQUIREMENTS

Within the business offices of the ICI construction sector, IT skill requirements are the same as they are for most businesses: data management, communications, project management, accounting, word processing, etc. In general, employers did not report an IT skills or labour shortage.

Within the larger companies, software licences usually include continuous upgrades, and employees are expected to keep up. Within smaller companies, upgrades may be less frequent and some newer features (voice-to-text software, voice over Internet protocol [VoIP], etc.) are being more slowly adopted. As in most industries, there are early adopters who take the initiative and are actively interested in IT skills.

Competency with industry-specific software packages, such as construction bidding and estimating applications, is in demand and several employers reported they were interested in increasing their capabilities. They were primarily focussed on training (either in house or through contract trainers) rather than hiring people with these skills.

Employers reported little interest in bringing IT to tradespeople and saw no pressing IT skill requirements.

A number of employers did report that foremen's IT capabilities were questionable but their approaches to dealing with varying IT capabilities differed. Some reported that there was no need to "push" IT until younger workers moved up the ladder. Others reported that existing capabilities at the foreman level are inadequate, given the competitiveness of the industry and the productivity gains that larger companies are reporting from IT adoption. One of the main obstacles reported to upgrading foremen's skills was finding time to dedicate to training.

### 3.6.5. ANTICIPATED IT SKILLS

Over the past five years, a number of industry-specific software packages have come on stream and some companies in Atlantic Canada have implemented packages such as:

[23] Despite the sentiments echoed here, other sectors such as emergency services and military applications do offer examples of "field tested technology". Computers made for these sectors are considerably more costly than more traditional options. PocketCop, Getac Ruggedized notebooks and tablets, Panasonic Toughbooks, Opus Solutions, GoBook, and Itronix have developed "rugged" mobile computing solutions. We suspect that the construction industry, in general, has not yet explored how other sectors address IT requirements.

- TeamBuilder (by e-Builder);
- Citadon; and
- Buzzsaw (by Autocad) (14 projects are using this technology).

Software such as TeamBuilder offers clients complete access to project information, providing web cams, central document repositories and project team workflow integrated with external e-mail systems that allow business partners to work together on a common platform.

### 3.6.6. GAP ANALYSIS

The primary IT skills gap that our research uncovered focused on foremen and supervisors. The advantage of bringing IT into project management, materials inventory, scheduling and related administrative functions is clear. Both larger and smaller firms are already implementing IT to address these functions on large-scale projects.

**Recommendation:**

**Develop an IT Implementation Planning Model**

The NSCSC–ICI and its partner companies should develop an IT Implementation Planning Model. The planning process would begin with commitment by participating firms to a strategy of leveraging IT for productivity improvement and building that into company business plans. Once IT goals and objectives are in place, a model for an IT implementation Plan would include:

1. IT Needs Assessment (a step-by-step approach to guide a business in evaluating a company's IT needs as they relate to management of industry workers and the link back to project management);
2. Skills Gap Analysis;
3. Training and Recruitment Solutions;
4. Change Management;
5. Performance Evaluation; and
6. Learning Support.[24]

The model should include processes that continually survey emerging ICT approaches and tools. The ICI sector and its respective stakeholder organisations should engage in a continuous improvement program to incorporate new and better technologies and practices into their trades training and management activities. This is a large task that may require assistance from external ICT and business process experts.

The implementation model, once developed, should be consistently evaluated and improved to ensure that it continues to meet the needs of the industry and remains effective.

### 3.6.7. IT-BASED OCCUPATIONS

We did not discover IT-based occupations in ICI construction *per se*, but IT use is increasing among:

- Estimators,
- Project managers,
- The project development team (architects, engineers, contractors),

[24] OPELS (Online Performance Evaluation and Learning Support) www.opels.ca, accomplishes performance evaluation and learning support at low cost. It was developed by the Nova Scotia Technology Training Council and is currently maintained by the national Software Human Resource Council. OPELS is a web-hosted application that provides a secure, online feedback/reporting system to track the impact of training on productivity and performance.

- Foremen/supervisors (scheduling, inventories, timesheets, voice communications, etc.), and
- Specific trades, particularly the mechanical and electrical trades that are beginning to rely on digital electronics, sensors, monitors, etc. in their tools.

### 3.6.8. IT SKILLS AND TRANSITION

Transitions are taking place at multiple levels and different groups will need different transition plans. The worker surveys, as well as comments from employers and business managers, reflect a sense that, among workers, there is a willingness and interest on adopting ICT in their work environment. Among employers and union managers, there appears to be recognition that the workforce is moving in this direction. Some make the point that this is a natural transition, while others perceive an advantage in accelerating this transition to more rapidly advance efficiency and productivity gains.

### 3.6.9. FUTURE OF IT SKILLS REQUIREMENTS

In 2004, the **Center for Integrated Facility Engineering** (CIFE) issued *The Scope and Role of Information Technology in Construction*, a report by Martin Fischer and John Kunz of Stanford University. The study focused "on the role and scope of IT in support of multidisciplinary planning and coordination of construction projects." The study contributes to a growing body of literature aimed at finding a better way to integrate IT into project design and construction processes. It assessed a number of case studies of IT application and defined three levels of IT usage that they describe as POP (product, organization, process):[25]

- **Visual 3D and 4D Models** (Product)—These are imaging and scheduling (timing is the fourth dimension) applications that relate project design to all stakeholders using commercially available software. The authors point out that:
  - This activity is typically accounted in a project budget as part of the design fees typically funded from project budgets.
  - It is sometimes used to differentiate firms from others—e.g., better visualization can help win work. They also foresee that differentiation based on visualization will diminish as it becomes the standard.
- **Building Information Models** (Organization)—These models are particularly relevant to our study because they "support the exchange of data between software tools to reduce analysis cycle times and data input and transfer errors." Associated costs are borne by administration and not tied to a particular project. Accordingly, these systems have greater upfront costs with no direct offsetting revenue. Benefits come in the form of immediately realized efficiencies.
- **Knowledge-based Models** (Process)—These models assist in the effective use of the information that is collected. If monitored, kept current and analysed effectively, knowledge-based models support firms and workers in repeating winning approaches in future bidding and job-site situations. As with the building information models, knowledge-based models incur a direct cost whose benefits lie in potential increased tenders won and improved job-site efficiency.

The firm-level adoption of IT described by Fischer and Kunz across these three levels is observable in Nova Scotia's ICI sector. Most firms we spoke with placed a higher value on their CAD operations and are generally slower to provide IT at the worker level in the production chain. One of the barriers is direct cost without an immediate improvement in direct revenue.

[25] Fischer and Kunz, *The Scope and Role of Information Technology in Construction*, Center For Integrated Facility Engineering; CIFE Technical Report #156, February 2004, p. 16.

Fischer and Kunz describe this barrier as owners (CFOs) assessing "costs, not value of projects" and industry culture and methods that seek to "minimize cost, not maximize value." They also point out that IT is still in its developmental phase in construction, and therefore lacks "well-established metrics that would allow us to articulate the improvements" and challenges around integration.

They conclude: [26]

> This discussion of the role and scope of IT in construction is, of course, situated in the current industrial context with projects becoming increasingly complex technically, environmentally, socially, legally, and culturally, with increasing economic pressures on facility owners and therefore on their projects, and with shorter and shorter timelines. Putting these challenges into the [models] framework:
>
> - The high-performance product requirements create more interdependence between the product's subsystems;
> - The prevalent fast-track concurrent process propagates changes across subsystems in real time (this exacerbates product subsystem interdependence); and
> - Organizations must process a larger number of changes, exceptions, decisions in less time.
>
> Hence, an organization's capacity to process information becomes the limiting factor in determining schedule, cost, and quality performance. Therefore, IT needs to support an organization's capacity to model, analyze, simulate, and predict a project's performance as outlined in this paper.

The CTCA, through its affiliation with the Interactive Collaboration Laboratory (ICL) at UNB, offers many of the advanced software applications used by early adopters and IT leaders in Atlantic Canada. The software applications available in the lab are:[27]

- **AutoCAD Building Systems/Architectural Desktop 2006**—2D/3D CAD;
- **Primavera Project Planner-Enterprise (P3e)**—Scheduling;
- **Microsoft Project**—Scheduling;
- **Timberline**—Estimating;
- **CommonPoint Project 4D**—4D CAD (Scheduling/CAD Integrator);
- **Sketch-Up** (with ArcGIS Plugin)—3D Sketching Software;
- **ArcGIS 9.1**—Geographic Information System;
- **Google Earth—**Satellite Imaging Software;
- **Bridgit—**Screen Sharing/Conferencing Application; and
- **SMART Ideas—**Mindmap/Brainstorming Application.

The future of IT skill requirements goes beyond these applications. ICL employs collaboration technology.[28] For example, "SMART technology uses rear-projected screens that project a computer's display onto a large screen. Built into the screen's corners are digital cameras that triangulate where you are pointing on the screen when a camera's view plane is broken. You can

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[26] Ibid.

[27] Readers of this report in electronic format may hold down the CTRL key and click directly on the underlined text to go the web site explaining the application.

[28] http://ctca.unb.ca/CTCA/webfiles/ICL.htm

write on the board with digital ink over any application and erase it as easy as using a chalkboard eraser. When a user picks up a pen or the eraser, the pen tray automatically detects which tool was selected."

As described on the CTCA/ICL web site, the benefits of this technology for collaboration in the ICI construction sector include:

- **Communicating information** in multiple formats simultaneously to reduce misunderstanding and misinterpretation within a group of participants. This information can easily be interacted with by use of the board's touch-screen technology. Wireless keyboards and slates allow users to stay at their seats while interacting with the boards.
- **Allowing remote collaboration** using conferencing software. Companies can communicate with employees in different offices. For example, in combination with the SMART boards, a CAD technician can bring up a drawing on his/her computer, conference with an engineer in another city, and share the desktop display via the conference connection; the engineer can use the SMART pens to mark up the drawing in real time, capturing the mark-ups electronically. The mark-ups can be saved directly into the drawing and appear as their own redline layer which can be turned on or off at any time. Group feedback can be incorporated immediately, saving time and reducing occurrences of misunderstanding or miscommunication as changes are made "on-the-fly", because these changes are made in full view of all stakeholders present.
- **Capturing and saving notes**—The SMART technology allows users to capture notes in "digital ink" that can then be saved and e-mailed to the group instantly. It also allows users to record everything that is displayed on the board. Data captured can be distributed electronically and stored.

This collaboration technology has been integrated with Microsoft Office applications such as PowerPoint, Word and Excel.

At the inter-company and intra-company level, the future of IT is in real-time collaboration with remote voice and data communication capabilities.

At the job-site level, the future of IT includes[29]:

- **Wireless applications**—For remote monitoring and control of equipment, inventory and supply, geo-location of people and objects and voice gateways.
- **New methods of human interaction**—With mobile computing devices. Current methods of interaction with wired desktop devices, such as the mouse, keyboard or even the touch screen cannot be readily adapted to environments that require frequent and easy mobility. How will people interact with information processing devices in these settings? Investigations include using head and hand gestures as well as audio interaction. The research is exciting and challenging, the more so because the outcome is still far from clear.
- **Wireless handheld units**—These include "CICP", the culvert inspection costing platform; "RASCAL", the risk assessment survey for assessment and containment of lead; and "PARCEL", the property assessment-reporting tool to centralize and evaluate liability. The three systems use wireless handheld devices to collect and retain data for subsequent transfer to a web site or another software package.

[29] based on INFORMATION MOBILITY 2004, Fredericton NB, http://ctca.unb.ca/CTCA/webfiles/online%20files/intro-mobility.htm

### 3.6.10. IT AND RETAINING THE WORKFORCE

The interviewees in our research did not support the idea that the industry can retain the existing workforce by promoting IT skills. In general, older workers are not eager to take on radically new ways of working involving skill sets based on digital technology. There are, however, exceptions to the generalization, and employers should be readily able to identify older or displaced workers who are interested in extending their careers as estimators, administrators or specialists in niche sub-trades. The identification of older workers willing to learn IT skills should be an element in the NSCSC–ICI's strategic IT Implementation Planning Model (Step 3 of the Implementation Planning Model as it relates to Training and Recruitment—page 34 above).

Although demographic studies predict skills and labour shortages, especially in certain trades, Nova Scotia ICI construction employers are not generally reporting a shortage of IT skills. They report concerns about skill and labour shortages in many traditional trades and they are focused on improving the flow of apprentices through the pipeline. In Nova Scotia, there has been a 13 percent increase in the construction work force from 2001 to 2005 while nationally there has been a 24 percent increase.[30] Indications are that part of the lower rate of growth in a construction labour force is due to Nova Scotia's declining demographics. Implementing IT is a strategy to increase productivity and at least partially offset demographic changes. In that sense, increasing IT skills is a pillar in building a strong ICI construction sector workforce.

[30] 2005 Nova Scotia Labour Force Review.

## 4. SUMMARY OF RECOMMENDATIONS AND ACTION PLAN

The following section describes our recommendations, including responsibilities for implementation, timing, estimated costs and a narrative discussion of the expected benefits.

Each recommendation has a specific function or role in influencing how the construction sector operates with respect to information management. Whether at the beginning (trade schools, etc.), ongoing learning (trade unions, seminars, etc.) or at the individual role level (foreman, supervisor, etc.), each recommendation is presented to work as a "standalone" initiative with a common objective of accelerating the update of IT within the sector. Nevertheless, they are presented as a series of interventions that, if carried out in the following sequence, would achieve greater influence than they would if implemented as individual efforts in some other order. Thus, the recommendations can be taken individually or in combination to reflect a systemic approach to managing change.

### 4.1. RECOMMENDATION # 1: CONDUCT RESEARCH ON FOREMEN/SUPERVISOR FUNCTIONAL INFORMATION NEEDS

Given the close relationship between the roles of the foreman and job supervisor, a number of the functional needs identified (and any resulting technical solutions) will be interdependent and interconnected, e.g., working with a common database and two-way multimedia systems. Conversely, some information needs will be unique to each role.

The suitability of any technology must be assessed in the context and physical environment of its intended use. The processes and functional needs for information must be fully assessed before recommending specific equipment or IT systems. Therefore, we recommended an examination of the role(s) of the foreman/supervisor to find the optimal intersection between user needs (practical requirements) and what technology can enable.

**Organization to Implement:** The implementation of this recommendation would be managed and led by the NSCSC-ICI, with support of its industry partners.

This research would lead to a set of implementation steps designed to:

- identify the functional needs of the foremen/site managers;
- define the information needs in relation to the job site and the interrelation with their immediate company and other construction partners;
- specify the particular information management service that is needed;
- identify the current mode of operation and contrast it with ICT enabled options; and
- identify specific applications that can be piloted or immediately deployed.

The research could be a standalone project or be conducted in conjunction with a firm-level IT Implementation Planning Model (Recommendation 4). A pilot project (as we outline below) would also involve participation by other firms/parties.

**Timing:** Research into the functional needs of foremen and job supervisors should begin in the near term, particularly because this target area (foremen and supervisors) is likely the best place to optimize information management in the field (job site).

**Expected Cost Range:**[31] Developing a profile of the functional information needs of foremen/job supervisors would cost in the range of **$45,000 to $50,000.** This would vary depending on the depth of analysis, array of occupational categories being explored and extent of a pilot to implement a shift of information management to an ICT based system.

| Estimated Budget | |
|---|---|
| Professional fees (design, interviews, analysis, presentation, revisions) | $40,000 |
| Support staff and materials | 3,000 |
| Travel and communications | 3,000 |
| **Grand Total** | **$46,000** |

**Expected Benefits:** The benefits forthcoming from a better understanding of the functional information needs of foreman/job supervisors, and the firms/project proponents they represent would include:

- Better understanding of common job-site information needs as well as specific information management needs that may be unique to particular occupations;
- Technological solutions created to provide solutions that suit the needs;
- Better understanding of the benefits and costs associated with present operating modes verses ICT enabled modes (i.e., availability of a technology does not necessarily mean its adoption is an improvement over current practices.); and
- Better HR planning and skills matching with respect to the role of IT at a job site. (Demands may reach the point where it is not a supervisor who manages information flow but an assistant whose skill sets are more closely aligned with the role of ICT in support of the supervisor's trades management skills.)

### 4.2. RECOMMENDATION # 2: INTRODUCE FOREMEN/SUPERVISORS TO THE BENEFITS OF ICT

Foremen/supervisors and selected tradespeople need education and training in the benefits and requirements of IT because IT has direct pertinence to the changing infrastructure and tools in their industry. Presentations, seminars and workshops for foremen/supervisors must "personalize the return on investment" so that participants see clearly how this will benefit them on a routine basis.

**Organization to Implement:** This should be an industry-driven initiative and could involve a partnership with the CTCA in Fredericton and/or the NSCC. The NSCSC-ICI would develop the work plan associated with implementation of this task in consultation with other stakeholders.

**Timing:** This should be implemented as soon as possible, since foremen and supervisors are regarded as the first and best opportunity to implement job-site IT solutions.

[31] Estimated project costs are based on our assessment of the scope of work that may be necessary to address recommendation. Professional fees are the equivalent of consulting fees (if the project is outsourced) or staff time (fully burdened if the proponent were to internalize resources necessary to fulfill the recommendation internally). We have not included in the budget any amount of resources that might be necessary for the project management function (i.e., the time and resources it may take for the NSCSC-ICI to manage these projects).

**Expected Cost Range:** From similar rollouts in other jurisdictions, we estimate that the education and training could be effectively completed for about **$30,000.** This would include the preparation, setup and conduct of a single training session for 30 to 40 participants.

| Estimated Budget | |
|---|---|
| Professional fees (design, interviews, analysis, presentation, revisions) | $25,000 |
| Support staff and materials | 3,000 |
| Travel and communications | 2,000 |
| Single Session | 2,000 |
| **Grand Total** | **$32,000** |

Once developed, a single session would cost in the range of $2,000 to $3,000, depending on venue, materials, and the number of participants.

**Expected Benefits:**

- Greater awareness of applied benefits and opportunities to employ IT;
- More comfort among foremen in implementing IT solutions; and
- Greater capacity within the sector to adapt to increasing IT related demands.

### 4.3. RECOMMENDATION # 3: DEVELOP AND DELIVER FOLLOW-UP MODULES FOR FOREMEN/SUPERVISORS

The NSCSC–ICI should arrange access to basic IT training sessions for foremen in tasks that they perform on a regular basis. Scheduling should be arranged during off-season or slow periods for ICI construction. This may be done with the NSCC or other training providers, depending on costs, timing, delivery method options and quality considerations.

**Organization to Implement:** The NSCSC-ICI would lead the implementation.

**Timing:** Immediate or following development and delivery of the introductory education and training session.

**Expected Cost Range:** The expected cost would be on the order of **$22,000** (including one session) to develop and an additional **$2,000** to **$3,000** per session.

| Estimated Budget | |
|---|---|
| Professional fees (design, interviews, analysis, presentation, revisions) | $15,000 |
| Support staff and materials | 3,000 |
| Travel and communications | 2,000 |
| Single Session | 2,000 |
| **Grand Total** | **$22,000** |

Once developed, a single session would cost in the range of $2,000 to $3,000, depending on venue, materials, and the number of participants.

**Expected Benefits:**

- Greater awareness of applied benefits and opportunities to employ IT;
- More comfort among foremen in implementing IT solutions;
- Support throughout learning process, and, therefore, greater success; and
- Greater capacity within the sector to adapt to increasing IT related demands.

### 4.4. RECOMMENDATION # 4: DEVELOP IT IMPLEMENTATION PLANNING MODEL

The NSCSC–ICI and its partner companies should develop an IT Implementation Planning Model. The process would begin with commitment by a company or group of companies to build a strategy to leverage IT for productivity improvement into their business plans. Once IT goals and objectives are in place, a model for an IT implementation Plan would be developed; it would include the following elements:

1. IT Needs Assessment (a step-by-step approach to guide a business in evaluating their company's IT needs as they relate to the field worker management and the link back to project management);
2. Skills Gap Analysis;
3. Training and Recruitment Solutions;
4. Change Management;
5. Performance Evaluation; and
6. Learning Support.

The implementation model should be consistently evaluated and improved to ensure that it continues to meet the needs of the industry and remains effective.

The model should be able to distinguish between the needs of different sized firms. For example, the possibility of providing some shared systems and services for smaller businesses, as well as resolving ownership and operation issues, should be considered during research and development of the model.

A guide for a self-assessment of needs and skills gaps would be developed. The NSCSC-ICI or its designate would be available to support the process through advice and counselling throughout implementation.

Industry participants who have developed their own IT plan/systems should be consulted during development of the model "kit" for the benefit of their applied experience within the Nova Scotia context.

The implementation model is the "theory" for adopting change; in terms of its implementation, it becomes an ongoing change management process focused on how new IT tools can be used, and new processes adopted from leveraging IT, so that productivity and service can improve. This is about helping firms internalizing that learning process. There is also a "coupling" of this recommendation (4) with recommendation 5, as the Sector Council can support individual organizations' understanding through best practices, which are then internalized into organizational operations.

**Organization to Implement:** Implementation of this recommendation would be managed and led by the NSCSC-ICI and their designated agents.

The NSCSC-ICI is well placed to develop a tool kit for the industry, with support of its industry partners. The IT Implementation Planning Model would provide a framework for all firms, but small and medium sized firms would probably derive the greatest benefit, since larger firms are likely to have a greater capacity to absorb and internalize the development of an IT plan. Therefore, a partnership with employer representation will be important to successful development of the IT Implementation Planning Model. The partnership could include CANS, Merit Contractors, and other industry partners.

**Timing:** The IT Implementation Planning Model should be developed in the near term with a view to deployment in the spring of 2007.

**Expected Cost Range:** The development of this IT Implementation Planning Model would cost in the range of **$40,000**. The cost would also include the test application of the framework to an existing firm/organization.

| **Estimated Budget** | |
|---|---|
| Professional fees (design, interviews, analysis, presentation, revisions) | $35,000 |
| Support staff and materials | 3,000 |
| Travel and communications | 2,000 |
| **Grand Total** | **$40,000** |

**Expected Benefits:** The use of the IT Implementation Planning Model is expected to result in:

- Awareness and understanding of the benefits and costs of IT within the firm;
- Firm-level ownership of the self-assessment process and therefore the conclusions reached;
- More strategic thinking about ICT solutions that are right for the organization (based on need and means);
- Partnerships among organizations that require solutions but may need to combine resources to achieve the targeted solutions; and
- Strategic, long-term thinking about ICT.

The plan would help ensure that IT system designs, and training and support requirements, are based on an understanding of the ICI industry's business processes.

### 4.5. Recommendation # 5: Develop and Deliver Best Practice Seminars for All Stakeholders in ICI Construction.

The NSCSC-ICI has a role and several options for promoting information technology in the ICI industry. The Council should work to communicate the benefits of IT to the ICI trades based on a broad look at the firm-level benefits and costs. One option is to have existing companies at a local and regional level speak to the industry about their uses and benefits of IT. Similar sessions could be aimed at employers, business owners, and union managers.

To focus on awareness and education, the NSCSC–ICI should collect and present local case studies of IT users to demonstrate its benefits to peers (with assurance of confidentiality regarding proprietary information).

Interviewees also asked for:

- "Lessons learned" including the "downside" of implementing IT solutions (e.g., Does IT invite "micromanagement" by agents not familiar with the practicalities of the job site?);
- Access to demonstrations of IT solutions specific to the construction sector; and
- Information on research findings from the CTCA (by remote video and/or events conducted in Nova Scotia).

While all employers should be encouraged to raise their awareness of IT uses, we recommend special encouragement of SMEs, given their more limited resources to survey and identify cost-effective IT solutions. This effort could be combined with the implementation of Recommendations 3 and 4 to enhance the overall effort to raise awareness among the construction mangers and owners.

**Organization to Implement:** Industry partners, together with the NSCSC-ICI would lead the implementation.

Information sessions could be organized around existing NSCSC-ICI business or a dedicated one-day or half-day session. The Sector Council would take the lead in developing the key messages and delivery options, as well as coordinating the awareness campaign. (The IT Human Resource Council developed and delivered best practice seminars in 2003 and 2004 and webcast them live to four locations around the province via the NSCC interactive video system. Participation was interactive across the locations. This was done once for SMEs in IT and once for the Tourism Industry Sector. Both projects were well received by industry clients.)

**Timing:** This recommendation should be implemented immediately.

**Expected Cost Range:** The development of a Best Practices seminar is estimated at **$47,000**.

| **Estimated Budget** | |
|---|---|
| Professional fees | $40,000 |
| Support staff and materials | 5,000 |
| Travel and communications | 2,000 |
| **Grand Total** | **$47,000** |

**Expected Benefits:**

- An understanding of the role of ICT, trends in ICT, and the immediate and long term benefits of using IT to manage information in the construction sector; and
- Examples of personalized return on investment (ROI) for managers and supervisors.

### 4.6. RECOMMENDATION # 6: SOLICIT INDUSTRY SUPPORT FOR HANDS-ON LEARNING

The NSCSC-ICI could help attract resources and funding from the construction sector and ICT suppliers for more hands-on learning within the NSCC programs. The Electrical Federation of Canada has previously made donations; the Council could build on this precedent.

**Organization to Implement:**

**Timing:** This recommendation should be implemented on completion of the IT Implementation Model.

**Expected Cost Range:** Most costs will come as Sector Council staff time and administrative expenses.

**Expected Benefits:** The collection of the resources necessary to administer and implement IT recommendation.

### 4.7. RECOMMENDATION # 7: PARTNER WITH CTCA ON RESEARCH INITIATIVES

The NSCSC–ICI should invite manufacturer representatives to visit ICI job sites in Nova Scotia to conduct formative research and field test new versions of their ICT. Several employers interviewed appeared to be open to cooperation and perhaps partnerships with IT equipment manufacturers. The CTCA and the NRC IT branch could cosponsor research.

The NSCSC–ICI should also meet with the NRC IT branch and encourage research and reporting on IT solutions in the ICI construction sector at all levels: between companies, within companies and on job sites.

**Organization to Implement:** in the short term the NSCSC-ICI should schedule a meeting with the Director of the CTCA to discuss implementing this recommendation.

**Timing:** Timing for full implementation depends on the interest of IT leaders in the CSC**.**

**Expected Cost Range:** Most costs will come as Sector Council staff time and administrative expenses.

**Expected Benefits:**

- Improved usability and durability of ICT technologies on job sites; and
- New product design and development opportunities.

The construction industry can also adopt IT tools and practices from other sectors with similar functional structures, reporting requirements, project teaming requirements, etc. The benefit of this approach is that those practices have already been field tested in other sectors; the challenge will be to determine what IT tools or methodologies applied elsewhere are relevant and improvements over present operating modes and how to adapt them to the construction sector.

### 4.8. RECOMMENDATION # 8: ADVISE NSCC AND OTHER TRAINING PROVIDERS ON ICT RELATED CONTENT AND DELIVERY TO THE CONSTRUCTION SECTOR

As more firms develop IT implementation plans, the NSCSC–ICI should solicit their participation in discussions with the NSCC ICT program advisory and the NSCC construction trades committees. These committees should work together to ensure that sector needs will be met. Their advice to the NSCC should be shared with other training providers and unions that may set up their own ICT-intensive training.

We recommend that the NSCSC–ICI support the implementation of blended learning models (combining hands-on learning, e-learning, and technical support on the job). There is a longstanding successful precedent success for this in trades' apprenticeship programs.

**Organization to Implement:** Champions from with the NSCSC–ICI should be identified first. Then, along with the Association of Industry Sector Councils, the NSCSC–ICI would be in a good position to advocate for the inclusion of ICT related training as standard content at NSCC. Individual meetings will be necessary to discuss curriculum and delivery with other training providers.

**Timing:** This recommendation should be implemented in the near or medium term. It could be implemented on a standalone basis but would have greater penetration if done following Recommendations 8 and/or 9.

**Expected Cost Range:** Most costs will come as Sector Council staff time and administrative expenses.

**Expected Benefits:** The expected benefits will primarily comprise support of IT skills development among industry workers

### 4.9. CONCLUSION

The national Construction Sector Council's 2004 report, *The Impact of Technology in the Construction Labour Market*, summarized the adoption of innovation in general by saying, "Overall the industry is pretty conservative. Technology needs to prove itself before it will be adopted. Designers need to be convinced that they will not suffer any liability."

People who do not understand the costs and time expectations will hesitate. Encouraging adoption of technology is a change management issue that must deal with different risk thresholds and attitudes and skill sets that often differ by age groups. With respect to the adoption of innovations, people in construction are similar to those in other occupations and economic sectors—if IT brings value and efficiency to their day-to-day jobs they will be more likely to "buy into" it.

Barriers to IT usage must also be directly addressed. For some people, the barrier may be related to literacy issues and possible fear that their limitations will be exposed by a system that forces users to write. Emerging (and improving) voice-to-text software may bridge this gap, but in any case, IT will cause these issues to surface and plans must be in place to deal with them when they do. Others view IT with fear and seem to regard IT as being more complicated than it actually is.

Support for increased use of IT must also come from the industry. Are their peers using IT, and if so, how? What are the benefits? What are the usability issues on site? Stories of success and reward will provide incentive for foremen and managers. Companies may also choose to make IT a requirement, but they must lead, as well as follow, by example and experience.

Experience in other jurisdictions shows that frustration with the introduction of IT can build quickly. Therefore, employers may wish to start slowly with pilot projects involving small groups of workers, which provide a one-on-one chance to try IT using BlackBerrys, Trios, or other devices. Progress should be monitored by asking and answering questions such as:

- Are foremen/job supervisors really using it?
- Is it working?
- What information is being managed, and are foremen and job supervisors operating these devices with good user habits?
- Can the office interface with the information that is coming back?
- What is the benefit/cost?

While the individuals we interviewed may have considered the benefits of IT, they often did not see the full range of benefits. This is to be expected, because application of IT in the ICI sector is still quite new. Therefore, the interviews often included expanded discussions of the range of possibilities. In these cases, we added to our role as consultants in search of information the role of messenger of the potential of IT in the ICI industry.

Implementing the recommendations and adoption of IT within an organization will require champions. The NSCSC-ICI must carefully consider:

- Its role as a champion; and
- Who has the level of respect in the industry that enables them to take on the role of champion?

The role of champion does not necessarily fall to persons or organizations that can compel change. The role of champion requires leadership skills, particularly those that build trust and encourage willing, intelligent and dedicated adopters of change.

## Appendix A: Bibliography with Selected Annotation


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15. *Essential Skills Strategy for the Construction Industry*, Construction Sector Council (national), no date.
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18. Nova Scotia Community College School of Trades and Technology Graduates and Enrolment 2006
19. *Research in Construction: CTCA Report*, Construction Technology Centre Atlantic, 2005
20. *The Impact of Technology on the Construction Labour Market*, Construction Sector Council (national) 2004
21. Various short reports from the CTCA web site and the University of British Columbia Summer Project Report 2002
22. Youth Decision Survey Report, Nova Scotia Apprenticeship Board, 2004

## Appendix B: Interview Participants

1. Adrian Morrison, Black and MacDonald
2. Allan Stapleton, Construction Management Bureau Ltd.
3. Bernie Carr, Sheet Metal Workers International Association
4. Bob Dresch, VSL Canada Ltd.
5. Brian Stevens, Sheet Metal Workers International Association Local 409
6. Brian Tobin, International Brotherhood of Electrical Workers Local 1852
7. Carol McCullough Construction Association of Nova Scotia
8. Clayton Bartlett, Roclan Industries
9. Cliff Murphy, United Association of Journeyman & Apprentices of the Plumbing, Steamfitting & Pipefitting Industry of the United States & Canada Local 682
10. Colin Campbell, Brotherhood United of Carpenters & Joiners of America Local 1588
11. Cordell Cole, International Brotherhood of Electrical Workers Local 625
12. Dave Oulton, Marid Industries
13. Dave Pottier, Lead Structural Formwork
14. Don Chisholm, Tartan Drywall
15. Doug Holstead, Sayers and Associates
16. Doug Serroul, Labourers' International UNION of North America Local 1115
17. Frank Ross, FabcoAecon
18. Gordie MacNeil, Academic Chair for Electrical Technology Programs, NSCC
19. Jim Wilkie, AB Mechanical
20. John Furneaux, Rideau Construction Inc
21. Keith Driver, Easco Electric Limited
22. Kirk Himmelman, Himmelman Contractors
23. M. Patrick Gillin, Chair in Construction Engineering and Management, Assoc. Prof., Dept. of Civil Engineering, University of New Brunswick
24. Miguel Salgueiro, Omega Formworks
25. Mike MacDonald, Pro Insulate
26. Mike Marsh, Irving Equipment
27. Peter Greer, United Brotherhood of Carpenters & Joiners of America Local 83
28. Roddie MacLennan, International Association of Bridge, Structural & Ornamental Ironworkers Local 752
29. Roy Pennell, Markland Associates Ltd.
30. Stephen Graves, Mainland NS Building Trades Office/International Association of Heat and Frost Insulators and Asbestos Workers Local 116
31. Tim Swinamer, International Brotherhood of Electrical Workers Local 625
32. Tom Griffiths, International Brotherhood of Electrical Workers Local 625

## Appendix C: Interview Comments

Note: Interview comments have been reviewed to ensure that confidential information is not contained within the responses. Where this was the case, deletions are indicated by '###'.

| | |
|---|---|
| 1. | What are the current and anticipated IT skill requirements in your company? Are there gaps between current IT capabilities and the IT skills needed in your company (at job sites and in the home office)? If so, what are they? |
| | • I have been extremely disappointed with NSCC with respect to their CAD training. One NSCC teacher had offered the course but was teaching with no experience in the field. Moreover, I was not impressed with the students' work ethics or their attitudes. Teachers should be sent out on work programs find out more what is going on in the work place. We are looking to fill 18 stations. Recently I hired students out of NBCC and NLCC—five people. We need about twelve more. We need more drafting detailers on AutoCAD familiar with reinforced steel drawings. We have work for over 200 drafting detailers altogether. We need more certified programs.<br>• We currently have no problems with IT skills requirements.<br>• Estimating for the managers and drafting for the technologists are essentials. We more or less have what we need. In the field, there are not a lot of IT skills needed, although supervisors need some plan reading skills. More IT skills will be needed in the future. For the young guys coming up—we don't have an avenue to train them. Many of the more experienced people have picked it up because more and more information comes electronically. Therefore, they have to train guys on the job. Union is doing some training in plan reading and drafting for foremen. We may need someone dedicated to processing electronic info at every job site.<br>• The management people have some IT skills, but do not have all the skills they need. There are some gaps. They all need to know how they can use e-mail, scanning technology and IT to improve their output productivity. People in the field do not use any IT.<br>• Our most significant IT skills need is people who are capable of using planning and scheduling software applications such as Primavera and Timberline. We often have a couple of systems running in parallel—redundant data entry for example in bookkeeping, virtually no systems cover the whole territory. So there is need for more integrated applications [note: perhaps enterprise software for construction contractors?]<br>• We are in a gradual transition of IT skills needed mainly in the office to IT skills on the job site. At present guys on site don't require computer skills, just cell phone and fax, but over the next ten years (or maybe even a couple of years) we will need foremen who can use IT skills—we are moving away from faxes toward e-mail (laptops and BlackBerrys). Supervisors 45 and under know how to use e-mail but older guys will retire first before IT use becomes dominant.<br>• Nevertheless, there is a gap. We could focus more support on those who have been in the field for 25–30 years and then take an office position. |

| | |
|---|---|
| 2. | What are the new technologies (products and applications) and trends in IT usage? (.e.g., the use of hand held electronic scheduling and reporting products) |

- We need a course in reinforcing steel, people need better math skills, and they need to read drawings. We could include people coming back from field operations because of injuries, etc. Now we are using e-mail for sending drawings, fabrication information; just spent 50K on printers. However, the IT is not in the field. Some of the workers on the job site do not even have high school diplomas.
- I am not aware of any out there. We do not use BlackBerrys, but we do use AutoCAD and standard office products. A computer is good for certain things but not others. Sometimes using IT is not the right way to solve our problems at this point.
- We have a surveyor who does that kind of stuff—gets info to the foreman who gets it out to the workers.
- Need the latest CAD software at the operator level—someone has to read, understand and print drawing and to get what we need. Laptops, or a desktop computer and printer for 11”x17” paper in a trailer. We need a portable CAD system. BlackBerrys are coming, but they are not really used much yet. Most needs are drawing related so need larger drawings than small screens provide.
- I do not see IT as a retention strategy, people retiring want to retire and get out.
- Laptops are being used to create status reports from the field. There are also some handheld devices being used now in this company. Instrumentation is another category—the technicians are using digital equipment. Electrical technicians use digital equipment as well.
- E-mail, Internet, some use Accubid or something like it; each trade has one or two applications that are popular.


- There is a distinction between mechanical and electrical bidding software. Electrical because there are so many bits and pieces, a lot of the process is still manual. Databases extend and compile data. They have different accessories. In addition, connection to suppliers, computerized inventories, are becoming an issue.

| | |
|---|---|
| 3. | Specifically, can you identify IT skills that will assist in the development of employment retention and expansion opportunities for older workers in managerial, supervisory and mentoring positions? If so, what are they? |
| | • We are doing that with older workers. It's not for everybody. [The partner] is 65 and the company will help people stay on who can learn AutoCAD and take on a desk job. So far, there are two people like that in the Halifax office and 10 in [out of province].<br>• No. We're a two person office staff—I'm 31 and the other person is 22.<br>• Foremen are more used to the old style. A lot of the older workers and foremen shy away from computers. They need to understand Internet and e-mail, that's first. If we could get them familiar with basic computer functions like that and it would be helpful.<br>• Workplace and classroom would be more popular; distance learning would not be used.<br>• The concept may make sense for some, but there is real reluctance in the workforce to embrace these technologies. Some people are not even willing to use e-mail; they won't be here much longer—if more people did, it would be good.<br>• Some guys have gone to the union hall and taken basic courses on computers—e-mail and Internet—the only obstacle is that it is still something new, fear -- they don't know how simple it is to use. So if some sort of promotion was done through unions or whatever, that would help the transition for the older guys from the field coming to work in the office and assist in their retention. A lot of them do not really want to retire; they just want to stop breaking their backs in the field. If it is promoted in the right places, within companies, it won't matter where it's coming from, it could come from the Council. We have a guy who is 72 years old and came back to work in the office and learned computerized estimating. Another man was in the field for 30 years before he took on the office IT. |
| 4. | Identify what methods of training are preferred to enhance IT skills (e.g., workplace training, classroom, distance learning, etc.) |
| | • NS Construction Safety Association courses are on computer. There are four courses online—it was difficult to get people in the field to take first aid, WHIMIS, etc. online. About 50% have been trained online in the field and the rest in the office. We also use computers to mentor workers—show them how to access information online.<br>• Costs have gone up but with respect to the results of safety training, we now have cleaner environments, fewer accidents, we are able to move around better, and all that gets costs down. So, people are happier where they're working. It's a company culture issue and IT helped.<br>• It would be best to do it in the office and on the job. Most of what we do, we do ourselves, so we would train someone ourselves.<br>• Employees and workers are working all the time; they are too valuable to put in the classroom—that's a huge problem. Best way is to learn it in the field, on the run, an intermediate person in the field. Hard to get these guys to learn at home—they are too tired, it's asking too much. Maybe we could get them away for a Thursday afternoon for 3-4 hours and do that several weeks in a row. For the workers who are part-timers, they can take the courses.<br>• Yes, invitations to demonstration sites. I would rather have it on Halifax, but even if it were only in Moncton, I would still make use of it.<br>• We need a combination of classroom and online [note: blended learning].<br>• We need the classroom setting to introduce and orient them to the systems.<br>• Work place training is OK, but it has to be done in classroom too, cannot just do it on the job site. |

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| 5. | The potential benefits of increasing information technology in the construction sector lead to increased productivity through improved communications, access to information on the job site, better billing data, better job costing information, better resource deployment, etc. Should the ICI Construction Sector Council support the uptake and transition to these enhanced work methods? If so, how?<br>**a. What would employers need?**<br>**b. What would workers need?** |
| | • The Council needs to work with the Construction Association to disseminate information. We do believe in lifelong learning—you never stop learning or being trained. We require safety manger reports on all accidents from all sites so they can learn how to do it better. So information flow is important to create a legacy by documenting was has been learned. IT could be used to develop teams to support each other.<br>• No; not based on our workplace, because we are a 50 person staff—48 tradespersons and they do not need to focus on IT. Shortages are more in the traditional trades' skills than in IT. Needs might be different for mechanical or electrical contractors. Other valuable areas they should spend time on besides trade skills would be worth ethics, more knowledge about how union agreements work, how workers comp works, etc., the benefits of being a tradesperson.<br>• Yes, the Sector Council should take this as a mandate. If we don't change, we're going drown. |
| | (Do the employers see value in working with CTCA for their applied IT demonstrations and simulations, or would something centered in Halifax and Sydney work better? |
| | • Yes, the priority is to improve information flow. [No comment on whether it is in Halifax or Moncton.]<br>• There are more important kinds of support than IT.<br>• I would go myself to Fredericton to see what's happening. A demo site even closer would be even better.<br>• We need to fill the gap between the "high tech" office output and the industry workers. We need someone who filters that info for them. That's what will be needed in the short term. Younger people will get familiar and then they will all know it in the end.<br>• No, not necessarily, we have funding; we don't have to look for subsidies. |
| | Would they see a program where IT take-up is subsidized by government, possibly by subsidies for training and/or tax incentives for equipment investments? |
| | • We don't care about subsidies. [Company Name] doesn't do that. We don't use government funds.<br>• The Council should advocate for both. |

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| | Would they find value in communication programs that emphasizes the productivity and efficiency value of IT in the workplace—such as a speaker series of case studies where manufacturers and industry participants tell about their advanced technology solutions? |
| | • Yes.<br>• Yes, we're not against using IT, so if there were things I am not aware of it would be good to know. Right now, we get heavy equipment magazine and that contains info on IT sometimes. So, the service would need to be more as an information session without something to push, like a sales event.<br>• Real examples would be great. At our company, Formworks, there might be some concern about proprietary info, but with respect to information that's general—problems that we all have in the industry with getting and sending information—we would be ready to share that.<br>• Yes. On our projects there is no inter-operation, no sharing of files to date. I would not like to see it happen yet. Our information is confidential. There is some room for sharing designs, construction drawings, specifications, that should be shared. But, not billing information, not contract communication and accounting.<br>• Awareness and education would be valuable. People 40 and younger have no problem; IT is second nature to them. Those over 50, tradespeople and supervisory level might benefit. We don't get rolls of drawings any more. [It's mostly in digital format now.] So, there could be some potential benefit, but there is a long way from the potential demonstrated at CTCA to the foremen in the field.<br>• Some of what has happened w/r to IT has been negative on large industrial jobs: too much time taken to analyze information and data, but not enough time where the work actually goes on. IT takes people away from where the real work is done. We have to deal with that, particularly for supervisors who need to be on site not staring into a screen at all the information. Not sure how we cure that.<br>• Conduct campaigns; do advertising to encourage the older workers to get the training, also advocate for training funding. Lobby government for some kind of fund or assistance to union halls so the workforce doesn't deteriorate as quickly as it may otherwise. |