ARA

Pipe Trades National Human Resources Needs Analysis

Final Report - January, 1997
Prepared for: National Steering Committee

95054

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Executive Summary

The construction industry is facing major structural change. New materials and technologies are pushing aside the traditional craft methods of work. This is not a neat and orderly process. The pace of change is rapid and random. New tools, materials and processes appear, disappear and reappear. Regulations first impede and then facilitate change. Business risks are huge -- including opportunities to embrace systems, products and partners. The wrong choice can be fatal.

In addition to these challenges construction has to cope in the 1990s with a devastating decline in demand and a dramatic shift in demographics. Government has offered to help the industry cope with these changes. Their motives are not entirely altruistic. A major implication of all this change is massive structural unemployment that is placing a huge cost on public social programs.

Mandate

Human Resources Development Canada (HRDC) has offered assistance through sectoral councils and industrial adjustment service (IAS) committees. The United Association of Journeymen and Apprentices of the Plumbing and Pipefitting Industry (the UA) and the Mechanical Contractors Association of Canada (MCA) approached HRDC with a plan in 1994 and this report represents the results of this effort. The Pipe Trades National Sector Council was created with representation from all provinces and trades. A Request for Proposals for a labour market analysis for mechanical piping industry trades and occupations was circulated and a contract was awarded to ARA Consulting and its associates. The objective of the work is:

> *"...to provide a guide for training and labour force development and adjustment over the next decade for the piping trades (plumbing, pipefitting and steamfitting, sprinklerfitting, refrigeration and air conditioning mechanics, instrumentation mechanics and welding) in Canada. The study will determine the requirements for the piping trades for put in place construction and maintenance and the new skills that are expected to come into demand over the period as a result of technological change. These estimates will be compared to the size of the existing trades work force and its skills attributes to determine the training needs of the piping sector over the period."*[1]

The following activities were proposed to achieve these objectives:

- interviews with the National Steering Committee and regional/trade subcommittees;
- projections of hours worked by the indicated trades for the period 1996 - 2005 and a discussion of factors driving this demand;
- projections of the work force for the piping trades for the same period based on analysis of the age structure of the work force, apprenticeship, exit rates and other factors;
- assessment of the skills attributes of the work force based on a survey of workers;

[1] See "Industrial Adjustment Committee request for Proposals for Labour Market Analysis for mechanical piping Industry Trades and Occupations" Pipe Trades National Sectoral Study, April 1995.

- assessment of the skills and needs of management staff;
- a review of the pattern of technological change in the trades and an assessment of its impact on skills, training, hours worked and employment;
- a review of regional and equity issues related to entry into the trades by designated groups;
- a Delphi survey to validate all of the above analysis; and
- an analysis of the apprenticeship entry process.

A summary of the findings for each of these activities is presented here.

Part 1 - Existing and Projected Work Force and Technology

The first part reviews information from secondary sources to describe the current and expected working conditions for the trades. The availability of work is analyzed through projections of both supply and demand for labour. Working conditions are described in a review of existing and emerging technologies.

History and Forecasts of Demand

Demand projections for hours required from the pipe trades were built up from national and provincial forecasts for the value of construction activity. Value measures were then converted into hours with a correction for productivity.

HRDC worked with all the construction IAS Committees and Informetrica Ltd. to create two scenarios for construction spending between 1996 and 2005. Projections describe investment in new structures of twelve types (e.g., industrial, residential, roads, etc.) and for all ten provinces. Recognizing that such projections are uncertain, the process included two scenarios: "orange" or optimistic and "brown" or pessimistic.

These forecasts are the first point in the study confronting the crucial issue of productivity - the increase in construction put in place for a given amount of labour. A broad assumption of 2% annual growth in labour productivity is applied to all types of construction in both scenarios. *This condition builds in an assumption that labour required in 1996 will be able to produce over 20% more building in 2005. As a general rule in all labour markets, the higher the productivity is assumed to go, the lower the associated labour requirements will be given production levels.*

- **Orange Scenario**
  Conditions in the optimistic case reflected strong economic growth for the entire economy - led by low interest rates, strong foreign economic expansion and associated expansion of export markets. In this situation the demand for construction activity revives after the five year recession that has taken hold in most regions. The strongest construction activity is focused in industrial and resource sectors where new capacity is needed to keep pace with growing markets. Residential building is also strong as low interest rates and expanding incomes prompt housing demands that were delayed in the 1990s. Infrastructure building (roads, ports, schools, etc.) grows to support expanded activity and to make up for capital spending cuts in the last decade. The result is that most categories of construction activity

grow back to levels reached in the boom of the 1980s early in the new millennium. By 2005 most construction spending has reached new highs.

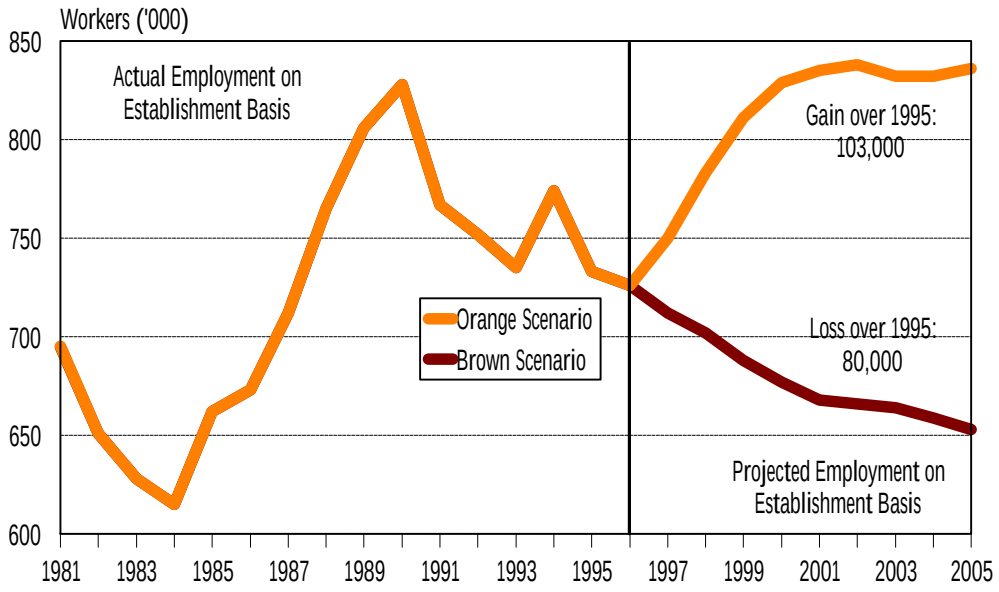
Employment in the orange case grows from low levels in 1996 to reach the past peak at the end of the projection (see Exhibit A). Even in this optimistic case the number of jobs in construction at any point in the next ten years never exceeds the 1989 boom and remains well below the past peak for most of the time. This apparently discouraging view is consistent with many other projections and reflects the assumed gains in productivity.

- **Brown Scenario**

The brown case reproduces the generally gloomy conditions that have prevailed in Canada for the past five years. Economic growth is restrained by high interest rates, high debt levels and weak consumer expenditures. Similar conditions in the rest of the world restrain exports. Construction spending is held back to levels needed to replace aging structures and the limited needs of a modest expansion. For much of the next decade building activity remains close to the depressed levels of 1995.

Employment under pessimistic conditions drops slowly from current levels as productivity gains allow the existing work force to build slightly more each year. In 2005 construction jobs total 650,000 -- the same as in the early 1980s.

Exhibit A Employment in Construction Industry - High and Low Projection Scenarios



Source: Informetrica Limited (April 1996)

Conditions are not the same in all regional markets. Virtually all provincial construction markets fell dramatically in the early 1980s but since then major differences have emerged. Construction activity in the Atlantic region and the prairies has recovered led by major energy, transportation and industrial projects. Overall construction employment is growing steadily towards previous levels. Extremely volatile markets have driven employment in Quebec and Ontario into dramatic declines in the early 1990s and recoveries are incomplete in both regions. Projections for Quebec allow for the outside possibility that previous employment levels will be rebuilt but Ontario is not expected to regain all the lost jobs. After a major drop in the early

1980s construction employment has grown steadily and now stands a record levels in British Columbia. Projected growth is not dramatic in the Pacific Coast but market conditions there are the strongest in Canada.

This broad vision of construction is intended only as a starting point for analysis. Many refinements are needed. For example, measuring employment in "jobs" misses the crucial allowance for hours worked. Utilization rates (hours worked per year) are built into the study; reflecting the fact that the pipe trades workers manage anywhere from 400 to 1,400 hours each year and actual results are highly variable. The average rate is just under 1,000 hours per year. While working conditions for most construction jobs will not permit "normal" activity at 1900 hours per year, the current low levels of utilization reflect a large measure of underemployment. Research presented by other IAS committees suggests that gains of 10% to 20% in utilization are possible; permitting more labour input from the existing group of employed workers.

The demand analysis concludes with projections of hours required by each of four pipe trades. Forecasts are calculated by adjusting the projected value of construction in sectors that are heavy users of pipe trades. Orange and brown projections are prepared for each trade and these show the same upper and lower boundaries described above. Hours required in 2005 rarely exceed the past peaks from the late 1980s and might remain at current depressed levels in some cases.

History and Forecast of Supply

Given the expectation about demand presented above, the analysis moves to the capacity of the work force to supply the needed work. The most important factor determining supply is the current size and age structure of the work force. There are at least two sources for measuring the overall size of the workforce: Statistics Canada data (from the census and the labour force survey) and the membership of the United Association.

Statistics Canada identifies several occupations that correspond to the pipe trades including: plumbers, pipe/steam and sprinklerfitters, gasfitters, industrial instrument technicians and mechanics, refrigeration and air conditioning mechanics and welders, solderers and automatic machine operators. Research by others suggests that the work force represented here (over 70,000 workers) is much broader than the target for this study. In particular the definition of welders includes a range of industrial workers not active in construction. The age distribution for all these trade includes the characteristic bulge in the 35 to 55 age group; representing the "Baby Boom" born between 1947 and 1965.

The UA membership is considered as an alternative measure of supply. This group clearly understates labour supply as a large and growing non-union sector is competing for work. However, the UA is probably the most concentrated group for our purposes and will be the major source for the worker survey presented below. The age profile for union members is shifted to older groups with an average age perhaps five years above the broad population.

The core of the supply side analysis is a simple computer model that "ages" the work force and calculates annual entries and exits. This system permits simulations of the work force for each year in the future. The crucial input is the entry and exit rates. These are calculated from pension records and from data on apprenticeship registrations, dropouts and completion.

Historical measures of these are quite stable and would serve as reasonable approximation for the next ten years under normal conditions.

Times, however, are not normal. Announced changes to the federal Unemployment Insurance program and to apprenticeship funding will reduce the rate of entry and increase exits. Very rough calculations are used to adjust the simulation models for these developments. An orange or optimistic case is developed using the historical entry and exit rates and a pessimistic (brown) case includes lower entry and higher exit driven by new government policy.

Supply calculations must also take account of the mobility of the work force across regions and among industries. Research on the construction labour force suggests that it is not extensively mobile across provinces but that there is very substantial movement both among construction sectors and other industries. Supply then, in the long run, can be boosted by the return of workers who have construction experience but have take employment "temporarily" in other areas. This source of potential supply is very substantial -- more so in non-regulated trades but also in the pipe trades.

Exhibit B Labour Force Projections - Pipe Trades in Canada, 1991-2015

Pipe Trades	Population 15-64*					Average Age	
	1991	1995	2005	2015	2015**	1991	2005
Instrumentation Mechanics	6,670	6,966	6,031	4,020	7,221	37.3	43.5
Plumbers	29,965	29,051	24,195	16,787	28,779	37.4	41.6
Pipefitters, Steam, Sprinklerfitters	20,395	19,553	14,574	8,001	17,051	39.0	43.1
Gasfitters	3,895	3,844	3,346	2,275	4,098	37.4	43.3
Refrigeration Mechanics	10,205	10,567	9,291	6,078	11,906	35.6	42.1
Subtotal	**71,130**	**69,981**	**57,437**	**37,161**	**69,055**	**--**	**--**
Welders, Solderers and Automatic Machine Operators	87,230	83,009	65,573	41,423	65,635	37.7	43.4
Total	**--**	**152,990**	**123,010**	**78,584**	**134,690**	**--**	**--**
% Change	--	0.0	-19.6	-48.6	-12.0	--	--

* *Brown Scenario - High Exit Rate*
** *Orange Scenario - Low Exit Rate*

Projections of the work force based on the assumptions presented above show steady and potentially dramatic declines in supply. The more realistic brown scenario to 2005 anticipate a 20% drop while the orange would show a slight drop. Extending these simulations out to 2015 accentuates the impact of current demographics and the decline in the labour force could reach nearly 50%.

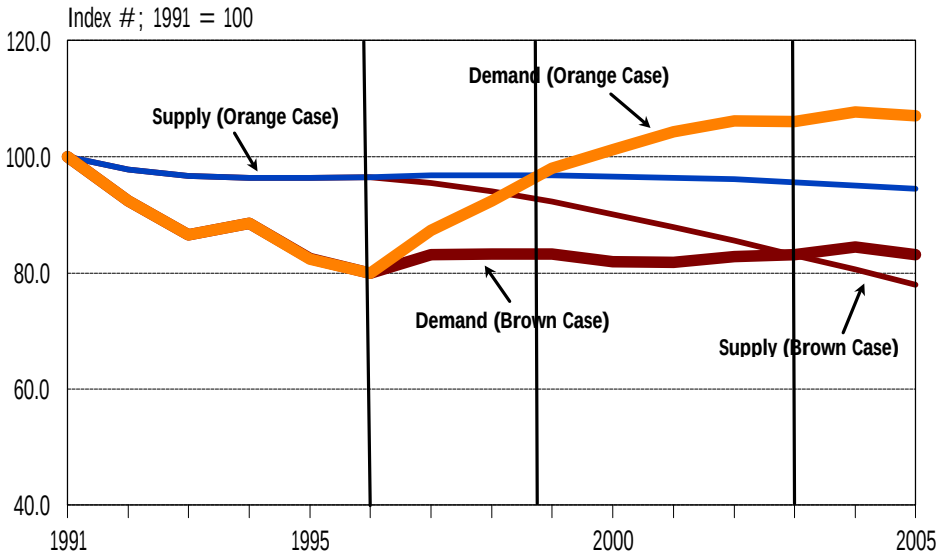
Analysis of Balance/Gaps

A very rough overview of market conditions can be derived by combining the demand and supply calculations presented in the first two sections. Such a comparison indicates that in the orange case (really the best possible outcome) market conditions will return to circumstances

resembling 1991 in 1999. Under the more realistic conditions in the brown scenario this balance will return closer to 2003.

These calculations are not meant to convey an exact picture of the future but rather to capture the risks and opportunities. The key conclusion here is that the available supply of workers to the market for pipe trades will exceed the needs of owner/clients for many years. This is not meant to suggest that temporary, local shortages of workers might not appear. These conditions, however, are not likely to persist.

Exhibit C Summary Indicators - Supply and Demand



Source: HRDC Construction Model (July 1996), ARA Projections

The Impact of Technological Change

This section considers the existing and emerging technologies that will impact the pipe trades in the next ten years. Key considerations are the potential effects on work conditions, skills, hours of work required and training needs. Estimating the pace at which these technologies will be introduced is an essential part of forecasting future increases in productivity, demand for pipe trade skills and hours worked.

The Nature of Technological Change in the Industry

The types of innovations to be introduced in the next ten years will be determined by several factors.

- the sectors of construction activity;
- the types of construction related activity (new building, renovations, repair and maintenance);
- the size of firms;
- the pipe trades;
- the location of the job site;
- marketing of new systems by manufacturers and suppliers;
- the state of the construction cycle; and

- the availability of trained tradesmen.

There are three broad groups of technologies:

- *Generic* technologies are widely available and covered by universal standards regarding sizes, tolerances, performance and materials. Standard training in the trade covers these.
- *Product specific* technologies are unique configurations or variations that offer new ways to meet traditional needs (e.g., roof top air-conditioning). These systems usually impose new but not extensive training needs.
- *Manufacturer specific* technologies are introduced by firms with their own dimensions, compatibility and systems. Training and capabilities for installation are usually restricted to the originating firm and its network of suppliers and installers.

Within each of these groups there are a variety of technology categories that are distinguished by their contributions to specific pipe trades or functions. These technology categories have been identified and are discussed in detail in the report:

- Electronic Control and Instrumentation Systems;
- Electronic Based Business and Communication Technologies;
- Pipe Technologies;
- Connections Technologies;
- Control Valves;
- Power Tools and Hoisting and Lifting Equipment;
- Energy Conservation Technology;
- Water Conservation Technology;
- Leak and Spill Reduction Techniques;
- Heating, Ventilation, Air Conditioning and Refrigeration Technology;
- Sprinkler Technology;
- Drain Technology; and
- Prefabrication.

The strong appeal of these innovations relates to the advantages that they offer including:

1) Improved overall management of construction and maintenance costs and scheduling -- not just by reducing specific components but by allowing synergistic gains across the whole process.
2) Reduced long run maintenance and operating costs through energy and water conversation and reduced service.
3) Protection of the environment in line with government regulations or private standards.
4) Improved health and safety in homes and plants where ventilation and climate control are upgraded.

Emerging Technologies and Their Impacts on Trades

Changes to work practices are being imposed through these technological changes. Impacts on the actions of individual workers are an immediate concern but some of the most important

changes are quite indirect. Improved inventory control through computer software and telecommunications will bring needed materials to the job site on time and reduce waiting and delays. Off site prefabrication or pre-assembly on the job will speed up and reduce costs for the entire building process.

Virtually all of the technologies improve productivity by eliminating tasks, reducing installation time, reducing weights, speeding up tool operations and using more manageable materials. These gains will reduce the number of people needed to perform tasks and require fewer hours for workers on the job. There will not only be less work but the nature of the work will change. Two quite distinct possibilities could arise.

Some technologies (e.g., new leak and spill techniques, advanced control valves) require that workers acquire new and demanding skills that draw on analytical, computer, diagnostic capabilities. This sort of skill deepening draws the worker into the process and increases their knowledge of the materials and parameters of operation. There are also many examples of new technologies that simplify tasks to the point where previously required physical dexterity and strength are simply no longer needed. Examples of this deskilling process would be plastics pipe and mechanical joints.

To further complicate the picture the impacts on skills are often different in new construction and repair/service situations. The classic example here would be very limited skills required to install sophisticated new equipment but very demanding diagnostic/computer skills needed to service machinery after installation.

There is virtually no consensus on the overall or average impacts of technologies in this area. Some changes are skill enhancing and others are deskilling. Fifteen quite specific examples of new technologies are reviewed in an appendix to illustrate the variations that are emerging in the trades.

Material presented thus far suggests that major gains in productivity are possible and the substitution of technology for labour is poised to have a dramatic impact. But this depends on the pace of introduction of new technology.

A combination of weak markets and entrenched resistance will likely slow adoption and job loss over the next ten years. Several factors act to hold back change including the weak financial state of contractors and the challenge of demonstrating the long term benefits of new systems to designers and owner clients. Certainly where there is a large up front cost to contractors any innovations will be tough to introduce.

Government policies in general and building/fire codes in particular have acted in the past to slow the arrival of innovations. Some obstacles remain in this area but others are being removed. The introduction of sprinklers is a prime example of regulatory change permitting innovation. Free trade agreements will prompt more of this sort of change as they impose harmonization of codes and regulations. Much of the technology being introduced into Canada comes from the United States so that NAFTA will reduce national barriers and speed change.

No clear trends emerge in all this. The reality is one of overlapping and crossing currents of change. Conditions will not be the same across sectors, trades and time. The associated training needs are thus complex.

Journeymen will require access to upgrading courses to stay on top of new systems and materials. Often the lessons to be learned are not complex or challenging and simply require a brief period explanation and orientation. Frequently the basics will draw heavily on computers.

Apprenticeship programs are often viewed as the best format for teaching much of needed skills for both existing and emerging technologies. However significant changes are expected in these programs and more is presented on this topic below.

Both apprenticeship and journeymen training will have to accommodate the emergence of manufacturer specific technologies. To remain competitive the training will need to be more condensed and flexible to upgrade skills with out disrupting the working schedules of people in the trades. A crucial question is the breadth and depth of required skills for the trades.

Part 2 - Management Skills and Training

Skill Needs and Business Conditions from the Contractors' Perspective

This section of the report moves to the contractors' perspective. Tough competitive conditions and rapid technological change combine to create a very demanding environment. Contractors reported on these factors, their perspective of the skills and training needs of the work force and the specific needs of management in their firms. A survey of firms and a series of focus groups were used to inquire into the issues.

The low level of demand and steady pressure on profit margins were the primary concerns on the minds of contractors. Under these conditions management has been squeezed and cut to a minimum; leaving most senior staff with more work to do than time permits. Management training -- especially in soft skills like communication and human resource management -- is given a lower priority in these circumstances. Faced with evaluating the overall importance of such training managers attach a high rank -- but concede that attracting their peers to such sessions will be difficult. Everyone understands that this training is important but few are willing to give time or money to the effort.

Lower margins also reduce the resources and time available for on the job training. Contractors and their supervisory staff have less support to offer workers; leaving them to rely on their own resources to learn new skills.

Recession and lower margins have raised the salience of management in one very practical manner. Contractors understand that many of their competitors have underbid jobs through poor estimating skills. These low bids undercut the market while often leading to financial crisis in the winning firm. This is a truly "no win" situation that could be avoided by refined financial management and estimating skills.

Management skills were evaluated in fourteen specific categories and ranked in the following order of importance:

- supervision and coordination;
- estimating;
- cost control;
- project planning and scheduling;
- communication skills;
- drawing and specifications;
- sales and marketing;
- safety management;
- purchasing;
- team building;
- document control; and
- negotiating.

The evaluation led to quite specific findings.

- There are many training providers offering a broad range of courses. This makes it difficult to discern what specific courses would best meet a firm's needs. A calendar of management training courses should be developed, listing various training providers and what they offer. This would make it easier for firms to find the specific courses that they require. In addition, it would be useful if the calendar included a review of the programs/courses by the individuals who have taken them. This would allow others to determine more readily if a particular course meets their needs.
- The majority of management level staff work their way up from the field. These individuals have not been exposed to any type of management skills training in their previous education. It would be useful to set out a training program for entry level management. This would involve setting out a basic curriculum of five to ten courses which would cover basic management skills, specific to pipe trades. This would simplify training for those who are new to the management ranks or it could also apply to those who would like to prepare themselves for a management position in the future.
- The focus groups discussed the pros and cons of the Gold Seal Program. Most participants supported the idea of national standards but did not like the idea of "grandfathering" by allowing people to qualify based on past experience. The mechanical contractors would like to see a set national standard for management certification for the Mechanical Trades, without any grandfathering clause.
- Individuals with several years of management experience require courses that expand their knowledge base, or as one participant said "add-value by teaching something useful". General management courses were considered too broad based for more senior managers. The training for this group would focus on helping managers run their business in a more efficient and productive manner, by exposing them to new ideas or processes.
- Participants are concerned that, many of the contractors/manager who would most benefit from training are not interested or do not see the benefits. Targeted promotion or advertising may attract some of these individuals, but most respondents indicated that it would be a difficult objective to achieve.

- The idea of exposing apprentices/journeyman, in the course of their training, to management skills was also raised in both the survey and the focus groups. At the apprenticeship level the exposure to management skills would be fairly general. It would inform apprentices that this is the type of knowledge they will require if they have any aspirations to run their own business or to move from the field into the office. In addition, with the trend toward more business responsibilities shifting out to the field, workers will be expected to have better communication and reasoning skills than in the past.

Since individual MCA offices develop their own courses which can then be acquired by other MCA offices, it was indicated that there is a role for industry associations to develop courses on a national cost share basis. This would result in a core curriculum which would be consistent across the country.

Part 3 - Skill and Training of the Work Force

A survey of 1,670 workers in the pipe trades investigated the age distribution, education background, work experience and skills of six trade groups: plumbers, pipe/steamfitters, sprinklerfitters, refrigeration mechanics, instrumentation mechanics and welders. Working with advisory groups in each trade the survey was designed to reveal considerable depth of experience -- recognizing up to forty types of work/materials and processes in the trades. Requesting this level of detail made the survey long and there was a concern that the response rate might suffer. Questionnaires were implemented through UA locals and participating non-union contractors.

The current sample is large enough for results to be representative of national characteristics. Age distribution in the sample captures the desired profile for the target population and reveals accurate information on the age specific results. Provincial analysis is a problem because the return rates for a few provinces were low. Trade representation is also uneven with a particular gap for refrigeration workers. The latter gap was filled by a 1995 study of this trade that was very close to this national analysis in scope.

While these weaknesses in the survey are a concern it is possible to draw broad national conclusions. Each province, however, imposes distinct regulations and there are often additional regional characteristics. These are not reflected in the findings and no province specific conclusions can be reached.

The survey sample captures the generally high level of education achievement for the pipe trades work force. Over 80% of the sample have high school education and most have a certificate of qualification in at least one trade. The survey gathered data on the use of language, math and computer skills on the job. Virtually the entire sample reported using reading for several aspects of work on a regular basis and more limited but regular application of math skills. Training and applications of health and safety skills was unevenly distributed with a significant minority of workers reporting no experience in this important area. Only 10% of the sample reported using computers on the job. These results are interpreted with caution as the questions specified more management related computer applications and may not have captured broader computer skills gained by workers at home. The separate survey of refrigeration workers found that roughly half of the work force has this type of experience.

This general profile of basic skills suggests that the pipe trades have a strong grounding in essential language and math but limited computer skills. Limited upgrading of these areas would be necessary to prepare most workers for needed upgrade of advanced skills.

Workers in each of the trades were asked to describe their experience in between thirty and forty very detailed areas. Part 2 described a wide range of technological change that is affecting work in all of these areas so that workers are challenged with the need to adapt across the full range of work. The study poses the central question of the needed depth and breadth of skills and experience. Workers are considered to have extensive experience in a work area, material or process if they report five or more years experience. Shorter exposure to these areas is regarded as limited expertise.

From a contractor's point of view depth of experience assures high productivity and effective skills and is the crucial attribute. For workers, this depth is valuable but should be balanced by a breadth of experience that affords them entry into other construction sectors, trades or work areas.

The survey reveals a broad range of experience for most of the sample. Workers generally have a certificate of qualification in more than one trade. Many have at least limited experience in welding and most have worked in two or more trade areas (e.g., plumbing and pipefitting, steamfitting and sprinklerfitting). There is a similarly broad exposure to construction sectors (residential, industrial, etc.) with most workers reporting experience in more than one area.

This breadth of experience extends to work areas with most members of the sample reporting that they have at least some experience in as many as thirty categories. This breadth of experience appears early in the career as the sample of workers under 35 years old had just five to ten fewer areas of experience than the over thirty-five age group.

When the study is focused in on "extensive" experience (e.g., five or more years) the range of skills narrows to between six and twelve areas. These findings are consistent for respondents in the plumbing, pipefitting, steamfitting and gasfitting trades. Workers in refrigeration, instrumentation and sprinklerfitting were slightly more specialized with less than ten areas of extensive experience.

The implications here is that most workers carry in depth skills and capabilities in as many as twelve areas and might wish to remain skilled in several more areas. Given the pace and nature of technological change reported in Section 5 this implies that they would need regular upgrading in most areas. Changes in materials, processes, equipment and other areas cover virtually all work areas and upgrading skills would be essential in at least one area perhaps annually.

This apparent need for upgrading is not consistent with the reported training experience of the sample. Only half of the sample reported taking upgrading courses. These observations imply that the need for upgrade training is running far ahead of the experience of most workers. Workers may well have received needed coaching or exposure to new skills on the job, but this source of support is at risk. There is also some evidence that training support from suppliers is at risk. An urgent need for upgrade training is apparent at the same time that the traditional sources to meet the demand are working.

These findings of an apparent gap between upgrading needs and accomplishments was confirmed in both the discussions with contractors and workers. The same theme appeared in the independent refrigeration study.

Limited returns from refrigeration and instrumentation mechanics restrict the findings for these groups. However, the refrigeration trade group found the results of a 1995 Ontario study to be similar to findings reported here and representative of conditions across Canada. Conclusions reached earlier in areas like basic education achievement and needs (including the uneven distribution of health and safety training) were confirmed in the Ontario study. In general, it was found that refrigeration mechanics had stronger computer and other technical backgrounds but there were still gaps for this trade that would inhibit their ability to keep pace with technological change. Combining the findings for both workers and contractors the Ontario report highlighted the following priority areas for development:

- customer relations techniques;
- work order editing;
- communications and interpersonal skills;
- stress management;
- refrigerants and oils;
- controls (especially electronic); and
- use of computers - building automation systems and general use of PCs.

Welding skills were widely dispersed among the respondents in the survey. Over half of the sample reported experience in this area. Considering these results members of the industry expressed concern that the nature of "welding" as an activity is not homogeneous. As noted in Section 3, the census and labour force survey allocate a large group of workers to this occupation in other industries. Within construction, welding is an important component of several other trades. Care was taken to break down the pipe trades sample to better understand the nature of welding skills in the group.

Two groups were identified - casual welders who reported experience in some aspect but no formal certification and certified welders who reported more in depth training and experience. About 60% of the respondents with a connection to welding fell into the casual group. The 40% who qualify as certified welders reported experience with advanced materials, more difficult welding techniques and automated welding systems. This latter group constitute an elite of the trade and their skills and experience are a valuable asset.

The survey results allowed a comparison of the characteristics of both casual and certified welders. In most areas (education, breadth of experience, residence) the two groups are the same. Certified welders are, however, more likely to work in the ICI sector and they are older by five to ten years. At the same time, requirements for frequent retesting and the physical demands of the work cause the average age of retirement for welders to be lower than other trades. This last finding is crucial in a population that is already considerably older than the general population. There is a considerable risk that the population of certified welders will decline rapidly in the next ten years.

Structural rigidities are also an issue for welding as provincial governments have implemented quite different systems for training and certifying welders. These differences act as barriers to interprovincial mobility and limit the capacity of the national work force to respond to short term project needs.

The Delphi Report

A two-round Delphi study technique was successfully used to solicit the views of a panel of experts regarding skill and training needs in the pipe trades. In particular, the study was used to validate recommendations.

The panel's consensus on training needs focused on "rapidly-changing technology", such as computers, electronic controls and instrumentation systems. Panel members specified priorities for training in general and for individual trades. As well, although panel members identified supervision and coordination as the management skill likely to be the most important over the next ten years, they also identified project planning and scheduling, along with communications, as being nearly as important.

The panel generally supported the idea of a nationally accredited management training program for the pipe trades, though members were not agreed on who should provide the training.

Information from the panel of experts indicates strong support for many of the recommendations from the draft report to the National Steering Committee. In particular, two recommendations were consensual selections as having the highest support from the panel:

- provide and encourage upgrade training for journeymen/women; and
- identify common course curriculum (in apprenticeship programs) between provinces and standardize content, teaching and evaluation.

Part 4 - Major Findings and Recommendations

This draft report is not intended to finalize the conclusions and recommendations of the Steering Committee. Further discussions and validation are planned so that a broad cross-section of the industry will have an opportunity to offer their ideas. However, certain highlights are apparent and can be summarized here:

- Demand for labour from the piping trades work force will expand through the period from 1995 to 2005 but moderate economic conditions and productivity gains will restrain the extent of hours required. Demand will be strongest for refrigeration, air conditioning and instrumentation mechanics. Demand will be weaker for low-end welding. Under modestly pessimistic assumptions demand might decline slightly. Under each of two scenarios demand remains below the levels experienced in 1989 until at least 2005.
- The current age distribution of the work force and the rising cost of apprenticeship training will lead to a significant decline in the number of workers available in 2005. Declines of 20% are possible if initiatives are not successful in attracting and retaining new apprentices and entrants. An even sharper drop will follow in the period 2006 - 2015.
- The supply of available labour will exceed requirements until at least the year 2000. Low utilization and high unemployment will remain key issues. Limited skill shortages are possible in some key areas. These include refrigeration and air conditioning, instrumentation and certain specialty areas of welding.
- Technological change is hitting the industry from several directions and with quite distinct impacts. On balance, these changes will reduce hours required for most types of

construction and thus limit demand for labour. Most new technologies (but not all) will require an increase in cognitive (but not physical) skill levels.

- Competitive conditions will force a major upgrading of management skills including computer systems, knowledge of new materials, processes and equipment, engineering and design skills, "soft" skills like negotiation, client relations, dispute resolution, personnel management and others.
- The piping trade work force has an adequate base of written and quantitative skills but relatively limited familiarity with computers. As a result there is a significant, urgent need and potential for upgrading skills.
- The current labour force is divided into a few specialty groups and a broad group of generalists. Most workers have a wide range of loosely held skills and a much narrower set of specialties. In some cases these specialized skills must be updated to assure even current levels of demand for work.
- Training needs will grow rapidly throughout the next ten years. There is a moderate need to rebuild the ranks of younger workers with modern skills to avoid limited shortages in the next ten to fifteen years. An even larger demand is growing for upgrading the skills of the existing population. A large minority of older members will not earn adequate incomes in the future if they do not soon learn new skills.
- A very difficult situation is emerging. Resources available for training may decline due to public sector cuts and fewer hours worked but the need to train apprentices and journeymen is large and rising. A significant investment in funding is needed for equipment, faculty and class facilities. This is a risky investment that must select "winning" technologies and satisfy the conflicting needs of individual contractors and the wider industry. The organized industry must rise to this challenge or face steady decline.
- Traditional methods of delivering training (long apprenticeship programs with extended classroom periods) may not meet these challenges. Shorter, more flexible systems and computer/mufti-media based instruction may be essential meet the training demands with the limited resources.

On the surface it appears that prospects are grim. Markets may decline and they certainly will not soon return to peaks achieved in the late 1980s. There is a large reserve of unemployed or underemployed that are seeking work but have limited opportunities

An opportunity is hidden in this gloomy picture. Industry leadership needs to take advantage of the current situation to gain greater control of crucial technological information and training. This recommendation is based on the observation that there is a process of concentration and consolidation going on where a small group of supplier/manufacturers are introducing proprietary technologies and using a small and closely organized network of contractor and installers to distribute their products. The market power of this "mainstream" group will grow as building codes and regulations are relaxed allowing a more rapid distribution of their products. The contractors that are able to compete in this mainstream are those with financial backing, design and engineering capabilities, advanced management techniques and skilled staff.

At the same time, a very large portion of the industry is fragmented, not equipped with needed prerequisite skills, facing lower earning potential and marginally attached to the mainstream suppliers

and contractors. Workers and contractors in this large, marginal group are relying on the maintenance and repair of older systems and equipment (e.g., pneumatic or mechanical control systems). Both demographics and technological change are threatening the future earnings of this second group. This group must rapidly upgrade its knowledge of new technologies and gain access to the systems and work now being developed by the mainstream.

Industry led training initiatives need to gather information on new technologies and package it using multi-media remote training systems. These training modules should be introduced for journeymen/women and contractor upgrading and then be introduced into apprenticeship programs. The core idea is to offer manufacturers a network for distributing basic instruction on installation and maintenance of their newest technologies that is more cost effective than their own delivery. This will transfer crucial technological information to a broader group of contractors and their workers. Essential the industry leaders must champion the new pipe trades technologies by jumping ahead of the mainstream with high tech computer based training capabilities. This would create the only broad based access route for introducing training related to new products into the market.

An essential parallel process is providing upgrading training for contractors. This focus here is on general management, engineering, design and related capabilities. Management skills in these areas are needed to improve competitiveness and keep pace with the needs of general contractors and sophisticated owner/clients. Through improved management techniques contractors can improve profitability and gain access to financial backing that will raise their threshold for bonding and for participating in design/build type projects.

These two core initiatives are urgently needed to assist workers and contractors struggling with a very difficult market situation. Once these changes are implemented a number of industry participants will be able to gain market and earning power. There will remain, however, a number of workers and contractors who are now on the margins of the industry and will not be able to survive the ongoing consolidation. It is difficult to estimate the number here as our research suggests that many are already working in other industries or regularly unemployed. Their needs will remain a heavy burden; threatening the mainstream activity with underground activity and placing demands on government services.

Gaining more control over the distribution of information on new technologies is the key to success for small to mid sized contractors and for most workers. The only way to convince suppliers that industry led training is superior to their own is by developing effective multi-media distribution systems.

The research findings of the National Steering Committee reported here lead to the following recommendations:

Recommendation 1 The National Steering Committee recommends that all members of the Pipe Trades industry-union and non-union, from all provinces - join in a common commitment to assume control of all aspects of training, including:

- entry (registration) of apprentices;
- curriculum;
- certification of trainers;
- delivery;

- funding;
- management and setting of standards; and
- testing and certification of graduates.

Recommendation 2 The National Steering Committee recommends the establishment of enhanced and expanded management training programs and standards, including the development and delivery this training.

National certification for management skills in the mechanical trades would set standards for skills levels and knowledge base for the industry. It would also provide employers with evaluation criteria for management staff.

Recommendation 3 The National Steering Committee recommends that courses such as communication skills be incorporated into all levels of industry training; including apprenticeship.

Recommendation 4 The National Steering Committee recommends the Pipe Trades Industry set up a National Pipe Trades Human Resources Committee (NPTHRC) that will establish occupational definitions and standards for all apprentices and journeymen in the following trades:

- plumber;
- pipefitter/steamfitter;
- gasfitter;
- sprinklerfitter;
- instrumentation mechanic;
- refrigeration mechanic; and
- welder (for pipe trades).

It is also recommended that the National Pipe Trades Human Resources Committee set detailed guidelines, in cooperation with the Red Seal program and the Interprovincial Computerized Examination Management System (ICEMS) and consistent with provincial legislation, for both apprenticeship and journeymen training in all areas, including:

- curriculum;
- delivery systems;
- testing; and
- certification.

The National Pipe Trades Human Resources Committee will be constituted to represent the interests of:

- employers working in new construction, maintenance, repair and renovation;
- all members of the work force;
- potential entrants including the unemployed, young people, designated minority groups; and
- employers and workers from all provinces and territories.

The structure of the NPTHRC will assure equal representation from employers and employees in the industry.

The following specific recommendations would guide the mandate of the National Pipe Trades Human Resources Committee. The Committee would:

a) Assign a top priority to adding significant new capabilities for upgrading the skills of journeymen in the pipe trades; targeting high levels of enrollment and creating incentives and initiatives to achieve the targeted attendance.

b) Work with the industry in assuming control over curriculum, delivery systems, testing and certification by gaining national recognition for the guidelines.

c) Work with training providers including community colleges, private institutions, joint contractor-union training councils and others to secure the general availability of needed courses at affordable prices.

d) Work with provincial governments and local authorities with responsibility for establishing and enforcing trade certifications. The long term objective would be to make certifications compatible across all provinces and consistent with national occupational definitions.

e) Assign a top priority to the preparation of all courses in computer based, multi-media formats that would be consistent with delivery in remote communities or in day release programs where participants would have limited access to traditional classroom settings.

f) Establish broad strategic targets for the composition of the work force in the future and recommend target levels of funding for training and numbers of graduates across levels (e.g. apprenticeship, journeyman upgrading, management skills) and trades (e.g. plumbing, pipe/steamfitting, refrigeration, instrumentation, welding).

g) Identify the abilities and certifications that distinguish various skill levels among welders. The higher skilled group must be clearly separated as a specialized occupation and national standards must be created defining certification. Common national testing regimes and training programs must be established to increase interprovincial mobility.

Recommendation 5 The National Steering Committee recommends that the National Piping Trades Human Resources Committee work with Human Resources Development Canada (HRDC), Statistics Canada and provincial governments to upgrade the current system of human resource planning and background statistics so that more accurate estimates of employment and hours worked are available.

Recommendation 6 The industry would seek funding for the establishment of a National Pipe Trades Human Resources Committee from Human Resources Development Canada.

Recommendation 7 The National Steering Committee recommends that the industry, perhaps through a National Human Resources Committee launch a communications strategy that would stress the advantages of national occupational and training standards and promote the concept of on-going training as an integral part of working in the pipe trades.