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## A Vision for the Canadian Welding Industry

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### **The Canadian Welding Association is partnering with Northern College**

Northern College has secured funding from the Government of Canada, the Government of Ontario and industry to develop a business plan for an applied innovation and development facility to be affiliated with the College's School of Welding Engineering Technology, based in Kirkland Lake in Northern Ontario.

As a first step in the project, the College understands the necessity of getting an up-to-date picture of the welding industry in Canada, the major issues it is facing and the key drivers for the future. The College approached the Canadian Welding Association to play a lead role in helping to develop a Vision for the industry and to subsequently share that vision with all involved in the industry.

### **Opening the consultation process with industry and government**

To this end, the following Industry Scan has been developed as an initial discussion point. The scan has been prepared by Suthey Holler Associates (contact: [crees@onlink.net](mailto:crees@onlink.net)), the consulting firm that is conducting the work for Northern College. The scan is based on materials available from the American Welding Society, the Canadian Welding Association and other published sources. **We would appreciate if you would respond to the questionnaire that is associated with the scan.**

Responses to the scan will be used as input to an industry "Visioning" Forum that will be held in Whitby, Ontario on Friday, December 12, 2003. In addition to Northern College and the CWA, local sponsors of the Forum will include the Durham College Whitby Skills Training Centre and the Durham Region Local Training Board.

Participation at the forum will be limited to about 25 participants. **If you would like to attend or provide input into the process, please complete the questionnaire.**

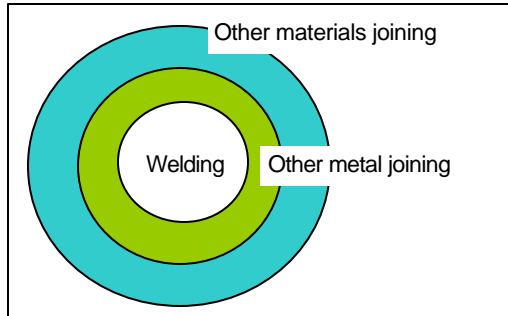
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## A Scan of the welding industry and emerging key issues<sup>1</sup>

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### Materials Joining

Materials joining, of which welding is the major component, is the process of bonding one material to another to create new products and innovative shapes and designs and to provide life-cycle product maintenance. The range of materials that can be joined is ever increasing, spanning many dissimilar and non-metallic materials – including metals, polymers, ceramics and emerging composite and engineered materials.



Other metal joining techniques include mechanical fastening, such as riveting and bolting. Materials can also be joined with a wide variety of adhesives.

### Welding

Welding is the most common way of permanently joining metal parts. Heat and/or pressure is applied to melt and fuse the metal pieces to make them one. More than 100 welding process variations are in use from the more common arc welding to the more advanced laser welding. Six types of welding technology application are defined: Manual welding, Semiautomatic welding, Mechanized welding, Automatic welding, Robotic welding and Adaptive control welding. Procedures must be provided for all metals and applications that comply with specifications and codes.

*The University of Waterloo's new Centre for Advanced Materials Joining is at the forefront of welding technology in North America, particularly with respect to "microjoining" used in the electronics and medical sectors.*

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<sup>1</sup> Sources of information for the Scan include the **American Welding Society**: Vision for the Welding Industry; Welding Technology Roadmap; Welding-Related Expenditures, Investments, and Productivity Measurement in U.S. Manufacturing, Construction, and Mining Industries; Industry News section of AWS website, the **Canadian Welding Association**: Meeting summaries of Education Committee; CWA Journal articles by Cheryl Rego, the **United States Bureau of Labor Statistics** and **Industry Canada** as well as internal documents of **Northern College**.

For a wide range of industries welding is a “critical enabling technology” meaning that no alternative technology exists. Alternative processes to welding that can be used in some applications include near-net shaping, deposition processes, adhesive technologies, high-speed machining and direct fabrication (rapid manufacturing).

However, because of its strength, welding is by far the primary joining technology (for both fabrication and repair) used in shipbuilding, automobile manufacturing, aerospace and many other light and heavy industry manufacturing activities. Welding is also used to join beams when constructing buildings, bridges and other structures and to join pipes in pipelines, power plants and refineries.

Nevertheless, many believe that the welding industry has an “image problem”. An ongoing online poll by WeldingJobs.com ([www.weldingjobs.com](http://www.weldingjobs.com)) asks the question, “Welding has an “Image Problem”. What’s the root cause? The response that has received the most votes to date is, “Welding is taken for granted until FAILURE occurs.” The majority of respondents to the poll have been welders but has also included welding engineers, welding inspectors, welding technicians and welding managers.

### **Economic contribution of welding**

In the United States, the revenue of industries in which welding is a critical enabling technology was US\$3.1 trillion in the year 2000 – one-third of the US Gross Domestic Product. Welding-related expenditures were US\$34.1 billion, of which payments to employees represented 70%, or US\$22.4 billion. Purchases of welding-related materials and consumables was US\$5.6 billion and expenditure on energy relating to welding was US\$1.1 billion.

In 2000, welding was responsible for over 500,000 jobs in the United States. But by including occupations where welding is either a specialized skill or an integral

*In 2003 Bombardier won a contract of C\$633 million to build nearly 300 double-decker railway cars for the German railway system. Welding-related expenditure is estimated at C\$42.5 million representing over 650 person-years of employment.*

part of the operation as well as others associated with the welding process such as design engineers and managers, the welding-related workforce is over 2 million.

In Canada, we estimate that in 2003 welding represents about 100,000 jobs at the level of technicians and welding operators. The exhibit below shows estimated Canadian welding-related employment by leading broad industry category.

***Leading industries of welding-related jobs in Canada – 2003 Estimate***

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<b>Industry Category</b>	<b>Number of Jobs</b>
Metal and machinery manufacturing	31,900
Construction	9,300
Motor vehicles	8,000
Logging, forest products, pulp & paper, furniture	5,200
Wholesale and retail	4,200
Mining and mining services	3,000
Railroad and other transport equipment	2,800
Transportation including pipelines	1,900
Shipbuilding	1,500
Electrical and electronics	1,400
Aircraft and aerospace	500

**Growth in the welding industry**

The welding industry is made up of those companies that supply welding-related equipment and consumable products (e.g. industrial gas distributors) and those companies that are end-users of such equipment and consumables in the fabrication of their own products. The end-user industries ranked in terms of their welding-related production expenditures in 2000 in United States<sup>2</sup> are the following:

***Total industry expenditures and welding-related expenditures (U.S. 2000)***

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<b>Industry</b>	<b>Total Expenditures (US\$ 000)</b>	<b>Welding-related Expenditures (US\$000)</b>
Construction	363,889,011	11,262,200
Heavy industrial manufacturing	147,030,156	7,629,184
Light industrial manufacturing	227,795,767	5,378,636
Capitalized repair & maintenance	1,281,051,399	4,389,696
Automotive	510,658,376	3,690,056
Electronics and Medical	436,399,753	1,464,978
Aircraft and Aerospace	141,897,032	300,033

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<sup>2</sup> Welding-Related Expenditures, Investments, and Productivity Measurement in U.S. Manufacturing, Construction and Mining Industries. American Welding Society and others, May 2002.

The main overall determinants of growth in the welding industry are:

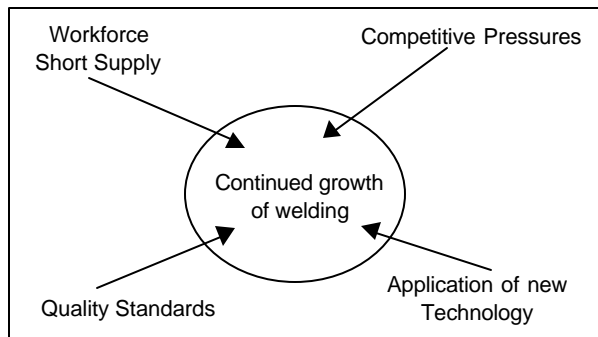
- The health of the above industries in which welding is an enabling technology.
- The aging of national infrastructure in developed nations and as well as new infrastructure in emerging nations and funding available for renewal and development.

*The welding industry in Canada certainly seems poised for growth. Canada's ability as far as putting automation systems together needs to be publicized better in Canada and internationally. It is an area where we can compete well. (Dave Fink, Panasonic Factory Automation)*

### **Factors that will determine the growth of welding as an enabling technology**

The extent to which welding will remain and grow as the fundamental enabling technology in the key industries will be determined by:

- The response to competitive pressures from markets and customers for greater productivity.
- The response to the short-supply in the welding and welding-related workforce (both quantity and quality).
- The response to new technology development and the ability to reduce the time-line between discovery of new technology and its practical implementation at the shop floor.
- The response to the need for internationally recognized standards of quality.



### ***Competitive Pressures***

All of the industries for which welding is a fundamental enabling technology are becoming increasingly global in nature and competition is worldwide. The pressure of markets and customers fuels the drive for increased productivity in manufacturing. This in turn means that all industries are attempting to shorten the

new product development cycle and to build in increased performance and enhancements in product quality – and all of this at more affordable prices.

For the welding industry, better integration into the overall manufacturing process is a requirement, notably through the application of advanced computational models that take the welding functions into consideration at the design stage. It also requires a shortening of the time line between new technology development and its introduction into the workplace.

*While Ontario leads Canada in manufacturing innovation, the maritime provinces are making important breakthroughs on marine applications and the western provinces are on top of welding applications for the oil sands industry.*

Identified growth trends include:

- Continued replacement of mechanical joining with semi-automatic and automatic joining processes –robotics. *(In United States one-half of all welding equipment sold is arc and spot welding robots.)*
- Growth in alternative materials such as plastics, composites and new alloys.
- Increased need for accuracy and precision in welding new materials. Need for high-quality work on thin materials.
- More efficient designs to minimize the amount of welding.
- A “zero defect” or “6-sigma” goal for welds with lifetime repairability (capability to model and analyze welding joints).

### ***An identified labour shortage***

*“There is a shortage of skilled welders everywhere in the world, and it is only getting worse as each year passes.*

*John Emmerson, President, Magnatech*

72% of respondents surveyed by the American Welding Society in 1999 considered the situation of the labour shortage problematic then and for the long-term. Clearly the attraction of new young people into welding and welding-related professions is a priority for the

*Employers in Canada are not sure the education system in Canada is sufficient to produce the labour needed to supply manufacturing across the country. One thing is apparent – at every level of education and across the country, industry involvement is essential to keep welding instruction current.*

future, requiring investment by both industry and government. This constraint is linked to the image problem of welding as a “dark, dirty and dangerous” environment. The overall image of the industry needs to be changed to one characterized by a high-tech, computer-based, clean and safe environment.

Some labour trends include:

- According to the Bureau of Labor Statistics (BLS) in the United States, job prospects for welding-related employment in the coming years are excellent – resulting not only from growth in virtually every user industry but also because of the need to replace an ageing workforce.
- The need for welding engineers will increase dramatically as welding automation becomes more prominent. In the United States, the lack of engineers with expertise in welding and welding process applications has resulted in the adoption of design and manufacturing practices that limit, rather than increase, the productivity of welding and the value that it is able to add to the final product.
- The lack of, or declining numbers of, skilled welders will itself be a reason for the growth of automation. For those companies that use more advanced welding techniques, a lack of technicians that understand the welding process hinders the optimal use of advanced processes.
- Need to understand and teach “the economics of welding”
- Continued development of a common national and international system of standards, assessment and certification of welding professionals.
- *Canadian Welding Association – Education Committee mission is “To determine and promote appropriate standards for all levels of education in welding and joining in Canada.”*
- *International Institute of Welding (IIW) – Levels of Welder, Practitioner, Specialist, Technologist and Engineer*

### ***Knowledge and technology transfer***

It is crucial that welding be seen increasingly as a “science not just an art”. Fundamental, co-operative research needs to be enhanced for process, materials and quality technologies.

Industry in the United States is continually calling for “more practical application of data relative to welding.” While universities and institutions conduct valuable basic research, industry needs information on best processes and benchmarks to be able to transfer current welding knowledge to the factory floor. Furthermore, in the future it will be necessary to implement methods of integrating welding requirements and welding knowledge into total manufacturing planning and management information systems.

*Doug Golosky of Clearwater Welding in Fort McMurray, Alberta is finding out that properly applied technology is vital to his business. His company, Clearwater Welding with over 700 employees is now one of Canada's largest welding shops.*

Some technology trends include:

- Make current processes more reliable and more robust.
- Develop welding technology concurrently with development of new materials.
- Develop processes and methods that facilitate joining of metals, glass, ceramics, plastics and other materials as required, to optimize performance of the product.
- Focus on more advanced technologies such as laser and plasma arcs
- Development of new materials that have been “designed to be welded” (energy efficient, environmentally benign, incorporating “smart” chips).

### ***International quality standards***

In the United States it has been determined that in order to remain a player in the changing, global manufacturing environment of the future, industry is likely to adopt a flexible system of codes and standards. But the industry has also determined that the major challenge is to move to a group of universally accepted international standards, allowing manufacturers to compete in any market without needing multiple designs. The US industry acknowledges that it is not easy to change an industry’s codes and standards but believes that such changes will help increase the acceptability of new joining techniques worldwide and is calling for a centralized control of standards, though not necessarily by government. Centralization is seen as helping to simplify issues that arise regarding the certification of welded products and helping to reduce industry’s liability for products that fail.

**Questionnaire on the Welding Industry Vision**

1. What is the image of welding in Canada? If you believe it needs to be improved, what should be done to improve it?

2. In terms of overall growth potential and welding technology needs, which 3 industries would you rank as most important for the next 10 years?

3. In the attached Scan, 4 factors are identified that will determine the growth of welding as an “enabling technology”: competitive pressures; a shortage of skilled and trained workers; knowledge and technology transfer; international quality standards. Do you agree that these are the most important factors? Are there others that you would add?

4. With respect to each of these factors, what are the most important gaps that need to be addressed?

5. What do you see as the most important gap that a technical materials joining institute would fulfill to act as a complement to welding education programs, research organisations and practical industry needs?

Draft for discussion only

6. I wish to participate in the Welding Industry Visioning Forum to be held in Whitby on December 12, 2003.  Yes  No

Name: \_\_\_\_\_

Business, association or government department: \_\_\_\_\_

Email address: \_\_\_\_\_