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# A Technology Roadmap for Welding and Joining in Canada – 2006 to 2016

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## Executive Summary

### **A Vision and a Strategy to ensure that Canada continues to play a leading role in manufacturing and construction based on the enabling technology of welding and joining**

*Welding and Joining – the art, science and engineering prowess of making metals and increasingly other advanced materials join together and function as one.*

Most manufactured products require that different parts be joined. The technology for doing so continues to develop. For example, laser welding is now widely utilized in the automotive industry. Great advances in joining technology have been made, and the field keeps rolling forward, incorporating leading-edge science, information technology, robotics and advanced manufacturing materials.

Welding has long been fundamental to “making things”. Even the Egyptians knew how to weld – items of iron and bronze that exhibit intricate forging and welding operations were found in the pyramids.

But what of the next ten to twenty-five years? One of the negative results of the advance of the “service economy” and the “information technology revolution” has been to create the impression in the minds of young people and of many policy makers that manufacturing, and particularly welding and joining, is no longer important in today’s world. Nothing could be further from reality. Welding and joining will continue to advance as the manufacturing and construction industries take on new vistas throughout the world and major new consumer societies come into play – China, India, Indonesia and a host of others. But the fundamental question is how much of the manufacturing – and the enabling welding and joining – will continue to take place in North America and, in particular, Canada?

This question provides the backdrop for creating this **Technology Roadmap for Welding and Joining in Canada – 2006 to 2016**. The answer is resoundingly positive but the implementation strategy requires a clear focus and commitment of industry, government, education and research institutes.

### **The primary target audience for this report is business leaders**

This report is addressed first and foremost to CEO’s and other business leaders of companies in industries that are users of welding and joining technologies. Often

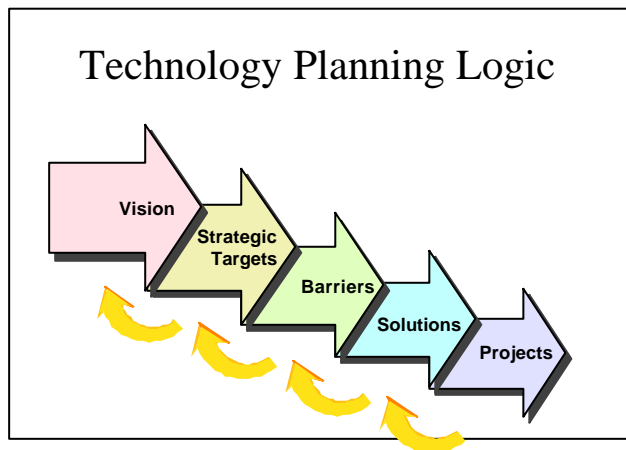
they see welding and joining purely as a “cost centre” and not as an enabling technology that is crucial in designing cost-competitive, quality products on the international stage. **It is also addressed to the federal and provincial governments in Canada** to ensure that they see welding and joining as an enabling technology and to convince them to support innovative initiatives in the sector from both a policy and financial perspective.

**In addition, the report is directed to educational institutions and research institutes** to encourage them to make their contributions to the Canadian welding and joining industry. Innovation is required to make Canada a leader in developing new design approaches and new unique joining technologies. The importance of welding and joining will require better collaboration among various educational institutions to develop a better system for education of the required personnel.

**Finally, it is also hoped that the general public will benefit** from the messages in this report which demonstrate the importance of welding and joining, and also that the welding and joining industry can provide exciting and rewarding career paths for young people at all levels of education.

### **The Process of developing the Welding and Joining Technology Roadmap involved hundreds of participants across Canada**

Technology Roadmaps (TRM’s) are a tool for industry, working with governments, education and research institutes to map out a strategy to accelerate industry growth and maintain competitive advantage as the future unfolds. In



Canada, TRM’s have been completed for a wide range of industries – Aluminum, Electric Power, Fuel Cells, Intelligent Buildings, Marine and Ocean Industries, Wood-based Panel Products. The majority of the industries that have completed TRM’s rely on Welding and Joining as a critical enabling technology. As new technology platforms unfold, such as

biotechnology and advanced materials, industry strategies such as logistics and welding and joining that cut across traditional single industry lines will become increasingly important.

The logic of the Technology Roadmap process moved from the Vision and Strategic Targets, through the Barriers to Solutions and Projects. The Welding and Joining TRM began with a session in Whitby, Ontario in late 2003 promoted by Industry Canada, FedNor, Northern College of Applied Arts and Technology (Kirkland Lake, Ontario), the Canadian Welding Association and numerous industry partners.

From the Vision and Strategic Goals developed at the Whitby Forum, the Welding and Joining TRM Steering Committee managed the process through numerous meetings culminating in four Regional Forums held in Montreal, Cambridge, Edmonton and Halifax in October 2005. Throughout the process more than 250 participants representing a wide range of companies, associations, educational and research institutions as well as all the levels of government participated. The entire process was documented on the website [www.weldingtrm.org](http://www.weldingtrm.org).

### **The Vision for Welding and Joining in Canada**

The Vision for the Welding and Joining TRM is that,

**Canada's excellence in welding and joining technology and its applications will be increasingly recognized and developed across the country and internationally over the next ten years.**

This will be achieved through the establishment and implementation of a national welding and joining strategy.

### **Strategic Targets**

The Strategic Targets associated with the Vision are the following:

1. Demonstrate and convince CEO's and other leaders of all manufacturing industries that welding and joining should be seen as an enabling technology that can make significant contributions to assist manufacturers who strive to put well-designed quality and cost-effective products and processes on the world marketplace.
2. Demonstrate and convince the federal and provincial governments that welding and joining is a strategic enabling technology which is required to enhance Canada's competitive position, and therefore merits both policy and financial support for world-class innovation, research, technology adoption and human resource development.
3. Develop a proactive, concerted and organized response from the welding and joining community in concert with educational institutions and research institutes, supported by government, to increase the pace of innovation in advanced welding and joining technology and application.

The target is to ensure responsiveness to the needs of user industries particularly with respect to cost-effectiveness and constantly increasing productivity in welding and joining processes, in Canada and at the international level. Welding and joining must be integrated into the design stage for manufacturing and construction.

4. Demonstrate that welding and joining is a field of activity that spans leading-edge science, information technology and advanced manufacturing processes and materials that are integral to the future prosperity of Canada. It will provide exciting career paths at all levels of skill and education which fully safeguards life, property and the environment.

In this context, establish Canada as one of the best education and training environments for welding and materials joining.

### **Barriers and Constraints: Downward Spiral and Leadership**

The welding and joining industry is cognizant that in order to achieve the Vision and Strategic Goals it must overcome two particular constraints.

The first constraint is the current situation of welding and joining in Canada. Welding technologies will move forward and contribute to industrial competitiveness to the extent that high quality information about new technical capabilities is available to industry leaders who have knowledge and authority to deploy them with confidence. This situation is not characteristic of the Canadian welding and joining scene. The majority of people with responsibility for design of welded products and manufacturing systems do not have advanced welding knowledge. Welding tends therefore to be treated as a commodity rather than as a strategic enabling technology. Since few senior industry executives perceive what they are missing, the result is a low demand for new technology and for engineering graduates with welding specializations. That in turn means that the capacity for advanced welding R&D in Canadian colleges and universities has remained seriously inadequate - a situation that will now take many years to correct. Initiatives in welding and joining education recently have been compromised by the retirement of experienced faculty members who have not been replaced. This "Downward Spiral" must be unwound!

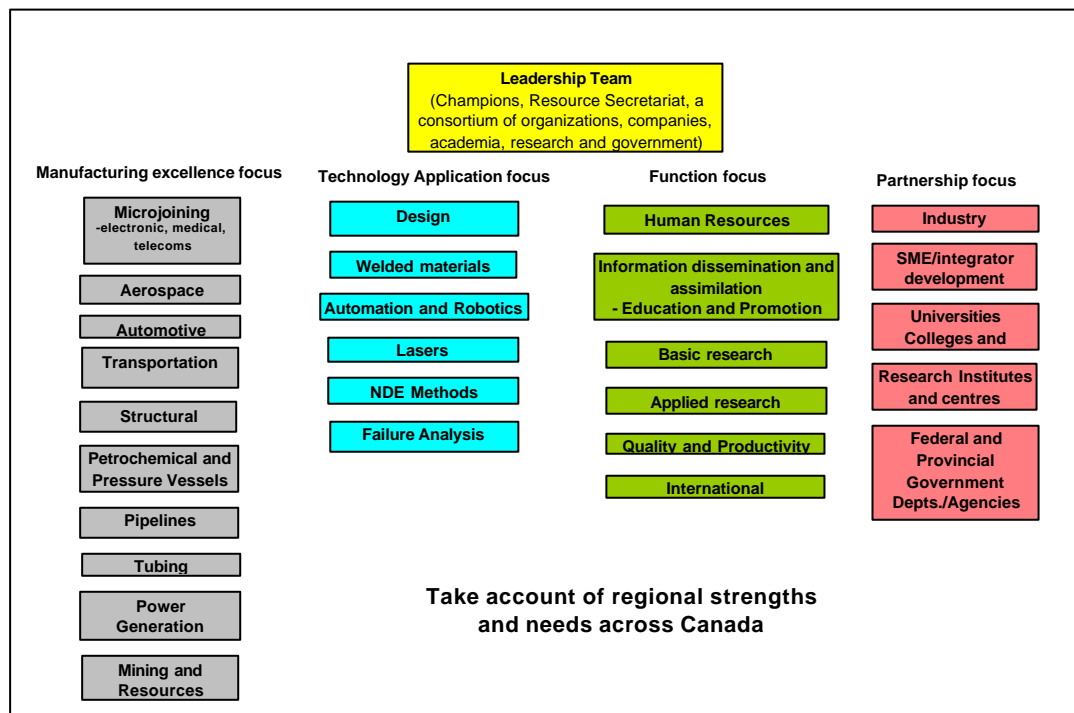
The second constraint is related to the first. Because welding and joining is "embedded" in many user industries and because the industry is widely dispersed across Canada, a clear and dynamic leadership focus is lacking. While a number of industry associations related to welding and joining are active, they lack the resources and the commitment of senior executives and the commitment of government support to present a visible and highly respected image of the industry. No widely recognized research and development centre or information sources for welding and joining exists in Canada.

## Solutions – A Leadership Team and a Solutions Matrix

In order to implement the Vision and Strategic Targets and to overcome the Constraints, the following Solutions Matrix is recommended.

1. The first element of the Solution is the creation of a strong funded Team of at least three Welding and Joining Champions supported by a Resource Secretariat. The purpose of the Team is to develop a strong, comprehensive national welding and joining consortium capable of developing and implementing the TRM welding and joining solutions matrix and specific projects.

The working philosophy of the Team will be the acronym DREAM. Clearly identify DESIRES, assign RESPONSIBILITY, ensure ENGAGEMENT that leads to ACTION in accordance with a clear METHODOLOGY.



The Matrix identifies the key user industries that will continue to be a strength of Canadian manufacturing and for which welding and joining must provide enabling solutions. It also identifies the key technology applications that must be advanced and the industry and enterprise focus

through which the technology applications need to be pursued. And finally it identifies the Partnerships through which the solutions must be presented, advanced and implemented.

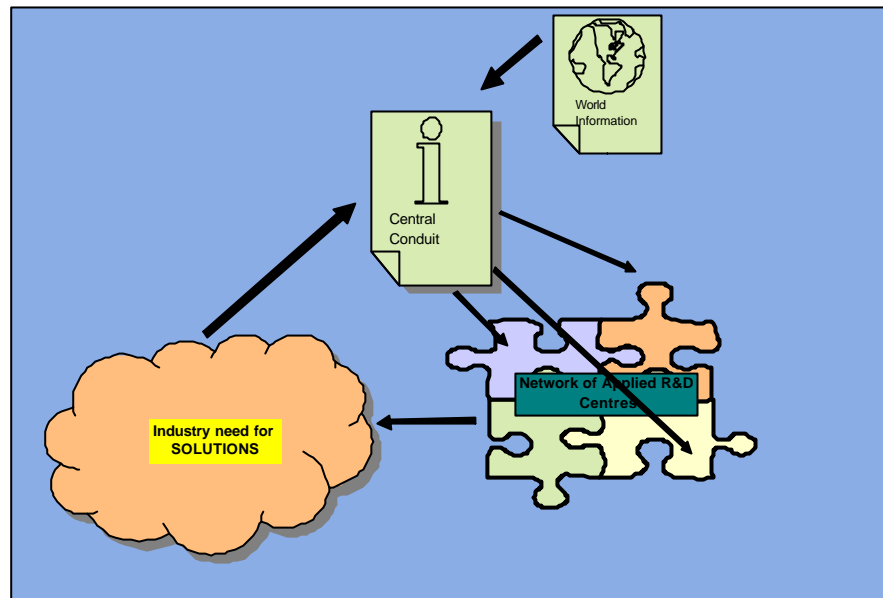
## Projects

The Leadership Team and Resource Secretariat will implement inter-connected projects based on the Solutions Matrix. The four identified priority project themes are indicated below. As the Leadership Team undertakes further analysis the individual project themes may be implemented as stand-alone elements or combined in a form conducive to achieving the best results.

1. Design and implement a funded, Canada-wide campaign – directed at leaders in industry, government, education and the research community - to create a positive, **energetic image of the welding and joining industry**, why it is important for Canada’s prosperity and how it can contribute to increasing the competitive position of Canadian manufacturing and construction over the next 10 years.
2. Implement a funded **manufacturing excellence and technology application** program for the Canadian welding and joining industry, based on the following elements:
  - a) Create a Canadian **Welding and Joining Productivity Network** with complementary locations in the Maritimes, Ontario, Quebec and Alberta with the mandate to:
    - I. Design and apply lean manufacturing concepts, one of several sustainable manufacturing practices, to welding and joining.
    - II. Integrate welding and joining into manufacturing excellence, particularly at the design stage.
    - III. Create a “Best Practices” technology application database..
    - IV. Develop and advocate policies to governments, such as tax incentives, for investment in automation and productivity improvement.
    - V. Develop an “Integrator” capacity among companies in Canadian industry capable of supplying complete sub-assemblies, not just individual parts.
    - VI. Sponsor specific welding/joining technology demonstration projects or workshops in all regions of the country.

- b) As a complement to the Productivity Network, establish and strengthen **Welding and Joining Centres at educational institutions** across the country, and develop better communications between them and industry to provide information for small and large Canadian companies for the testing and application of welding solutions. Create an associated Innovation Fund.
3. Implement a funded comprehensive research innovation and advanced technology adoption program for welding and joining that will encourage,
- a. Greater research capacity for innovative welding and joining process applications and adoption for all user industries.
  - b. Greater research capacity for new materials with improved joining capabilities, and their efficient use in welding and joining applications.
4. Implement a funded comprehensive **education and training response** for the Canadian welding and joining industry, based on the following elements:
- a) Create a **Human Resource Sector Council** for welding and joining, supported by a Canadian Welding Accreditation Board.
  - b) **Standardize and harmonize education, qualifications, training and apprenticeship** across Canada – harmonized with ISO, IIW and TWI.
    - I. Make Red Seal obligatory across Canada for certain types of welding (a compulsory apprenticeable trade).
    - II. Define a basics skills ladder.
    - III. Promote the coordination of college welding training across Canada applicable for students, apprentices and current workforce.
    - IV. Develop/support/revamp University welding engineering programs.
    - V. Showcase welding and joining careers with schools, industry and academia across Canada.
  - c) Outline a “Value-chain for investment in human intellectual property” – an explanatory report on how investment in human resources is at the base of achieving the Vision of the Welding and Joining industry.

5. Implement a funded **welding and joining Information Clearing House**, based on the schematic below:



Welding Technology Roadmap – Steering Committee

The purpose of the Clearing House is to act as a central information conduit for welding and joining:

- Providing an access point for industry to submit its needs for solutions to welding and joining issues,
- Providing access to the international knowledge base for welding and joining, and
- Providing the opportunity for the Welding and Joining Productivity Network and the Welding and Joining Centres at educational institutions to find the best solutions to industry needs.

**Now DREAM!**