MANITOBA AEROSPACE TECHNOLOGY ROAD MAP

SUMMARY

MANITOBA AEROSPACE

Introduction

Canada is a world leader in aerospace design, manufacturing, maintenance repair and overhaul (MRO), and space systems. Western Canada is a significant contributor to Canada's aerospace industry, with Manitoba being the largest component of the West's aerospace industry, and the third largest aerospace centre in Canada.

To maintain a leadership position in manufacturing and MR&O, and share in the rising market demand for new aircraft, space systems and aircraft servicing over the next 20 years, Manitoba companies must be increasingly successful in the fiercely competitive global supply chain. In an industry driven by technology and innovation, this means identifying and developing key technologies that will provide a sustainable, long-term competitive advantage.

A Technology Road Map (TRM) provides a framework of the key technologies built on consensus of the participants. Over the past year Manitoba's aerospace community has met to consider and propose a series of Technology Thrusts for the industry. The resulting Technology Thrust Reports and Manitoba Aerospace Technology Road Map provide clear direction for our technology development programs.

In industries such as aerospace, in which R&D is a costly, long-term undertaking, collaborative approaches often yield better results for both participants and the economy. Therefore, as we grow our capabilities and investments in R&D, we will need to encourage collaboration and support for regional, national and international efforts.

We wish to extend our thanks to all the participating organizations and their subject matter experts, as well as the National Research Council for their support of this process and their contributions to this report.

Kim Olson
Senior Vice-President StandardAero
Chair –Technology Road Map Steering Committee

February 2014

Manitoba Technology Road Map Process

An industry-led steering committee was established to lead the TRM project and identify the major technology thrust areas critical to the long-term competiveness of Manitoba's aerospace industry.

Six strategic thrust areas were identified and a Thrust Area Working Group (TAWG) was established to undertake a detailed review of the future needs and opportunities in each area. Over 50 technical experts from across the aerospace community participated in the six TAWGS, identifying 25 key technologies.

25 KEY TECHNOLOGIES:

- Additive Manufacturing
- Automated Scanning
- High Speed Machining
- 3D Scanning
- Adaptive Machining
- Machining Strategies
- Non-Destructive Evaluation
- Nanotechnology
- Robotic Assembly
- Robotic Finishing
- Vision Systems
- Out-of-Autoclave Processing
- High Temperature Composites
- Resin Infusion
- 3D Fibre Pre-Forms
- Automated Lamination
- Enhanced Technical Instructions and VR Analysis
- Simulation Platform for Complex Interconnected Systems
- Modelling of New and Emerging Composite Materials
- Emerging Tests
- Specialized Instrumentation
- Efficiency of Test Sites
- Gas Turbine Testing Simulator
- Space Autonomy
- Unmanned Aerial Vehicles

External resources, including environmental scans prepared by National Research Council (NRC) Knowledge Management as well as NRC subject matter experts, supported the TAWGs to ensure a broad understanding of the national and international state of development of the key technologies before formulating a Manitoba-centric Critical Technology Report for each one.

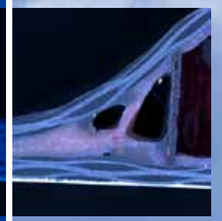
Collectively, these 25 Critical Technology Reports represent Manitoba's Aerospace Technology Road Map, providing a clear direction for our technology development programs.

Thrust Area 1 – Advanced Machining

- **Additive Manufacturing** – the use of "3D printing" technologies to create near net or net shape metallic or polymer parts with good material characteristics.
- **Automated Scanning** – automated 3D laser scanning and ultrasonic testing technologies to enable the measurement and inspection of a variety of aerospace parts.
- **High Speed Machining** – the use of modern machining technologies to increase the efficiency, accuracy, and quality of aerospace machining, while decreasing costs and processing time.
- **3D Scanning** – the development of 3D Computed Tomography (CT) X-ray technologies to enable enhanced non-destructive testing of metallic and composite aerospace parts.
- **Adaptive Machining** – the use of advanced 3D surfacing technologies to blend machined surface features seamlessly into the contours of existing aerospace parts.
- **Machining Strategies** – the development of advanced machining technologies to extend the range of aerospace component machining capabilities.
- **Non-Destructive Evaluation** – the use of advanced electromagnetic non-destructive test techniques to improve the capabilities and efficiencies of non-destructive evaluation processes.
- **Nanotechnology** – the development of metal and ceramic matrix composites reinforced with carbon nanotubes, to drive new opportunities in the aerospace materials and manufacturing sector.

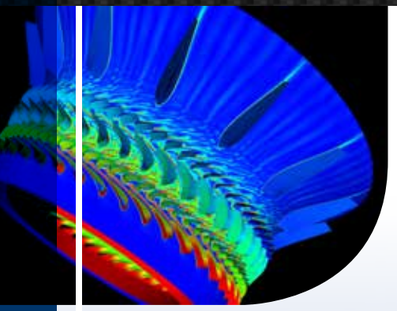
Thrust Area 2 - Robotics and Automation

- **Robotic Assembly** – the use of robotic machines, control systems, and information technologies to optimize productivity and quality in aero- space component assembly operations.
- **Robotic Finishing** – the use of robotic systems to automate labour-intensive aerospace finishing processes like painting, cladding, spray welding, etc.
- **Vision Systems** – the integration of vision-based technologies into robotic systems to enhance their real-time interaction and adaptability, enabling more accurate and efficient functioning.



Thrust Area 3 – Composites

- **Out-of-Autoclave Processing** – enables a fundamental shift in composites manufacturing approaches by allowing aerospace parts to be manufactured at reduced pressures, eliminating the need for autoclave cure.
- **High Temperature Composites** – the development of new composite material technologies to replace or augment the use of metallic components in multiple aerospace applications.
- **Resin Infusion** – the development of technologies whereby dry fibres are impregnated with a liquid resin in-situ, enabling efficiencies in the manufacture of near net shape composite products.
- **3D Fibre Pre-Forms** – the use of technologies to weave, stitch, or braid dry fibres into a reinforcement charge that is subsequently impregnated with a polymer matrix to form highly controlled composite structural components.
- **Automated Lamination** – the use of automated technologies to laminate, reticulate, drape form, and/or consolidate composite prepreg materials, thereby reducing labour input requirements.



Thrust Area 4 – Simulation Modelling and Analysis

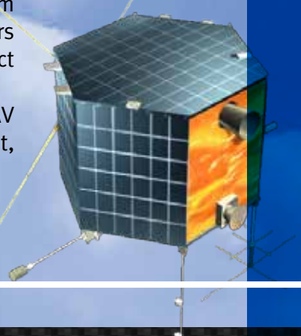
- **Enhanced Technical Instructions and Analysis** – The development of enhanced training technologies for aerospace manufacturing and maintenance technicians, including Virtual Reality (VR) training, will reduce the cost and time for training, and improve the level of competency.
- **Simulation Platform for Complex Interconnected Systems** – The development of sophisticated simulation technologies that facilitate the integration of various subsystem/subcomponent simulations into a broader, enhanced system-level simulation for the entire platform as a single integrated unit.
- **Modelling of New and Emerging Composite Materials** – New and sophisticated software and simulation tools will be needed to support the introduction of advanced materials and new composites for next generation aerospace designs.

Thrust Area 5 – Testing and Certification

- **Emerging Tests** – the development of new engine test capabilities at Winnipeg and Thompson test facilities to perform water, hail, ice crystal, and volcanic ash ingestion tests.
- **Specialized Instrumentation** – the custom design of specialized gas turbine engine instrumentation to support enhanced test capabilities at Manitoba's certification and production test facilities.
- **Efficiency of Test Sites** – the development of advanced data capture and communication technologies for Manitoba's test facilities, such as wireless sensors and instrumentation, high-speed imaging, and high-volume data acquisition and communication.
- **Gas Turbine Testing Simulator** – the development of a gas turbine engine test simulator to facilitate training of test technicians and engineers under normal and emergency situations.

Thrust Area 6 – Space and Rocket Systems

- **Space Autonomy** – the development of improved autonomous spacecraft systems to reliably and effectively monitor inputs from various sensors, determine the state of the system, detect errors or failures, implement isolation or recovery actions, and predict future states.
- **Unmanned Aerial Vehicles** – develop autonomous UAV technologies and systems for military, research and development, and commercial applications.



The Results

The TRM process identified 25 key technologies in six areas.

The key technologies are shared across and beyond the aerospace industry in Manitoba, and are consistent with those identified by the national Technology and Innovation Committee operating under the direction of the the Aerospace Industries Association of Canada (AIAC). Many of the technologies identified are universally applicable to both manufacturing and maintenance, repair and overhaul (MRO) applications.

The efforts required to develop many of the technologies will require collaborative approaches, both to create the required critical mass of knowledge and facilities and to share the risks and costs. The Manitoba aerospace community will need to increase its capacity to undertake collaborative research projects, including collaboration beyond Manitoba's borders.

Drawing upon existing collaborative research programs across Canada and elsewhere, Manitoba will need to establish strategies and mechanisms to pursue collaborative research and development. Both funding models and coordination/leadership models will be required.

The resulting Technology Thrust Reports and Manitoba Aerospace Technology Road Map provide clear direction for our technology development programs.

The entirety of the Manitoba Aerospace Technology Roadmap reports are available through the Manitoba Aerospace Association, EnviroTREC and WestCaRD websites:

Manitoba Aerospace Association

www.mbaerospace.ca

EnviroTREC

www.envirotrec.ca/projects

WestCaRD

www.westcard.ca

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