

NRC-CNRC

INTERNATIONAL WORKSHOP ON LIFE CYCLE ASSESSMENT FOR DESIGN AND MANAGEMENT OF SUSTAINABLE INFRASTRUCTURE

●●● Organizing Committee: J. Zhang, Z. Lounis and A. Attar



National Research
Council Canada

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Canada

International Workshop on LIFE CYCLE ASSESSMENT FOR DESIGN AND MANAGEMENT OF SUSTAINABLE INFRASTRUCTURE

September 30 to October 1, 2019

Fairmont Château Laurier, Laurier Room (Lobby Level)

1 Rideau Street

Ottawa ON K1N 8S7

Canada

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Workshop Overview

International Workshop on LIFE CYCLE ASSESSMENT FOR DESIGN AND MANAGEMENT OF SUSTAINABLE INFRASTRUCTURE

September 30 to October 1, 2019

Roads and bridges are long-lived core public infrastructure assets. They should be kept safe and functional to ensure a reliable and efficient transportation network and the sustainability of neighbouring communities.

There is a growing awareness about reducing the life cycle environmental footprint associated with the construction, operation, rehabilitation, and decommissioning of roads and bridges in order to achieve sustainable infrastructure. Different strategies can be used, such as designing long-life assets with low maintenance. This will reduce the life cycle embodied carbon and energy of the assets, minimize traffic disruption, and avoid lengthy detours, thus decreasing fuel consumption and air pollution. The development of tools for life cycle assessment (LCA) that incorporate the environmental impact is needed to provide effective decision support for life cycle design and management of infrastructure.

To address this challenge, the National Research Council of Canada (NRC) is leading a research initiative to develop robust and practical LCA tools and guides for infrastructure, with an emphasis on roads and bridges in a changing climate. This will strengthen the links between LCA, life cycle performance, and management of Canada's public infrastructure, a critical step toward the design of sustainable transportation infrastructure. The infrastructure LCA tools and guides will further stimulate innovation in low-carbon technologies for the design, rehabilitation and management of infrastructure assets. In addition, these tools and guides will contribute to the development and implementation of sustainability criteria and approaches for the design and management of transportation infrastructure.

This research on infrastructure LCA is an integral part of the NRC's strategic research to support Canada's Green Infrastructure mandate,

and to contribute to the Pan-Canadian Framework on Clean Growth and Climate Change. In addition, performance-based methodologies will be developed to provide the scientific evidence for improved and more informed decision-making. The NRC has launched a new initiative for the development of a Canadian life cycle inventory (LCI) database, which will provide the foundational and key resources for the development of infrastructure LCA tools and guides. This will contribute to reducing the environmental footprint of infrastructure to support the commitments of the federal, provincial and territorial governments to reduce their greenhouse gas (GHG) emissions.

In Canada, many agencies have considered implementing LCA for roads and bridges, and have acknowledged the lack of technical resources and practical tools, and the need for capacity development. Having LCA tools will enable the development of sustainable design and management of infrastructure by providing new sustainability design criteria, such as the newly implemented sustainability provisions in the 2019 edition of CSA S6 *Canadian Highway Bridge Design Code*.

The objective of this workshop is to establish a roadmap for the development of practical life cycle assessment tools and guides, and their implementation for the life cycle design and management of sustainable roads and bridges. This workshop brings together national and international experts and practitioners, federal, provincial, territorial, and municipal stakeholders, and industry to address the challenges of implementing LCA for the design and management of sustainable infrastructure.

The workshop is divided into the following five sessions:

1. LCA Standards, Guidelines and Tools
2. Canadian Perspective on Sustainable Infrastructure
3. Synthesis of Key Issues and Roadmap for Infrastructure LCA (Part 1)
4. LCA for Sustainable Design and Management of Transportation Infrastructure
5. Synthesis of Key Issues and Roadmap for Infrastructure LCA (Part 2)

Organizing Committee

Jieying Zhang, Ph.D., P.Eng.

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Workshop Program

Day 1: September 30, 2019

8:45–9:00 AM	Introduction and Opening Remarks <i>Ahmed Attar</i> <i>National Research Council Canada</i>
9:00–9:10 AM	Welcome and Workshop Objectives <i>Michel Dumoulin</i> <i>National Research Council Canada</i>
9:10–9:50 AM	KEYNOTE SPEAKER: We Need More Accurate and More Useful Environmental Assessment of Infrastructure <i>Arpad Horvath, Dept. of Civil and Environmental Engineering</i> <i>University of California, Berkeley, CA, USA</i>
9:50–10:00 AM	Q&A and Discussion
10:00–10:15 AM	Break
10:15–12:00 PM	SESSION 1: LCA Standards, Guidelines and Tools <i>Chair, John Harvey</i> <i>University of California, Davis, CA, USA</i>
10:15–10:45 AM	On the Importance of Accounting for Uncertainty in LCA of Infrastructure <i>Pascal Lesage, Dept. of Chemical Engineering</i> <i>Polytechnique Montréal, QC, Canada</i>
10:45–11:15 AM	Sustainability in Engineering Practice <i>David Lapp</i> <i>Engineers Canada, ON, Canada</i>

11:15–11:45 AM	NRC Development in LCI and LCA <i>Trevor Nightingale</i> <i>National Research Council Canada</i>
11:45–12:00 PM	Q&A and Discussion
12:00–1:00 PM	Lunch
1:00–1:40 PM	KEYNOTE SPEAKER: Envision®-based Life Cycle Analysis of Sustainable Infrastructure <i>Spiro Pollalis, Graduate School of Design</i> <i>Harvard University, MA, USA</i>
1:40–1:50 PM	Q&A and Discussion
1:50–3:00 PM	SESSION 2: Canadian Perspective on Sustainable Infrastructure <i>Chair, Saeed Mirza</i> <i>McGill University, QC, Canada</i>
1:50–2:20 PM	Greening Government Strategy and Real Properties: An Update on Government's Efforts to Green its Operations with Focus on Greening Buildings <i>Nick Xenos</i> <i>Treasury Board of Canada Secretariat</i>
2:20–2:50 PM	Sustainability in Canadian Highway Bridge Design Code <i>Jadwiga Kroman</i> <i>City of Calgary, AB, Canada</i>
2:50–3:00 PM	Q&A and Discussion
3:00–3:15 PM	Break
3:15–4:15 PM	SESSION 3: Synthesis of Key Issues and Roadmap for Infrastructure LCA (Part 1) <i>Chair, Zoubir Lounis</i> <i>National Research Council Canada</i>
4:15–4:30 PM	Closing Remarks and Adjournment <i>Jieying Zhang</i> <i>National Research Council Canada</i>

Day 2: October 1, 2019

9:00–9:40 AM	KEYNOTE SPEAKER: LCA and its Implementation for Roadways and Airfields <i>John Harvey, Dept. of Civil and Environmental Engineering University of California, Davis, CA, USA</i>
9:40–9:50 PM	Q&A and Discussion
9:50–10:05 AM	Break
10:05–12:00 PM	SESSION 4: LCA for Sustainable Design and Management of Transportation Infrastructure <i>Chair, Jieying Zhang National Research Council Canada</i>
10:05–10:35AM	Athena’s “Pavement LCA” Tool: An Overview and Case Study <i>Jamie Meil Athena Sustainable Materials Institute, ON, Canada</i>
10:35–11:05 AM	MTQ Policy on Pavement Type Selection: Methodology and Consideration of LCA <i>Julie Roby Ministère des Transports du Québec, QC, Canada</i>
11:05–11:35 AM	Integrating Sustainability in Major Infrastructure Management Context: Case of JCCBI Crown Corporation <i>Vincent Guimont-Hébert and Émilie Bamard The Jacques Cartier and Champlain Bridges Incorporated, QC, Canada</i>
11:35–12:00 PM	Q&A and Discussion

12:00–1:00 PM	Lunch
1:00–1:40 PM	KEYNOTE SPEAKER: Durability and Sustainability of Infrastructure: Where Do We Go From Here? <i>Saeed Mirza, Dept. of Civil Engineering & Applied Mechanics McGill University, QC, Canada</i>
1:40–1:50 PM	Q&A and Discussion
1:50–2:20 PM	SESSION 5: Synthesis of Key Issues and Roadmap for Infrastructure LCA (Part 2) <i>Chair, Zoubir Lounis National Research Council Canada</i>
2:20–2:30 PM	Closing Remarks and Adjournment <i>Jieying Zhang National Research Council Canada</i>

List of Speakers

Name	Institution
Ms. Émilie Bamard	The Jacques Cartier and Champlain Bridges Incorporated, QC, Canada
Mr. Vincent Guimont-Hébert	The Jacques Cartier and Champlain Bridges Incorporated, QC, Canada
Dr. John Harvey	University of California, Davis, CA, USA
Dr. Arpad Horvath	University of California, Berkeley, CA, USA
Ms. Jadwiga Kroman	City of Calgary, AB, Canada
Mr. David Lapp	Engineers Canada, ON, Canada
Dr. Pascal Lesage	Polytechnique Montréal, QC, Canada
Mr. Jamie Meil	Athena Sustainable Materials Institute, ON, Canada
Dr. Saeed Mirza	McGill University, QC, Canada
Dr. Trevor Nightingale	National Research Council Canada
Dr. Spiro N. Pollalis	Harvard University, MA, USA
Ms. Julie Roby	Ministère des Transports du Québec, QC, Canada
Mr. Nick Xenos	Treasury Board of Canada Secretariat

Abstracts and Biographies

We Need More Accurate and More Useful Environmental Assessment of Infrastructure

ARPAD HORVATH, Ph.D.

Lawrence E. Peirano Professor of Civil and Environmental Engineering

Departmental Vice Chair for Graduate Studies

University of California, Berkeley, CA, USA

Abstract

The external costs of infrastructure are not understood completely, but they are sure to be enormous. It is an obligation of all professionals involved with infrastructure to help lower the environmental and other societal costs, one of the most important components of a more sustainable future. We need to manage the life cycles of infrastructure components with resource depletion, rising economic costs, changing societal expectations, climate change, and an ever-changing global society in view.

There is widespread manifestation that we have not done enough about our civil infrastructure. While the energy system, vehicle manufacturing, and a handful of other industries have already

spent significant research and development resources to reduce their external costs, we can do much more about our buildings, mobility, water, and waste management systems with respect to smarter and more sustainable material selection, design, construction, operation, maintenance, and end of life. These systems are interconnected, and the way to reduce their impacts will have to come through multifaceted approaches that simultaneously consider the various systems and the grand challenges of society. We need to start asking questions that span multiple infrastructure systems, and develop models and methods that simultaneously improve them. Using average data and assuming that all infrastructure components are the same throughout their

life cycle around the world is unhelpful for robust decision-making.

Biography

Dr. Arpad Horvath is the Peirano Professor of Civil and Environmental Engineering at the University of California, Berkeley; Vice Chair for Graduate Studies; Head of the Energy, Civil Infrastructure and Climate Graduate Program; and the Director of the Transportation Sustainability Research Center. He has

conducted studies on the environmental implications of various products, systems, and services; in particular, transportation, water and wastewater, buildings, concrete, biofuels, and pavements. He serves on the Executive Board of *Environmental Research Letters* and the Editorial Board of the *Journal of Industrial Ecology*. Among others, he is an immediate past member of the Science Advisory Board's Environmental Engineering Committee of the U.S. Environmental Protection Agency.

On the Importance of Accounting for Uncertainty in LCA of Infrastructure

PASCAL LESAGE, Ph.D.

Researcher, CIRAIG

Polytechnique Montréal, QC, Canada

Abstract

Life Cycle Assessment (LCA) is increasingly used to inform infrastructure design and management decisions. Given that the underlying data and models used in LCA are uncertain, there is a risk that LCA-based information will lead to suboptimal decisions. This presentation will cover sources of uncertainty in infrastructure LCA, existing and emerging methods for estimating uncertainty of LCA results, and ways to integrate uncertainty in LCA result interpretation.

Biography

Dr. Pascal Lesage is a research officer at the CIRAIG (International Reference Centre for the Life Cycle of Products, Processes and Services). His duties include research, tool development, database development, supervision of graduate students, teaching, carrying out LCA studies, and participation in LCA critical review panels. His current focus is the integration of uncertainty in LCA-based decision-support tools.

About the CIRAIG

The CIRAIG is a research-driven organization that combines the expertise of Polytechnique Montreal and UQÀM School of Management. With two leading-edge industrial research chairs, we lead innovative academia projects in life cycle assessment, circular economy, planetary boundaries, and corporate social responsibility in the heart of Montreal. Our team of experts leads studies, develops tools and offers professional guidance in a range of sustainability topics.

CIRAIG: www.ciraig.org

Sustainability in Engineering Practice

DAVID LAPP, FEC, FCAE, P.Eng., IRP

Manager, Globalization and Sustainable Development

Engineers Canada, ON, Canada

Abstract

The sustainability of public infrastructure is achieved through informed and responsible engineering practice during design, operations, and maintenance over the life cycle. Engineers Canada has published national practice guidelines related to sustainable development and environmental stewardship, as well as climate change adaptation and mitigation that apply to sustainable infrastructure. These guidelines provide detailed descriptions of guiding principles and best practices. This presentation will describe the professional and ethical responsibilities of engineers towards sustainable infrastructure as described in these practice guidelines.

Engineers Canada is the national organization of the 12 engineering regulators that license the country's 295,000 members of the profession. Together, we work to advance the profession in the public interest that includes health, safety, economic interest, and consideration of the environment.

Biography

Mr. David Lapp graduated with a degree in geological engineering from the University of Toronto in 1978. After nearly 20 years working as a consulting engineer working in Canada's Arctic regions, he joined Engineers Canada in 1997. He has been part of the Secretariat supporting the Canadian Engineering Qualifications Board. His national and international work focuses on infrastructure, environment, sustainability, and climate change issues, and their impact on the practice of engineering.

In December 2015, David completed an eight-year, half-time assignment as the Secretary for the World Federation of Engineering Organizations' Standing Committee on Engineering and the Environment.

In the past several years, David has supported the development and publication of national and international professional practice guidelines for sustainable development, environmental stewardship, site remediation, and climate change adaptation and mitigation. He contributed to the development of a white paper on environmental engineering that will be published in 2020.

Since 2005 he has served as program manager for a long-term national project to assess the engineering vulnerability of public infrastructure to the impacts of a changing climate. This project developed an infrastructure climate risk assessment tool known as the

PIEVC Engineering Protocol, which has been successfully applied to a wide variety of infrastructure types. David provides advice, training, and ongoing technical and administrative support for applications across Canada and internationally.

He has been involved in the development and delivery of several climate-related short courses for engineers' professional development, including Climate Law, Asset Management, Risk Assessment, and the PIEVC Protocol.

NRC Development in LCI and LCA

TREVOR NIGHTINGALE, B.Sc., Ph.D.

**Director General, Construction Research Centre
National Research Council Canada**

Abstract

Under the Paris Agreement, Canada has committed to reducing its greenhouse gas emissions by 30% below 2005 levels by 2030. The Pan-Canadian Framework on Clean Growth and Climate Change was developed with the provinces and territories, and through engagement with Indigenous peoples, to meet Canada's emissions reduction targets. This framework will identify opportunities to innovate the economy through clean technological solutions. To help achieve these targets, the Low-Carbon Assets through Life Cycle Assessment (LCA²) initiative of the National Research Council of Canada (NRC) will develop important outputs that create a science-based approach to support the selection of materials and designs that offer the lowest carbon footprint while offering the lowest total cost of ownership. This initiative will support low-carbon procurement, and its anticipated outputs will be collaboratively developed by a balanced stakeholder consortium. Outputs will include the following: infrastructure-specific life cycle assessment (LCA) guidelines/tools, related procurement specifications, low-carbon benchmarks, and a Canadian life cycle inventory (LCI) database.

Biography

Dr. Trevor Nightingale is the Director General of the NRC's Construction Research Centre. He was appointed to the position in May 2019. Trevor began his career at the NRC in 1992 as a Research Officer in the Construction Research Centre's building acoustics team and rose to become a Principal Research Officer. As the Director of Research and Development for the Intelligent Building Operations research unit from 2010 to 2015, he guided research in the areas of lighting, heating, ventilation, human factors, building controls, and energy measurement and verification. From 2015 to 2019, Trevor was the Program Leader for the NRC's High-performance Buildings program, which supports industry in the development and commercialization of new technologies for energy retrofits of commercial and institutional buildings. Trevor holds a Bachelor of Science in Physics from the University of British Columbia, and a Ph.D. in Building Engineering specializing in Acoustics from Heriot-Watt University in the United Kingdom. He is the author of 135 technical publications, is an adjunct professor in Carleton University's Faculty of Engineering, and serves on the Federal Executive Committee responsible for Building and Communities, the Canada Green Building Council's Industry Advisory Board, and the Board of Directors of the Intelligent Building Committee of the Continental Automated Buildings Association.

Envision®-based Life Cycle Analysis of Sustainable Infrastructure

SPIRO POLLALIS, Ph.D

Director of the Zofnass Program, Harvard Design School

Harvard University, MA, USA

Abstract

Methods for measurement and evaluation of performance are a key component to improving the planning and operation of complex systems. They provide a common reference framework, comparing design scenarios and expected project performance. Such tools not only provide an understanding of the environmental qualities and impact of a project, but can be used as a decision-making tool to whether to proceed or not proceed with a project (a go/no-go decision-making tool).

Envision® is such a system, which rates infrastructure projects based on their contribution to the economic, environmental, and social aspects of sustainability. It was launched in 2012, a product of the Zofnass Program for Sustainable Infrastructure at Harvard University, a unique collaboration of academics and industry specialists. What LEED® offers to sustainability at the building scale, Envision does for infrastructure: educates citizens and increases public awareness, provides a means to quantify sustainability in infrastructure, and facilitates the adoption of sustainable planning and design. It also provides a base for addressing finances, both internal to the project as well as external costs and benefits. When applied to the life cycle of the project, Envision

provides useful insight on selecting the right project and maximizing the social, economic and sustainability benefits.

Zofnass Program at Harvard:

<http://research.gsd.harvard.edu/zofnass/>

Envision Rating System:

<http://sustainableinfrastructure.org/envision/>

Biography

Dr. Spiro Pollalis has been a Professor at Harvard for 34 years. He is an expert in the sustainability of infrastructure and cities. At Harvard, he has developed the Envision sustainability rating system.

Prof. Pollalis consults for governments and the private sector on sustainability, and he is the chief planner for several sustainable cities, including a new city in Pakistan for 600,000 people, which is under construction. Prof. Pollalis collaborates on sustainability with the World Bank, the Inter-American Development Bank, IFC, the United Nations, and the WWF.

Prof. Pollalis has three degrees from MIT, including his Ph.D, and an MBA.

Greening Government Strategy and Real Properties: An Update on Government's Efforts to Green its Operations with Focus on Greening Buildings

NICK XENOS

Executive Director, Centre for Greening Government

Treasury Board of Canada Secretariat

Abstract

Greening government and real property: An update on the government's efforts to green its operations with a particular focus on greening buildings.

Biography

Mr. Nick Xenos is the Executive Director of the Centre for Greening Government within the Treasury Board Secretariat of the Government of Canada. The Centre is working with federal departments and agencies towards low-carbon, sustainable and climate-resilient government operations, including the procuring of low-carbon buildings. Previous to this position, Mr. Xenos has worked on climate change impacts and adaptation, Arctic science policy, and infrastructure policy. Mr. Xenos has a Master's in Business Administration from Dalhousie University and a Bachelor of Commerce from the University of Ottawa.

Sustainability in *Canadian Highway Bridge Design Code*

JADWIGA KROMAN, M.Sc., P.Eng., FCSCE

Manager of Bridges and Structures

City of Calgary, AB, Canada

Abstract

The presentation will include an overview of the development and final content of Section 2, Durability and Sustainability, of CSA S6 *Canadian Highway Bridge Design Code*.

The focus of the presentation will be an introduction to sustainability requirements for design, construction, quality, and maintenance of bridges.

Guidance on the execution of the Code requirements is provided through the extensive Commentary. The presentation will include select Commentary content and will identify opportunities for future refinements of methods for sustainable design, construction, and operation of sustainable bridges.

Biography

Ms. Jadwiga Kroman is a chair of Technical Subcommittee for CSA S6-19, Chapter 2 Durability and Sustainability, and an active contributor to Transportation Agency of Canada (TAC) projects and publications. Jadwiga's professional interests include advancement of innovative methods and materials for improving bridge structures' durability, sustainable design, and bridge aesthetics.

LCA and its Implementation for Roadways and Airfields

JOHN HARVEY, Ph.D., P.Eng.

Department of Civil and Environmental Engineering

University of California, Davis, CA, USA

Abstract

The presentation will briefly summarize the development of LCA for roadways and airfields. Current status of development of the framework for roadway and airfield LCA, database definitions, databases, data collection efforts, industry/government/academia partnerships, task groups and collaborations, tools, and results of use will then be reviewed internationally. Potential and likely expansion of appropriate uses of LCA to support transportation infrastructure decision-making will be presented, and a vision and major challenges will be identified.

Biography

Dr. John Harvey is Professor of Civil and Environmental Engineering at the University of California, Davis (UCD); Director of the UC Pavement Research Center (UCPRC, UC Davis and Berkeley); and Director of the newly created City and County Pavement Improvement Center (CCPIC, a consortium of cities, counties, UC, and California State University). He is past Director of the Transportation Technology and Policy graduate group at UCD. He is Principal Investigator for projects for research, development, and implementation for a wide range of pavement technology, pavement management, cost, and environmental topics for the California Department of Transportation (Caltrans), FHWA, FAA, CalRecycle, the California Air Resources Board, the Transportation Research Board, other state DOTs, and industry. He is a professional civil engineer in California.

Athena's "Pavement LCA" Tool: An Overview and Case Study

JAMIE MEIL

Athena Sustainable Materials Institute, ON, Canada

Abstract

Since 2012, the Athena Sustainable Materials Institute has made its free Pavement LCA tool available to North American engineers and transportation agencies. The presentation will highlight the tool's functionality, attributes, and recent developments. Using a case study conducted for, and in collaboration with, Manitoba Infrastructure (MI), the presentation will present a number of scenario results for "greening" MI's Portland cement concrete roadway specifications, in tandem with their life cycle cost implications.

Biography

Mr. Jamie Meil is a co-founder of the Athena Sustainable Materials Institute and is a Director of its U.S. affiliate, Athena Institute International. Jamie is a Resource Economist with over 25 years of experience in the development and use of environmental life cycle assessment and life cycle costing in relation to buildings and infrastructure. Mr. Meil is the Institute's Research Principal, overseeing the Institute's core research program and client-based services. Jamie is an internationally recognized life cycle assessment expert, publishing over 40 articles in various technical and trade journals, as well as serving on numerous international committees related to life cycle assessment and the sustainability of the built environment.

About The Athena Sustainable Materials Institute

The Athena Institute is a non-profit think tank and consultancy in life cycle assessment (LCA) for the built environment. As the North American pioneer in construction-sector LCA, the Athena Institute works with sustainability leaders in product manufacturing, building design, construction, and green rating programs to enable smaller footprints in the production and consumption of materials, buildings and infrastructure. Athena's common-good work includes free LCA software tools for architects and engineers, and the development and maintenance of a large LCI/LCA database on construction materials and processes that underlies our tools. We additionally advocate and educate on the benefit of LCA in construction practice and in industry, in order to help meet our mandate to mitigate the environmental burdens embodied in works of construction. Our support network includes a range of product manufacturers, trade associations, design professionals, and other research organizations.

Athena Sustainable Materials Institute:

www.athenasmi.org

MTQ Policy on Pavement Type Selection: Methodology and Consideration of LCA

JULIE ROBY

Engineer

Ministère des Transports du Québec, QC, Canada

Abstract

Since 2001, the Ministère des Transports du Québec (MTQ) has a policy that deals with the selection of pavement types. This policy is a comprehensive approach rather than project-based, which defines the most appropriate types of pavement for roads under the department's jurisdiction. The department recognizes that all pavement types are viable options (asphalt and concrete). The important thing is to choose the ones that offer the best long-term investment from economic, social, and environmental analysis. The presentation will explain the analysis that was performed and how LCA has been integrated in the policy since 2010.

Biography

Ms. Julie Roby has worked as an engineer at the Ministère des Transports du Québec since 2011. She received her Bachelor's degree in Civil Engineering from the University of Sherbrooke in 2008. She obtained her Master's degree in Concrete Material in 2011 from the same University. Her fields of expertise are concrete and asphalt pavement design, performance and rehabilitation, and tire-pavement noise.

Integrating Sustainability in Major Infrastructure Management Context: Case of JCCBI Crown Corporation

VINCENT GUIMONT-HÉBERT and ÉMILIE BAMARD

The Jacques Cartier and Champlain Bridges Incorporated, QC, Canada

Abstract

For a few years now, the Jacques Cartier and Champlain Bridges Incorporated (JCCBI) Crown Corporation has integrated the concept of sustainable development into its corporate vision and mission statements. As a result, JCCBI has put in place the necessary foundations to operationalize the concept of sustainable development in its core activities, in particular by adopting a policy, a strategy, and a multi-year sustainability action plan in conjunction with the Federal Sustainable Development Strategy.

For each dollar invested in operational and administrative activities, JCCBI's goal is to generate enhanced environmental, community, and economical returns on investment.

Biographies

Mr. Vincent Guimont-Hébert has devoted his entire career to helping public and private organizations set themselves apart by making decisions that generate economic, environmental, and social value. Vincent's experience has led him to specialize in the integration of sustainability principles into organizations' operational and administrative functions. He has developed and implemented policies, strategies, multi-year action plans, and sustainability programs for international leading organizations in the manufacturing, retail, government services, transportation, and natural resource sectors. Vincent holds a civil engineering degree from Polytechnique Montréal and a Master's in Business Administration from Université du Québec à Montréal and Université Paris-Dauphine.

Ms. Émilie Bamard has always been passionate about the environment and sustainability. She holds a double engineering degree in environment and chemistry. She also gained strong expertise in sustainable development by working in different industrial sectors: aerospace, food industry, and waste materials management. Her goal is to make a difference and bring changes for a brighter future.

Durability and Sustainability of Infrastructure: Where Do We Go From Here?

SAEED MIRZA, B.Eng., M.Eng., Ph.D.

Emeritus Professor, Department of Civil Engineering and Applied Mechanics

McGill University, QC, Canada

Abstract

This presentation reviews the current state of infrastructure in Canada, the USA, and the world, along with the causes for the crisis. The needed paradigm shifts in our design, construction, maintenance, and rehabilitation techniques used over the entire asset life cycle are reviewed, and some recommendations are made to ensure that the infrastructure assets remain durable and sustainable over the life cycle, and beyond. When the asset is decommissioned and condemned to be demolished, these processes must be sustainable. Moreover, it is recommended that the current material specification-based specifications in the construction contracts be replaced with performance-based specifications (as in the current PPP-based contracts).

The design engineer should be responsible for designing, construction and maintenance of the asset for durability and sustainability over the entire life cycle. The presentation will suggest how to design a maintenance program for the entire life cycle, based on the anticipated deterioration due to all applied loads. These loads have worsened considerably, due to a significant increase in the frequency and intensity of man-made and natural hazards, including climate change, causing premature and unexpected deterioration in the asset at appropriate time intervals, say five years. It is proposed that the health of the asset be monitored continuously, using an intelligent

sensing system that can be incorporated in the asset members during construction. This will help to gather knowledge of the health of the asset at discrete time intervals or continuously. By comparing the deterioration occurring in the asset with the anticipated degradation, the maintenance program can be modified appropriately at the selected time intervals. In addition, reliable data will be available for mid-term audit of the health of the asset, and for design of any needed rehabilitation.

Biography

Professor Emeritus Saeed Mirza of McGill University, a Member of the Order of Canada, is regarded as “an outstanding engineer, highly accomplished researcher and a leading educator whose vision has had a tremendous impact on many infrastructure issues”. He has lobbied strongly for renewal of Canada’s deteriorating infrastructure, and has highlighted technical, environmental, socio-economic, financial, management, and policy issues. He has been the winner of several awards for outstanding teaching, research, scholarship, and international educational and professional advancement, including the Queen’s Diamond Jubilee Medal, the T.Y. Lin Medal, the John B. Stirling Medal, and many others. In 2006, a Special Issue of the *Canadian Journal of Civil Engineering* was published to honour his many contributions to civil engineering in Canada and around the world. A tree was planted in front of the Macdonald Engineering Building in 2008 to

honour his many contributions to the sustainable environment at McGill University. He has published extensively, and has coauthored

books, special publications, and reports on these and related topics.

List of Participants

Name	Institution
Ms. Leila Ahmadi	National Research Council Canada
Dr. Lamya Amleh	Ryerson University, ON, Canada
Ms. Marianne Armstrong	National Research Council Canada
Dr. Ahmed Attar	National Research Council Canada
Dr. Nadia Bhuiyan	Concordia University, QC, Canada
Dr. Sylvie Boulanger	MTB Consulting, QC, Canada
Mr. Jasper Boychuk	Federal Bridge Corporation, ON, Canada
Mr. Robert Cooney	National Research Council Canada
Ms. Marla Desat	Standards Council of Canada
Dr. Michel Dumoulin	National Research Council Canada
Mr. Gary Farnden	Ministry of Transportation and Infrastructure, BC, Canada
Dr. Geoffrey Guest	National Research Council Canada
Ms. Fiona Hill	National Research Council Canada
Mr. Arif Husain	Transport Canada

Mr. Donovan Jacobsen	Transport Canada
Ms. Pamela Kertland	Natural Resources Canada
Mr. Thye Lee	Federal Bridge Corporation, ON, Canada
Mr. Soufyane Loubar	The Jacques Cartier and Champlain Bridges Incorporated, QC, Canada
Dr. Zoubir Lounis	National Research Council Canada
Dr. Zainab Moghal	Environment and Climate Change Canada
Mr. Chad Nelson	Infrastructure Canada
Ms. Susan O'Connor	City of Ottawa, ON, Canada
Mr. Michel Ouellet	Infrastructure Canada
Mr. Kyle Perdue	Ministry of Transportation, ON, Canada
Dr. Mohammad Shafiee	National Research Council Canada
Mr. Kevin Smith	Environment and Climate Change Canada
Mr. Dimitri Treheles	Infrastructure Canada
Dr. Sarah Wells	Transportation Association of Canada
Dr. Jieying Zhang	National Research Council Canada

