

CENTRE FOR MAINTENANCE OPTIMIZATION AND RELIABILITY ENGINEERING

CONSORTIUM MEETING AGENDA

June 7, 2011: 9:00am–4:00pm, Hydro One, Toronto

WELCOME

10 minutes

Andrew Jardine, C-MORE Director

EXECUTIVE SUMMARY

20 minutes

Andrew Jardine, C-MORE

ON OPTIMIZATION OF CONDITION-BASED MAINTENANCE DECISIONS

40 minutes

Andrew Jardine, C-MORE
Norm Hann, Hydro One

EXAKT at Hydro One: Update

POWER TRANSFORMER CONDITION MONITORING AND RISK ANALYSIS

45 minutes

Barry Mirzaei, Hydro One
Neil Montgomery, C-MORE

COLLABORATIONS WITH CONSORTIUM MEMBERS AND BEYOND

90 minutes

Ministry of Defence, Project Health – with Tim Jefferis

Toronto Hydro: How to predict Transmission and
Distribution System Reliability Metrics

Neil Montgomery, C-MORE

Manitoba Hydro: CBM of Power Transformers - An
Update

Dragan Banjevic, C-MORE
Wendelin Schuhmann, Manitoba
Hydro

Hydro One: Reliability of Hydro One Distribution
Networks

William Luff, C-MORE

SOFTWARE DEVELOPMENT: SIMULATING LIFETIME DATA WITH COVARIATES

Neil Montgomery, C-MORE

LUNCH

ESTABLISHING NSERC INDUSTRIAL CHAIR TO C-MORE
15 minutes

Jennifer Lancaster
Senior development officer,
Major Gifts, U of T

MAINTENANCE SCHEDULING PROJECT WITH BOMBARDIER
20 minutes

Nima Safaei, C-MORE

IMPACT ASSESSMENT-BASED MODELS AT USE AND PRODUCTION LEVELS TO ACHIEVE SUSTAINABLE MAINTENANCE PLANS AND PRODUCTS
15 minutes

Hossein Mohammadian, C-MORE

DEVELOPING RESEARCH INTERESTS WITH STUDENTS
40 minutes

Quantifying Human-Related Factors to Assess System Reliability Using PHM and Logistic Regression

Corey Kiassat, C-MORE

Collaborative Health Research Project (CHRP) Program - Beginnings

Sharareh Taghipour, C-MORE

ANY OTHER BUSINESS

Andrew Jardine

EXECUTIVE SUMMARY

ANDREW K. S. JARDINE, C-MORE DIRECTOR

INTRODUCTION

The following report summarizes work undertaken between Consortium members and C-MORE since the December 7, 2010, meeting.

NEW RESEARCH FUNDING

Professor Andrew Jardine was recently awarded an NSERC-CIHR CHRP (Collaborative Health Research Projects) grant for a project titled “Risk factors and optimization model for breast cancer screening.” This is a collaborative project between the Centre for Maintenance Optimization and Reliability Engineering (C-MORE), and Co-PI Professor Bart Harvey and Co-Investigators, Professor Anthony Miller from the Dalla Lana School of Public Health, Professor Jeffrey Hoch from the Department of Health Policy, Management and Evaluation, and Dr. Terrence Sullivan of Cancer Care Ontario. The project received funding of \$411,638 over three years primarily to support a PDF (Dr. Sharareh Taghipour) and research students.

NEW RESEARCH FUNDING: APPLICATION TO NSERC FOR CRD SPARES

C-MORE has just submitted a new NSERC CRD grant proposal on Spare Parts: “Advanced Critical Spare Parts Provisioning Models.” It will further C-MORE’s work on spare part procurement decisions, developing new models for single and multiple types of parts, stored at single and multiple locations. The project will incorporate preventative maintenance policies, including condition-based maintenance, into the spare parts provisioning decision. This submission would not have been possible without the support of Hydro One, Barrick Gold, and ABB. Total funding sought from NSERC: \$88,048 per year for three years.

C-MORE STAFF AND STUDENTS

STUDENTS:

We welcome Luis Barberá Martinez, visiting doctoral student from the University of Seville, and JoAnne Fernandes, research assistant, who is working on the new CHRP.

We congratulate Sharareh Taghipour who successfully defended her doctoral thesis “Reliability and Maintenance of Medical Devices.” Additionally Sharareh has been recognized for the following:

- Best Student Paper Award of the 2011 Tom Fagan Reliability & Maintainability Symposium (RAMS), April 30.
- Nominated by the Department of Mechanical & Industrial Engineering for the 2011 Governor General's Gold Medal to honor academic excellence at the graduate level.
- NSERC Industrial R&D Fellowship (pre-approved) for 2011-2013.
- Third place, 2011 American College of Clinical Engineering (ACCE) student paper award.

Doctoral student Lorna Wong has received the following awards:

- Third place Student Paper Award of the 2011 Tom Fagan Reliability & Maintainability Symposium (RAMS). (April 30)
- Ontario Graduate Scholarship for 2011-2012. (May 2011)

Doctoral student Corey Kiassat has been awarded:

- Bill Shaw Memorial Graduate Fellowship (Ivara Corporation)
- OGS (Ontario Graduate Scholarship)
- SGS (School of Graduate Studies) conference grant

Doctoral student Janet Sung has received:

- SGS Winter 2011 conference grant
- MIE Graduate student travel grant, May 2011

This afternoon we will have presentations by two graduate students:

- Corey Kiassat: Quantifying Human-Related Factors to Assess System Reliability Using PHM and Logistic Regression
- Sharareh Taghipour: Collaborative Health Research Project (CHRP) Program - Beginnings

C-MORE LAB STAFF AND POST DOCTORAL FELLOWS (PDF):

Our Project Director, Dr. Dragan Banjevic, has continued his collaboration with Manitoba Hydro on CBM for power transformers with PhD candidate Lorna Wong. As always, he has worked with all members of C-MORE Lab: Sharareh on maintenance of medical devices, Janet on inspection intervals, Nima and Maliheh on scheduling problems, Tanya on FFI, and Neil on case studies. In addition, he has collaborated with Professors Jardine and Balcioglu in supervising graduate students.

Neil Montgomery has continued to be essential to ongoing collaborations with Consortium members. He provided support and commentary for the ongoing EXAKT modeling being done by two undergraduate students under the guidance of Barry Mirzaei at Hydro One. He worked on a final report for the UK MOD gearbox project and continued data gathering work on the ongoing Project Health Prediction project. Neil also worked with an undergraduate student in Statistics on programming PHM fitting and data simulation, which will be useful in further software development. Neil continued to provide general support to C-MORE graduate students working on their research projects.

PDF Dr. Ali Zuashkiani has been working on Maintenance Performance Management, with a focus on drawing dynamics governing asset management. Ali is also working on how companies

can use the dynamic map of their maintenance organization and manage their maintenance performances. Together with Nima, he has written a paper on Manufacturing System Design which is under review by IIE Transaction. Ali and Nima are also working on a paper dealing with forecasting future O&M costs of a fleet of transformers based on a past project done for a major utility company in North America. In addition to research activities, over the last few months, Ali has been working with Suncor Energy to help them implement Evidence Based Asset Management practices. Since March 2011, he has trained/coached more than 50 reliability engineers at Suncor. These projects have created/ will create substantial (multi-million-dollar) savings for the company. Ali continues to be in charge of C-MORE educational programs and is actively involved in planning IMEC 2011.

PDF Dr. Nima Safaei is involved in collaborative research “Resource Planning to Schedule the Maintenance Tasks in Bombardier” approved by MITACS in January. Since the project began in February, Nima has had a number of intensive interactions with Bombardier, particularly related to the definition of the project’s main objectives and data gathering. He regularly spends part of his working time in Bombardier offices.

PDF Dr. Hossein Mohammadian has recently joined us from Laval University. Dr. Mohammadian is working on “An Impact Assessment-Based Maintenance Model to Achieve a Sustainable Production/Use by Reliability Optimization.” His research interests are in reliability engineering, maintenance, sustainability, and accelerated life testing. He has already completed two projects on the reliability of automatic lathe machines and powered wheelchairs. He will be with C-MORE for the next two years.

SOFTWARE (EXAKT)

EXAKT, our CBM optimization software, is now available to consortium members for the following operating systems: XP/ Vista/ Windows.

C-MORE ACTIVITIES

Since December 2010, C-MORE lab members have been working on research, participating in conferences, and meeting with consortium members. C-MORE is currently involved in the following projects with industry partners.

- ABB: Supporting the NSERC CRD proposal being submitted on Spare Parts Provisioning.
- Hydro One: Supporting the NSERC CRD proposal being submitted on Spare Parts Provisioning.
- Teck Metals: Spare parts problem, in which demand for spares could come from a failure or an age-based replacement.
- MOD UK: Gearbox CBM case study.
- Manitoba Hydro: Data analysis of power transformers.
- Enmax: Supporting the current CRD on condition-based maintenance models.
- Ontario Clean Water Agency: Continued collaboration on maintenance of centrifuges
- Ontario Power Generation: Battery maintenance collaboration

C-MORE EDUCATIONAL PROGRAMS

Dr. Ali Zuashkiani has continued in his role as Director of Educational Programs with responsibility for developing various knowledge transfer activities through both new Physical Asset Management Certificate programs and our regular International Maintenance Excellence Conference (IMEC). The objective is to combine high quality content delivered by leading instructors with the academic rigour of the University of Toronto.

Notably, the most recent course, Physical Asset Management: Initiatives that Work, held last week at the University of Toronto, attracted 35 participants from Canada, the USA, Trinidad, and Thailand.

**THE INTERNATIONAL MAINTENANCE EXCELLENCE CONFERENCE (IMEC):
THE ASSET MANAGEMENT CONFERENCE – OCOBER 5-7, 2011**

We are delighted that in 2011, we are again working with Applied Technology Publications (ATP) as our media partner for IMEC-The Asset Management Conference (www.IMEC.ca).

This agreement formalizes a mutually beneficial partnership that connects C-MORE's leading research and training in the area of asset management with the vast marketing and industry reach of ATP, a respected publisher of high-quality information for asset management practitioners in North America.

THE C-MORE TEAM

We continue to have an excellent team of C-MORE staff and students. All are excited about our ongoing and new research activities. We can't say it often enough: the continuation of such activities requires close collaboration and frequent contact with consortium members. We value what has been achieved and are confident that we can maintain the support of members through the hard work and dedication of our staff and students.



Andrew K.S. Jardine

June 7, 2011