CENTRE FOR MAINTENANCE OPTIMIZATION AND RELIABILITY ENGINEERING SEMIANNUAL CONSORTIUM MEETING

MAINTENANCE OPTIMIZATION AND RELIABILITY ENGINEERING
CONDITION-BASED MAINTENANCE AND BEYOND

DIRECTOR
Professor Andrew K. S. Jardine

REPORT

Tuesday April 29, 2008
9:00 a.m.–4:00 p.m.

HILTON GARDEN INN
OAKVILLE, Ontario

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EXECUTIVE SUMMARY

ANDREW K. S. JARDINE, C-MORE DIRECTOR

INTRODUCTION

The following report summarizes work undertaken between Consortium members and C-MORE since the October 30, 2007 meeting on the project *MORE (Maintenance Optimization and Reliability Engineering): CBM (Condition-Based Maintenance) and Beyond.*

We are delighted today to welcome Enmax, Manitoba Hydro and TransCanada as our newest Consortium members.

NEW RESEARCH FUNDING

In January 2008 confirmation was received from the Natural Sciences and Research Council (NSERC) that they would fund our proposal titled, "Critical Spare Parts Provisioning: Models and their Application," at the level of $273,318 over a 3 year period ($91,016 per year). Professor Baris Balcioglu is the co-investigator on this project. This would not have been possible without the support of members ArcelorMittal Dofasco, Barrick Gold, Hydro One and Irving Pulp and Paper, who confirmed to NSERC their support of the research program.

A second research proposal titled, "Commercialization of the integrated maintenance analytical package, REWOP (Reliability Engineering Workbench Optimizer)" spearheaded by Dr. Daming Lin was submitted to ORCP (Ontario Research Commercialization Program) in partnership with OMDEC and was approved on March 18. This support provides $50,000 for a period of 1 year. In addition OMDEC will provide $20,000 of in-kind support.

C-MORE STAFF AND STUDENTS

Since our October 30 meeting former PhD student Diederik Lugtigheid successfully defended his doctoral thesis "Systems Subject to Repair and Maintenance Actions: Modeling and Optimization" at the beginning of November. Two new research students joined our group in January 2008: Lorna Wong as a doctoral student focusing on CBM, and Pedram Sahba as a research Masters student with a plan to fast-track to PhD, who will work on spare parts provisioning.

Sharareh Taghipour (PhD Candidate) successfully defended her research proposal entitled "Risk-based inspection and maintenance for medical equipment" on March 24. Kelly Kinahan (MASc candidate) is close to finalizing her MASc thesis under the supervision of Professor Balcioglu, and we expect her to complete her studies over the summer months.

We are pleased to be hosting Alfredo Suarez as a Visiting Research Associate from Cerrejón Mine in Columbia. He has more than 20 years of extensive hands-on experience in the field of Maintenance and Reliability Engineering and, while at C-MORE, is focussing on Wear-Debris-Centred Condition Monitoring.

We have been pleased to have visiting doctoral student Jan Block with us for a period of 3 months. Jan is from Lulea University in Sweden and is also Lead Computational Engineer, Logistics Analysis and Fleet Monitoring, Ground Support Services Division, Saab Aerotech.

Also with us for the past 2 months has been Aiwina Heng who joined the Lab as a visiting doctoral student from the Australian Cooperative Research Centre for Integrated Engineering Asset Management (CIEAM) at Queensland University of Technology in Brisbane.

We look forward to welcoming 3 new research students in September: Corey Kiassat, Ji Ye (Janet) Sang and Tiffany Matuk.

This afternoon we will have 4 presentations by graduate students:

- Optimizing capital equipment replacement decisions by Steve Stoyan
- Risk-based maintenance of medical devices by Sharareh Taghipour
- Optimization of repairable item maintenance at the phase-out of an aircraft fleet by Jan Block
- Repair shop centralization by Pedram Sahba

C-MORE Lab staff and Post Doctoral Fellows (PDFs): In January we welcomed Veena Kumar as our new Administrative/Research Assistant. Our Project Director, Dragan Banjevic, has continued development of procedures for knowledge extraction from experts in collaboration with PDF Dr. Ali Zuashkiani and continued examining the remaining useful life problem. Daming Lin did extensive research in the area of failure finding interval (FFI) for devices whose failures are hidden or not self-announced (dormant failures) and developed a proof-of-concept (alpha) version of FFI Optimizer software. Neil Montgomery continues his involvement in his primary activity of collaboration with supporting companies.

PDF Dr. Ali Zuashkiani's research is in the design of a maintenance performance management system. PDF Dr. Nima Safaei continues his research interests in solving complex combinatorial optimization problems and has started an extensive collaboration with ArcelorMittal Dofasco on their maintenance workforce dynamic scheduling problem.

We look forward to welcoming a new PDF, Dr. Behzad Ghodrati, who will join us in June from Lulea University in Sweden. He will be working closely with Consortium members on our collaborative projects.

SOFTWARE

I am very pleased that today an alpha version of FFI software to optimize the policy of testing/inspecting protective devices whose failures are hidden or not self-announced (dormant failures) will be delivered to Consortium members.

C-MORE ACTIVITIES

C-MORE has been busy during the October 2007 – April 2008 period participating in conferences and meeting with consortium members. C-MORE is currently involved in the following projects with our industry partners:

- Barrick Gold: Right sizing of truck shop bays
- ArcelorMittal Dofasco: Scheduling of maintenance crews
- Teck Cominco: Zinc dust line CBM and Spare parts provisioning with an installed standby unit
- Syncrude: Combining data from multiple sources.

COLLABORATIONS WITH CONSORTIUM MEMBERS

Due to the arrival of new students and new funding, Professor Jardine, usually accompanied by Neil Montgomery, has been visiting Consortium members with the goal of alerting colleagues of company representatives to C-MORE's activities and exploring possible new collaborations, including case study applications, in the focus areas of:

1. Condition-based maintenance of expensive long-life assets subject to condition monitoring
2. Capital/emergency spare stock sizing for parts critical to plant availability
3. Protective devices reliability for health, safety and the environment

Consortium members who were visited since our October 2007 meeting are: ABB, Enmax, Hydro One, Manitoba Hydro, Teck Cominco, Trans Canada and Vale Inco.

The visits have been invaluable, resulting in identification of several new collaborations. They will be outlined in more detail at this meeting.

C-MORE EDUCATIONAL PROGRAMS

I am very pleased that Dr. Ali Zuashkiani has taken on the role of Director of Educational Programs, with the responsibility for developing various knowledge transfer activities through both new Master Classes 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.

Master Classes

The Master Classes are designed to provide practitioners with first-hand knowledge to make them more effective in their workplaces in a short period of time- through an intensive, interactive training environment. We have several planned:

- Optimizing Maintenance Decisions to Achieve Excellence in Physical Asset Management: June 9-10, 2008
- Uptime - Strategies for Excellence in Maintenance Management: December 8-9, 2008

Future Master Classes will include:

- Risk and Financial Management in Maintenance
- Reliability Centered Maintenance

The International Maintenance Excellence Conference (IMEC)

IMEC 2008: October 22 - 24

As part of the Physical Asset Management Initiative at the University of Toronto, the University's Professional Development Centre is organizing IMEC 2008.

THE FUTURE

We continue to have an excellent team of C-MORE staff and students. All are excited about the future development of our research activities. As is always stressed, to continue such activities requires continuing close collaboration and contact with Consortium members. We value what has been achieved and are confident that we can maintain the support of members through the excellent staff and students committed to the research program funded by members, OCE and NSERC. I am pleased to have received many positive comments from Consortium members and others to our new name launched at our last meeting, namely the Centre for Maintenance Optimization and Reliability Engineering (C-MORE).