UNIVERSITY OF TORONTO
SCHOOL OF CONTINUING STUDIES

# Physical Asset Management Certificate Program

**AN INTENSIVE 8-DAY COURSE OFFERED IN PARTNERSHIP WITH THE FACULTY OF APPLIED SCIENCE AND ENGINEERING**

## NOVEMBER 6 – 10 and NOVEMBER 13 – 15, 2017

UNIVERSITY OF TORONTO
SCHOOL OF CONTINUING STUDIES

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FACULTY OF APPLIED SCIENCE & ENGINEERING

# Contents



## Proven Best Practices for Asset Management

Some organizations manage their assets well, while others do not. Why? Why are some outfits good at keeping costs low, reducing stoppages, spotting trouble, and achieving greater output, while others are not? How can you learn these skills? An excellent way to gain these skills is by attending this intensive eight-day program. You'll join a group of like-minded professionals who are guaranteed to come away with the necessary tools to competently and profoundly upgrade their asset management practices. Participants at earlier sessions have been extremely impressed by the high calibre of the program.

## Who Should Attend

Our November 2017 offering will mark the seventeenth year that the Physical Assent Management (PAM) program has been run. Managers from all corners of the globe, and from a wide variety of industrial and governmental organizations, have attended our earlier sessions. Attendees have included line managers responsible for the maintenance of their machinery and equipment, reliability specialists who must recommend effective maintenance practices, asset managers responsible for their organizations' maintenance strategies, and plant managers who seek excellent and proven strategies that give them competitive advantage over their competitors. Much of the instruction focuses on cost-related issues, and makes PAM appropriate as well for those on the financial side of their organizations.

If your responsibilities include any aspect at all of managing physical assets, we urge you to take a close look at this exceptional learning opportunity.

## The Extraordinary Value of this Program

The eight-day Physical Asset Management Certificate Program is offered in partnership with the Faculty of Science and Engineering at the University of Toronto, which has been designated the #1 Engineering school in Canada.

The program is taught by three world-class instructors who bring a wealth of experience to the classroom:

- a mastery of the subject matter;
- the ability to relate theory and practice;
- real-world experience with corporations and organizations;
- the ability to deliver material in an interesting and clear manner.

The program is led by Dr. Andrew Jardine, an international authority in the asset management field and a respected consultant, author, teacher and innovator in the area of reliability, replacement and equipment maintenance.

The program combines fundamental need-to-know material with new, but proven, leading-edge approaches that have shown measurable payoffs.

Participants will receive eight full days of instruction over the course of eight consecutive weekdays, including a wide range of case studies which demonstrate how these principles have been successfully and widely applied. You will come away equipped with complete binder notes on the program material, valuable hard-cover books, and an unparalleled learning experience.

The University of Toronto Faculty of Applied Science and Engineering is the

**#1**

**Engineering School in Canada.**

## Program Dates, Location, Tuition Fee and Registration

**Program Dates**

The eight full-day sessions will be held Monday, November 6 to Friday, November 10 and Monday, November 13 to Wednesday, November 15, 2017

**Location**

All program sessions will be held at the Faculty of Applied Science and Engineering on the University of Toronto's St. George campus.

**Tuition Fee**

The full tuition fee (including course materials) for the eight-day program is CDN$6,500., plus applicable taxes.

**How to register**

For more information, or to register for the November 2017 Physical Asset Management Certificate Program (SCS Course Number 2338-010), call **416.978.2400** or visit: **http://learn.utoronto.ca/courses-programs/business-professionals/certificates/physical-asset-management-certificate-2**

## Engineering Professional Development

The University of Toronto School of Continuing Studies (SCS), in collaboration with the Faculty of Applied Science and Engineering, offers many courses and certificates for people with a background in engineering and applied science. Additional SCS courses include:

- **Building Science Certificate**
- **Certificate in Facility Management**
- **Project Management**
- **Project Management Advanced**
- **Business Analysis**

For more detailed information about these and other programs, visit **www.learn.utoronto.ca**

**Days 1, 2, 3, 8**

INSTRUCTOR: Donald Barry

Donald Barry is Associate Partner, Global Center of Competency Lead/Advisor Predictive Analytics, Internet of Things and Asset Management IBM Global Business Services.

He is experienced at creating maintenance and distribution process improvements and developing inventory reduction strategies with increased service levels. His in-depth experience includes world-class inventory optimization and reutilization techniques.

In addition to teaching this asset management program, Mr. Barry also teaches a Maintenance Parts Excellence Program which is one of the maintenance Masters programs at the U of T.

His consulting clients have included leading companies in computer technologies, field service operations, airlines, railway manufacturing, mining, oil and gas, CPG, and power generation, transmission and distribution.

Mr. Barry is a recipient of the Lifetime Achievement Award in Plant and Production Maintenance, awarded by the Federated Press.

## What you will learn

Donald Barry's four days provide an in-depth examination of principles such as leadership, managing risk, and maintenance optimizations. His sessions will cover:

- The **ten key focus elements** that contribute to a successful maintenance organization;
- How to assess your organization's **maintenance maturity**;
- How to **prioritize** opportunities within your maintenance organization;
- The **key financial influences** of asset management;
- The **key metrics** for asset management;
- The **leading practices** in asset management;
- The value of properly executed **planning and scheduling**;
- The value of Reliability-Centred Maintenance (RCM2);
- The need to consider **people** as the major component of a successful asset management program;
- **Technology** trends in asset management;
- An approach to Total Asset Life-cycle Management (TALM);
- The value of **ISO 55000** in asset management;
- Key **initiatives to take back to your organization** to improve your asset management.

## Day 1

Monday, November 6
9am–5pm

### Leadership and Control

**In-class Session**
Faculty of Applied Science and Engineering

**Maintenance pyramid of excellence overview**
- Leadership, control, continuous improvement, and quantum leaps

**Maintenance strategy, managing change, maintenance tactics, Maintenance, Repair and Operations (MRO) materials management, and performance measures**

**The six key steps to planning and scheduling resources effectively**
- Planning exercise

**Strategic cost reduction**
- What does it really mean in maintenance?
- What can we realistically achieve?

## Day 2

Tuesday, November 7
9am–5pm

### Managing Risk and Reliability

**In-class Session**
Faculty of Applied Science and Engineering

**Risk and management**
- A discussion of the various approaches that are used, including: Hazard and Operability (HAZOP), risk-based inspection, the various Reliability-Centred Maintenance (RCM) methods, Root Cause Failure Analysis (RCFA) and PM optimization

**Reliability-centred maintenance and failure modes and effects**
- Asset-centric continuous improvement and risk reduction

**Total productive maintenance**
- People-centric continuous improvement

**Effective data management**
- Information strategies for risk management

**Maintenance management systems**
- Their role, selection and implementation

## Day 3

Wednesday, November 8
9am–5pm

### Optimizing Methodologies

**In-class Session**
Faculty of Applied Science and Engineering

**Quantum leaps in process improvement**
- Redesigning maintenance and MRO processes for maximum efficiency and effectiveness
- The Just-in-Time Process Re-Design Game

**Beyond Reliability-Centred Maintenance (RCM) and Total Productive Maintenance (TPM)**
- Entrenching continuous improvement

**Root cause failure analysis (RCFA)**
- Optimizing RCM results

**Balance scorecard, benchmarking, and key performance indicators**
- Optimizing human and asset performance by focusing on behaviour and results

**Introduction to decision making**
- Decision making optimization and its applications, optimizing life cycle decisions

## Day 8

Wednesday, November 15
9am–5pm

### Implementing Maintenance Optimization and Reliability Management

**In-class Session**
Faculty of Applied Science and Engineering

**The impact of change management in asset management transformation**
- Why is change management important in asset management effectiveness?
- How have successful programs embraced change effectively?
- What key steps contribute to successful change?

**Introduction to ISO 55000**
- What it is and how it can be used to leverage controlled change in asset management

**The evolution of the maintenance organization**
- New directions in the 21st century
- Moving from maintenance

**The impact of demographics on maintenance**
- How we must manage into the future

**New and leading trends in maintenance practices, tools and management**

**Trends in asset management supporting technology**
- Internet, m-business, sensors, RFID, and other tools in physical asset management

**A strategic approach to achieving maintenance excellence**
- Getting the technology, process and people "mix" right

**Days 4, 5, 6**

INSTRUCTOR: Dr. Andrew Jardine

Dr. Andrew K.S. Jardine, Ph.D., C.Eng., M.I.Mech.E., M.I.E.T., P.Eng. FCAE, FIIE, FISEAM (Hon.), is the Founding Director of the Centre for Maintenance Optimization and Reliability Engineering (C-MORE) at the University of Toronto. C-MORE's research is driven by close interactions with industry, in particular with C-MORE consortium members and with researchers at universities worldwide.

He is the co-editor (with J.D. Campbell and J. McGlynn) of *Asset Management Excellence: Optimizing Equipment Life Cycle Decisions*, published by CRC Press in 2010. His most recent book is the 2nd edition of his earlier work, *Maintenance, Replacement and Reliability: Theory and Applications*, published by CRC Press in 2013 and co-authored with Dr. A.H.C. Tsang.

Professor Jardine has garnered an impressive array of awards, honours and tributes, including having been the Eminent Speaker to the Maintenance Engineering Society of Australia, as well as the first recipient of the Sergio Guy Memorial Award from the Plant Engineering and Maintenance Association of Canada in recognition of his outstanding contribution to the maintenance profession. In 2013, he received the Lifetime Achievement Award from the International Society of Engineering Asset Management (ISEAM). In 2016 he received the 2016 Distinguished Educator Award from the Industrial Engineering and Operations Management (IEOM) Society at their Detroit conference. Professor Jardine is listed in Who's Who in Canada.

Besides writing, researching and teaching, Dr.Jardine has carried out innumerable consulting assignments with organizations around the world, including mines, government agencies, power and transit companies, and scores of others.

## What you will learn

Dr. Andrew Jardine's three days provide an in-depth examination of preventive maintenance, spare parts provisioning, inspection policies, and much more:

- Which **equipment components** should be part of your preventive maintenance plan;
- Which components should be run to failure;
- Why **Weibull Analysis** is a must in analyzing equipment failure;
- The importance of the **Weibull b parameter**;
- A sure-fire way to calculate your **spare parts requirements**;
- Which **replacement policy** to use for critical components: the block replacement or age-based replacement times;
- How to deal with **limited data**;
- Steps you can take to improve your current preventive maintenance program;
- How to interpret the **Bath-Tub Curve**'s "three regions" and what the interpretation will tell you;
- How to use **OREST software** to optimize component preventive replacement times;
- How to use OREST software to forecast the **demand for spare parts** taking into account an optimal preventive replacement policy;
- The right way to establish the **optimal inspection frequency** for equipment in continuous operation;
- The right way to evaluate the current interval between classes of inspection, such as A, B, C, and D;
- How to establish the most appropriate **failure finding interval** for protective devices;
- How to come up with the failure risk of equipment that is subject to **condition-based maintenance**;
- What the University of Toronto's new **EXAKT software** (for condition-based maintenance) and **SMS software** (for the provisioning of emergency/capital spares) may be able to do for you;
- How to establish the optimal composition of a **maintenance crew**;
- How to decide quantitatively whether to **contract out** specified maintenance tasks;
- The importance of **visual interactive simulation** to examine alternative resource configurations;
- How to develop optimal or near optimal **maintenance plans and schedules**;
- What goes into the design of an intelligent **computerized maintenance management system** (CMMS).

## Day 4

Thursday, November 9
9am–5pm

# Reliability Improvement through Preventive Maintenance and Optimal Spares Stocking Policies

**In-class Session**
Faculty of Applied Science and Engineering

**Analysis of component failure data**
- Probability density function
- Reliability function
- Hazard function
- Weibull density
- Infant mortality
- Bath-Tub Curve

**Exercise in analyzing component failure data using the Weibull distribution**
- Estimating the Weibull parameters
- The role of the OREST software package

**Dealing with censored data, the 3-Parameter Weibull, and the Kolomorgov-Smirnov Test**
- Upper-end censoring
- Multiply censored group data
- Estimating the location parameter in the Weibull distribution
- Checking the goodness-of-fit of the distribution

**Component replacement procedures including Glasser's Graph**
- Block replacement policies
- Age-based replacement policy
- Setting policies based on safety constraints, cost-minimization and availability-maximization
- Repairable systems

**Case studies in component preventive replacement**
- Including boiler plant, bearings, transmissions, clutches, pumps, sugar feeds, compressor valves and centrifuges

**Spare parts provisioning**
- Fast-moving spares
- Emergency (insurance) spares

**Case studies in spares provisioning**
- Including line replaceable units (LRUs), cylinder heads, repairable electric motors and transformers

**Group and individual exercises**

**Clinic**
- Hands-on use of PC software (OREST) for preventive replacement strategies
- Participants will solve pre-set problems

## Day 5

Friday, November 10
9am–5pm

# Reliability Improvement through Preventive Maintenance

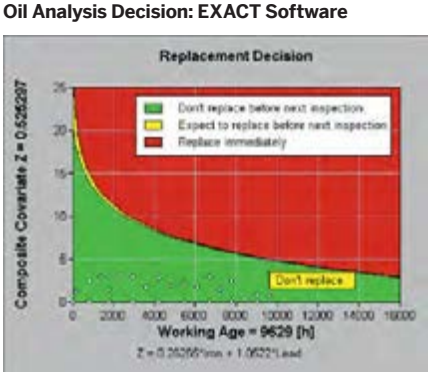
**In-class Session**
Faculty of Applied Science and Engineering

**Reliability improvement through inspection**
- Inspection frequency and depth for equipment in continuous operation
- Inspection intervals to maximize profit
- Maximizing equipment availability
- Inspection intervals for equipment used in emergency situations (e.g. protective devices)
- Case studies including transportation fleets (for inspection frequency) oil and gas field equipment such as pressure safely valves (for protective devices)

**Reliability improvement through health-monitoring procedures**
- Proportional hazards modelling
- Spectroscopic oil analysis programs
- Optimization of condition-based maintenance procedures
- Role of EXAKT software for Condition-Based Maintenance (CBM) optimization
- Case studies including food processing industry (vibration monitoring), pulp and paper and shipping equipment such as compressors (vibration monitoring) and diesel engines (oil analysis), turbines in an electrical generating station (pressure measurements)

**Demonstration of EXAKT software for optimizing condition-based maintenance decisions**

**Oil Analysis Decision: EXACT Software**




# Day 6

Monday, November 13
9am–5pm

## Effective Use of Maintenance Resources, Scheduling and Planning

**In-class Session**
Faculty of Applied Science and Engineering

**Organizational structure, crew sizes, workshop resource requirements**

- Balancing maintenance costs against plant reliability
- Establishing the optimal number of machines to have in a workshop
- Resource requirements using queuing theory and simulation
- Utilization of outside resources
- Lease vs. buy decision
- Case studies including optimizing mobile fleet size to meet an annual demand, establishing optimal mix of machines to have in a steel mill maintenance workshop

**Maintenance management information systems**

- A 7-step methodology for auditing a computerized maintenance management system (CMMS)

**Maintenance planning/scheduling**
Four classic maintenance scheduling/planning cases will be explored and solution procedures identified:

- **Case 1**
  The first case is related to an organization that moved to a plant-wide scheduling approach through a central department, called the central services department (CSD), to respond to the maintenance requirements of manufacturing/business areas (MAs) in the plant. The aim of this department is to minimize workforce costs and avoid long-term disruptions and shutdowns of the equipment within MAs. Each MA schedules its maintenance jobs and submits them to CSD, which attempts to schedule the workforce to meet needs across the plant. An optimal schedule is developed for such a scenario. The skilled workforce is provided by internal and external resources using regular time, overtime and contracting. The equipment availability is measured by the downtime required for preventive maintenance (scheduled) and failure repair jobs (unscheduled).
- **Case 2**
  The second case is related to the operation of a fleet of military aircraft with a particular flying program in which the availability of aircraft sufficient to meet the flying program is a challenging issue. During pre- or post-flight inspections, some component failures of the aircraft may be found. In such cases, the aircraft are sent to the repair shop to be scheduled as maintenance jobs, consisting of failure repairs or preventive maintenance tasks. The objective is to schedule the jobs in such a way that a sufficient number of aircraft are available for the subsequent flight programs. The main resource in the shop — as well as the main constraint — is a skilled workforce.
- **Case 3**
  The third case relates to the annual planning of the maintenance workforce of an electricity transmission and distribution company. Internal and external workforces are employed to perform maintenance actions and restore power after interruptions throughout the region. Each region is divided into 50 operating centres (OC), each having local crews to perform maintenance actions and fix power interruptions. However, determining the size of the crew in each OC, and also for each month, is challenging. The reason for this is that the frequency of the interruptions differs from one OC to another and from one month to another, being affected by various factors such as system configuration, deterioration and failure of the equipment, weather conditions, etc. The objective of this scheduling problem is to establish how many internal and external workers should be available during the year to cover possible interruptions across the region with minimum cost and minimum interruption duration.
- **Case 4**
  The final case is an aircraft manufacturer that has a multi-skilled workforce in which skilled maintainers are divided into a number of trades with specific skills. Each scheduled job needs a fixed number of workers from each trade. In addition, jobs are multi-type, and may be on-site (line maintenance) or off-site (hangar maintenance). The manufacturer also has a multi-shift workforce where the number of work shifts per day varies depending on the operator/airline fleet size, the scope of the work being completed, and the availability of manpower. In some instances, line and hangar maintenance are split into two separate groups, while in other cases, they are combined, thereby creating split/overlapping shifts. This creates a maintenance scheduling problem with a multi-skilled, multi-shift workforce, and multi-shop properties. The goal is to minimize the labour workload and idle-time fluctuations, while finishing maintenance tasks in a timely fashion.

**Maintenance Planning and Scheduling cases will be discussed by Dr. Nima Safaei (see page 11 for Dr. Safaei's bio.)**

**Day 7**

INSTRUCTOR: Dr. Ali Zuashkiani

Dr. Zuashkiani, Ph.D., B.Sc., is Director of Educational Programs at C-MORE and has years of practical experience combined with scientific rigour in optimizing asset management decisions. His consulting endeavours include several Life Cycle Costing management projects for utility and gas distribution companies in North America, RCM implementation projects in power plants, oil and gas plants, and electricity distribution industry, and assignments dealing with asset management practices in 85 plants in the Middle East and South America.

His areas of expertise include maintenance performance management, life cycle costing, use of tacit knowledge in asset management, optimization of maintenance tactics, reliability-centred maintenance, root cause analysis, planning and scheduling, spare part management, asset management strategy development, implementation of CMMS software packages, and managing change in organizations.

He is the author of *Expert Knowledge Based Reliability Models* and a frequent global speaker on a range of pertinent subjects in asset management.

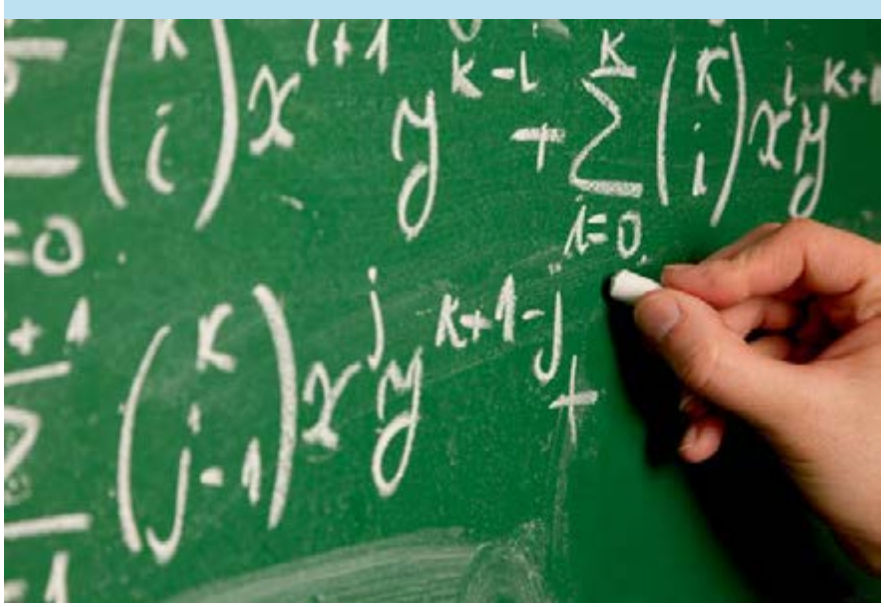
Dr. Zuashkiani has been Chair of the International Physical Asset Management Conference for the last 13 years.

Dr. Zuashkiani was named by the Asia Society as one of the world's most dynamic young leaders in 2008. He is also recognized by the World Economic Forum as a Young Global Leader of 2013. Ali is an RCM2 practitioner working with Aladon Network and is responsible for RCM implementation in the Middle East region.

## What you will learn

Dr. Ali Zuashkiani's day-long session provides an in-depth examination of life cycle costing, and much more. His session covers:

- **When to buy** a new asset;
- Identifying the **best buy**;
- Why you should incorporate **the time value of money** when establishing the economic life of an asset;
- How to arrive at the economic life of an asset where its **utilization declines** as it ages;
- What approaches to use for **monitoring the performance** of an individual asset;
- The answer to optimizing the **repair-or-replace** decision;
- How to work with AGE/CON and PERDEC to perform **economic life calculations**;
- How **tax considerations** influence the economic life of an asset;
- Whether or not to take advantage of a **technologically-improved** asset;
- How to predict future O & M costs when there is **little data available**;
- How to elicit **tacit knowledge** from specialists to improve economic life decisions.



## Day 7

Tuesday, November 14
9am–5pm

# Life Cycle Costing (LLC) Management

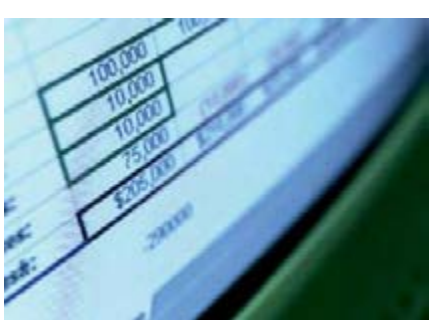
**In-class Session**
Faculty of Applied Science and Engineering

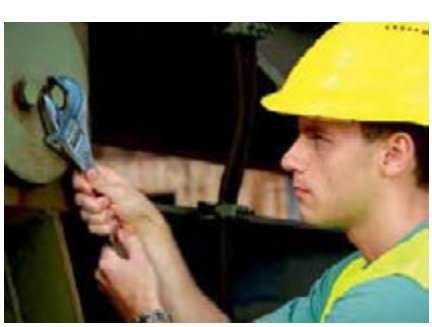
Organizations adopting Life Cycle Costing are rapidly increasing in number, as more of them recognize its role in making optimal long-term decisions. The idea of "buying the cheapest" is losing its appeal as more managers realize that, in the long run, the cheapest acquisition costs rarely coincide with the least expensive buy. This session combines Life Cycle Costing decisions with many real-world examples in an interactive and hands-on forum. It will help those responsible for LCC-related decisions to learn when to buy a new asset, how to determine the best time to replace an existing asset, and how to forecast the future life cycle costs of their fixed and mobile machinery and equipment.

The application of the models discussed in the workshop will be demonstrated by means of real case studies. We will introduce software packages called AGE/CON (for mobile equipment replacement decisions) and PERDEC (for fixed capital equipment decisions) and demonstrate how to use them to solve LCC problems. We will also display a software package that can be used to predict future operation and maintenance costs.

**Life cycle costing management and why it is important**
- Definition of life cycle and its implications
- Life cycle costs categories
- Solving inter-departmental conflicts in asset replacement/acquisition decisions
- The size of the prize

**Choosing the best buy in the long term**
- The concept of the time value of money
- Defining cash flow diagram
- Calculating net present value of a decision
- Estimating the time value of money in practice



**Calculating the economic life of an asset**
- The trade-off between O & M costs and capital expenditures: establishing the economic life of fixed equipment such as an internal combustion engine
- South American case study: establishing the economic life of mobile equipment, including fleet vehicles and fork lift trucks
- North American case study: establishing the economic life of manufacturing equipment that is highly utilized when new, but used for peak demands as it ages
- North American case studies: transportation
- Turbo expander case study: how to calculate the best time to replace the current asset with a more technologically-improved asset

**Repairing an existing asset versus buying a new one**
- South American case study: repair or replace a loader
- North American case study: repair a leak or replace the damaged section of an underground pipe

**Predicting future life cycle costs of a fleet**
- North American case study: a fleet of transformers of a major electricity distribution company

**Carrying out LCC analysis when there is limited (or no) data available**
- North American case study: establishing the economic life of linear assets such as the steel mains of a major gas distribution company
- North American case study: estimating the distribution of end of life of transformers based on experts' opinions

**Case Studies**
The case studies referred to above include internal combustion engines, fleet vehicles, forklift trucks, a turbo expander, a loader repair-or-replace decision and a fleet of transformers. They represent real-world examples where companies saved hundreds of millions of dollars by applying LCC management principles.

**Clinic**
- AGE/CON software for the optimization of the economic life of mobile equipment
- PERDEC software for the optimization of the economic life of plant equipment

# Guest Speakers

GUEST SPEAKER: Dr. Nima Safaei

Dr. Nima Safaei is Associate Director, Network Analytics at Scotiabank, Data Science and Analytics Lab, Toronto, ON.

## Maintenance Scheduling for Commercial Aircraft Fleets

**Right Aircraft, Right Place, Right Time: The Art of Coordination Between Aircraft Routing and Maintenance Scheduling Modules**

Dr. Nima Safaei has a Ph.D. in system and industrial engineering with a background in Applied Mathematics. He is currently Associate Director, Network Analytics at Scotiabank's Data Science and Analytics Lab. Formerly Nima was with the Department of Maintenance Support and Planning, Bombardier Aerospace where his main focus was on maintenance routing and planning for commercial aircraft fleets. Before joining Bombardier Dr. Safaei was a Research Fellow at C-MORE working on various maintenance planning and scheduling problems in collaboration with ArcelorMittal, UK Ministry of Defence, and Hydro One Networks.

GUEST SPEAKER: Lloyd Chiotti

Lloyd Chiotti is the Former Director of Asset Management Strategy at Enbridge Gas Distribution.

## Industry expertise

**A Practical Application of Life Cycle Costing and Maintenance Optimization to Natural Gas Distribution Assets**

Lloyd Chiotti holds an Engineering degree and an MBA, both from the University of Toronto. He held a number of senior management positions with Enbridge Gas Distribution (formerly The Consumers Gas Company) over his 30-year career. Now retired, Lloyd is still actively involved in engineering and asset management. Prior to his retirement, he joined the Engineering Department to lead the Asset Management initiative as Director, Asset Management Strategy. In addition to these responsibilities, he took a leadership role in helping Enbridge prepare for a new regulatory framework (moving from "Cost of Service" regulation to "Incentive" regulation).

GUEST SPEAKER:Neil Montgomery

Neil Montgomery is Associate Director at the Centre for Maintenance Optimization and Reliability Engineering (C-MORE) at the University of Toronto.

## Make your databases work for your asset management needs

**Data fitness for purpose: assessing the quality of industrial data for use in evidence based asset management**

Neil Montgomery is educated in mathematics and statistics, and has been applying this knowledge to real-world optimal maintenance decisions while working at C-MORE for eleven years. Neil's principal responsibility is collaborating with Consortium members on optimal maintenance decision problems, case studies involving real industrial data, and applications of C-MORE software packages EXAKT for optimizing maintenance decisions and Spares Management Software (SMS). He has extensive EXAKT application experience with Syncrude, Irving Pulp and Paper, U.K. Ministry of Defence, Zachry Construction, Teck Resources, TransCanada Pipelines, EDF (French nuclear power generation), Hydro One, and XEROX.

# Evidence-Based Asset Management

**Examples of the program's leading-edge thinking**

Our classroom sessions cover the important fundamentals in the field of physical asset management, including the decision-making principles for inspections, scheduling, repair vs. replacement, spare parts, etc. These principles are presented in an innovative and refreshing manner.

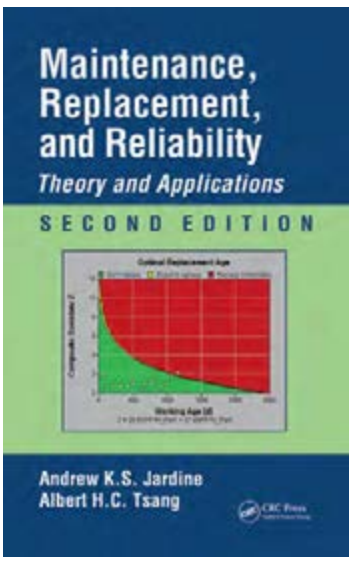
You will learn that *hunches*, *rules of thumb*, *intuition*, and *years of experience* are no longer effective tools for making important asset management decisions. Our team of experienced instructors is solidly committed to today's prevailing acceptance of decision making based on **evidence** and **data collection**. They demonstrate this by presenting innovative concepts that have been proven in practice and which are acknowledged as true advances by experts in the field. Two key advances that will be covered in depth are the principles of evidence-based asset management and tacit knowledge.

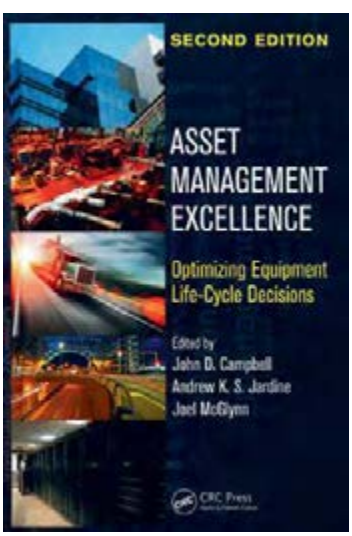
**Evidence-Based Asset Management (EBAM)**
Dr. Jardine describes evidence-based asset management this way: "Evidence-based medicine is considered the gold standard in modern medical practice. Why shouldn't evidence occupy the same rank in the costly, critical area of asset management? We think it should, which is why we so strongly recommend that decisions made today be based on the solid foundation of EBAM."

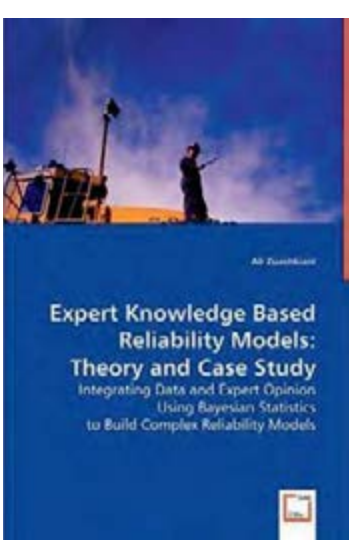
Where does this evidence reside? Where can we find it, and how can we identify and extract it?

**Tacit Knowledge**
New work on tacit knowledge has already produced tangible results. It started as a concept — the idea that, very often, seemingly thin data records or ostensibly ill-defined numbers can, with the inventive application of certain algorithms, uncover an abundance of useful information. Tacit knowledge has now progressed beyond the notional stage to yield valuable information that allows proper analysis to be carried out. Tacit knowledge is gained through the employment of a technique known as **knowledge elicitation**, which calls for the enlistment of colleagues in operations, maintenance, engineering and finance to determine modelling parameters and fill gaps in the available stored data.

These are but two examples of the kind of unique learning you can expect to come away with at the end of our intensive eight-day program.




## Real-World Experience

The eight sessions will feature a variety of instructional modes and interactivity. Dialogue is encouraged and specific questions relating to one's own challenges will be addressed (or responded to outside of classroom time).

Case studies drawn from actual industry experience will be used extensively, supplemented by individual and group problem-solving sessions.

Unique elements will enhance the learning experience. For example, Dr. Jardine will combine the presentation of EBAM (evidence-based asset management) methodologies and tools with many applications of their use in multiple asset management settings such as steel making, food processing, military, mining, oil and gas, pulp and paper, railway systems, transportation, and electricity generation, transmission and distribution.

In addition, Dr. Jardine will facilitate participants through several exercises using three software packages specifically developed for optimizing preventive replacement decisions and forecasting the demand for fast-moving spare parts (OREST), establishing the optimal number of critical spares to stock (SMS), and optimizing CBM decisions (EXAKT). Don Barry will lead participants through a particularly important and revealing real-world case study. A highlight of his sessions is the always popular Planning and Scheduling Game that will help participants understand the real value of maintenance planning and scheduling and the importance of good execution.

Course details are subject to change. For the most up to date information, please see our website at:

**learn.utoronto.ca**

## Deliverables

**What you will receive**

The eight intensive, day-long classroom sessions are the centerpiece of your experience at the Physical Asset Management Certificate Program. However, *much more* is provided, creating an overall package that will engage you while you're here, and deliver long-lasting results that will pay off when applied within your organization.

You will receive:

- 56 hours of classroom time
- Breakfasts and luncheons served at the seminar facility
- Three impressive hard-cover books (pictured at left): two co-authored by Dr. Jardine, one written by Dr. Zuashkiani
- Three knowledgeable guest speakers, who will talk about life cycle costing and maintenance optimization, and effective maintenance scheduling
- A program certificate from the University of Toronto acknowledging your completion of the program
- Two evening occasions for mixing and socializing: dinner at the University of Toronto's venerable Faculty Club, and a spectacular visit (with dinner) to the top of the CN Tower, the tallest free-standing structure in the Americas
- Ample opportunities (before the program begins, during evenings and on the free weekend) to get to know Toronto — Canada's largest city, renowned for its artistic and multi-cultural offerings

# Accolades from past attendees

**Here's what earlier attendees have said:**

"Real industry examples and cases on application of theory."

"It presents an overall view and provides tools for management."

"Good blend of theory and practical applications."

"Liked the C-MORE case studies."

"Very much appreciated the course material reviews at the beginning and end of the day."

"Wide-ranging..."

"Touched on all areas."

"Learned the differences between supplier, manufacturer and user-based maintenance plans and strategies."

"The sharing of attendees' experiences added a lot."

"The leaders had the ability to relate complicated formulas to the applications needed back at work."

"The instructors had lots of hands-on experience to draw from."

"Good mix of academic material with practical applications."

"Combines asset management ideals with maintenance realities."

"There were lots of examples that included real companies' experiences."

"Constantly brought together theory."

"It was great — learned from the leaders' wealth of experience and real-world examples."

"A difficult subject — well presented, instructors are excellent communicators."

"Lots of material. I can use it to improve our company."

"Thought provoking. We've come a long way, but this course has encouraged even more future development."

# Sponsors

## Corporate Sponsor

We are honoured to have received valuable material and advisory support from IBM Canada.

## Participating Organizations

This is a partial list of organizations which have sponsored participants attending our physical asset management programs. These organizations come from both the corporate and public service sectors — from outfits that deal with a wide variety of products and services and from various countries around the world.

Agrium
Accenture Canada
Astra Zaneca Canada Inc.
ATCO Electric
Babcock Canada
Barrick Gold Corporation
BC Hydro
Bell Canada
BP America Production Inc.
British Airport Authority
British American Tobacco
Canadian Forest Products Ltd.
Celanese Canada Inc.
Chevron Australia Ltd.
City of Niagara Falls
Clark
Con Cast Pipe
Department of National Defence
Department of Defence (Navy)
ExxonMobil Corporation
GO Transit
Great Lakes Power Ltd
HaasKorea Corporation
Horizon Utilities
Hydro Electric System Ltd.
IBM Canada
Inco Ltd.
Irving Pulp and Paper
J.D. Irving Limited
Kennecott Copper Corp. Kimberly
Kinross Gold Corporation
Komatsu Canada Ltd.
Krupp Engineering Australia
Loblaw Companies Toronto
Machine Diagnostic Inc.
Manitoba Hydro
Newfoundland & Labrador Hydro
Novartis Pharmaceuticals
Ontario Clean Water Agency
Ontario Ministry of Natural Resources
Ontario Power Generation
Pacific Power
Petroleum Co. of T&T Ltd.
Placer Dome Inc.
Purolator Courier Limited
Queensland Alumina
Rockwell Automation
Saint-Gobain Glass UK
Sherritt International Corp.
Shin Etsu Handotai Europe
SKF Canada Inc.
SLH Transport Inc.
Smurfit-Stone Container Corp.
Terasen Gas Inc.
Tillsonburg Fire Services
Toyota Motor Manufacturing UK
TXU Electric
Unilever Canada
Weyerhaeuser Canada

## Toronto: A great destination

If you're from out-of-town, you'll find that Toronto itself is an exciting "extra". Our vibrant and cosmopolitan city attracts visitors from around the world who come to experience Toronto's rich and fascinating multi-cultural character, its delicious international cuisines, and its compelling choice of arts, architecture, live theatre and music offerings. Not to mention sporting events — your chance to see the Maple Leafs in action! You'll have a whole weekend between course sessions to experience our city and all it has to offer.

Visit **toronto.com** or **seetorontonow.com** for exciting ideas that will make your visit to Toronto delightfully memorable.

# Reinvent
# Rediscover
# Rethink
# Reimagine
# Refocus

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