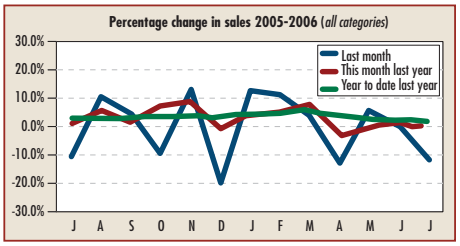
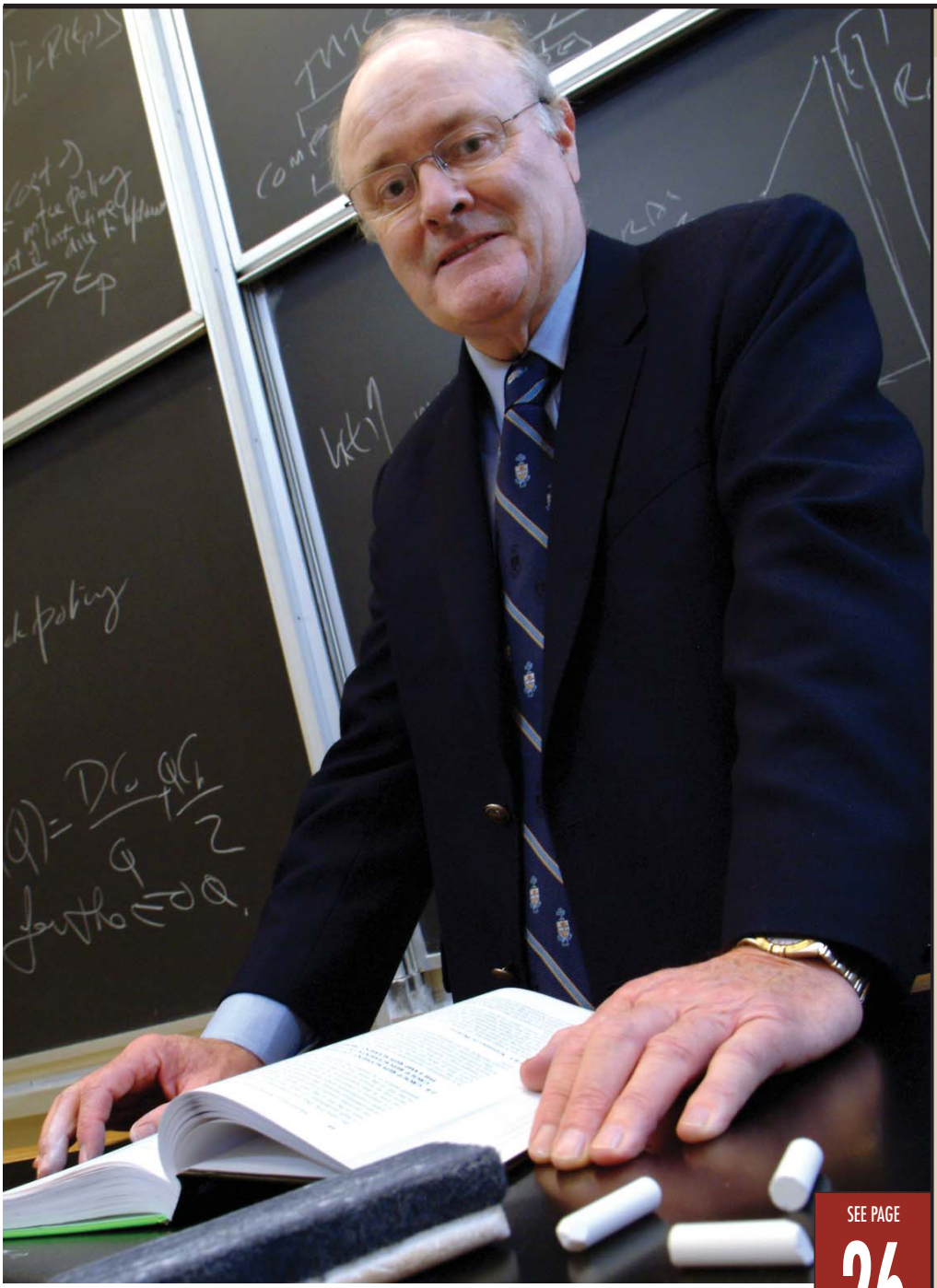
MEM
MACHINERY ENGINEERING & MAINTENANCE



Canadian manufacturers' year-to-July sales of power transmission/motion control products gained 2% compared to sales for January through July in 2005. Sales declined 11.5 % over the previous month and decreased 0.6% compared to July 2005. SOURCE: POWER TRANSMISSION DISTRIBUTORS ASSOCIATION



Andrew Jardine, professor at the University of Toronto, has been applying science and mathematical modeling to maintenance for years. The software he develops that optimizes maintenance decisions is sought by companies around the world. PHOTO: STEPHEN UHRANEY

SEE PAGE 26

30

TAMING ROGUE COMPONENTS, 29
OPG RESTRUCTURES ITS COAL FLEET, 30

NEWS CLIPS

Suncor's oil sands primary extraction plants separate raw bitumen from the sand in giant separation cells.

PHOTO: SUNCOR ENERGY

Suncor production returns to capacity

Fort McMurray, Alta: Suncor Energy Inc. successfully completed maintenance on a coker fractionator at the company's oil sands facility.

During the maintenance period, which began Sept. 14 and ended ahead of schedule on Sept. 24, oil sands production was reduced by 40 per cent. But Suncor doesn't expect the maintenance outage will impact annual production of 260,000 barrels per day.

Suncor Energy is an integrated energy company headquartered in Calgary.

Blast furnace outage

Hamilton: Stelco Inc. said a scheduled maintenance outage at its Hamilton Steel blast furnace likely won't affect workers or customers.

The temporary shutdown starts Oct. 23.

"Workers will be reassigned into other project work in other departments" at the factory," said Stelco CEO Rodney Mott.

Stelco also announced a six-day maintenance outage in the fourth quarter at its Lake Erie hot mill.

Husky issues dividend

Toronto: Husky Injection Molding Systems Ltd. has instituted a dividend after earning US$25.7 million in its financial year ended July 31, up from $2.1 million in the prior year as sales increased 9 per cent.

The plastic injection equipment maker's sales were US$935.3 million, up from $860 million. Sales in the fourth quarter slipped to $248.2 million from $253.6 million, and net income was $2.2 million, down from $6 million.

The May-July profit decline "resulted from higher selling and administration expenses combined with an increased effective income tax rate, which more than offset higher gross profit and lower interest expense," the company stated.

However, orders increased to $243 million from $188 million.

Canadian Press, Plant

Thriving on failure

BY MIKE OUELLETTE, ASSOCIATE EDITOR

How do you define failure? This question was recently posed by Andrew Jardine to tickle the brains of his youngest mechanical engineering students, and he wasn't looking for the standard dictionary definition. Jardine, who has no less than 22 letters after his name signifying the extent of his academic and professional achievements, is a professor of some distinction at the University of Toronto.

While he does handle some classes–he teaches a graduate course on engineering maintenance management to the university's engineering students–you won't learn that from his bio. Instead, the document outlines his role running the Condition-Based Maintenance (CBM) consortium, a group of 11 successful Canadian companies driving Jardine's highly analytical research.

His bio also lists the string of maintenance and reliability books he has authored dating back to 1973, and an equally long list of software he developed for maintenance decision makers. Add to this a smattering of awards and other maintenance-related Kudos and a listing in the *Canadian Who's Who*–a directory of notable Canadians–and you begin to get a feel for the importance of this maintenance luminary.

"I'm a mathematical modeller–an engineer–I am concerned with helping people make better asset-management decisions," he says in a quiet Scottish accent.

Jardine packs giant intellect in a compact frame, exuding quiet confidence and modesty. His responses are prefaced by long pauses as he weighs his words carefully to fully reflect his intended meaning.

"When I started, many people thought maintenance was art rather than science. But I could bring the management decision-making I learned in University to bear on the maintenance field, where I had some practical experience. It was not a hot research area and I was fortunate to have the opportunity to explore it. It's developing now."

Jardine and his crew of nine staff, students and researchers spend their days applying science to common–and some not-so-common–asset management scenarios.

"Our work at CBM optimization is a big area of development over the last few years–a lot of condition monitoring is happening because the technology to acquire the data and do signal processing is getting cheaper. We are trying to help companies smartly interpret those signals."

Because of this research, Jardine and his team now recognize which signals are highly correlated with failure and can plug-in the economic consequence of such an event to help make the best economic decision. Call it a business case for performing good asset management.

"What we have seen, especially in major corporations that spend a lot of money on maintenance, is that they have all this data and no one is interrogating it," says Jardine. "Now they want to make smarter decisions that take advantage of the data they're already collecting. Often they don't know what tools to use." He says many of those tools have existed for years, such as models that show when it's best to change out equipment, what the life is of an asset, but the data has not always been available. That has changed.

"The tools have developed over the years and as they are used, limitations become known, which gives us new ideas to develop new tools."

Bringing the power of mathematics, statistics and software programming to bear on maintenance problems has earned Professor Andrew Jardine's team more than one gold star.

PHOTOS: STEPHEN UHRANEY

Jardine gets excited about the implications of applying these software routines and algorithms on a broader basis, sensing prolific savings are on the horizon for companies doing it properly.

"When a company purchases a new asset, they often follow manufacturers' maintenance recommendation. But with all the ERPs and other systems coming into place, [end-users] are collecting data about operating environments they can use to get better performance than the supplier recommendation."

He notes that while there is nothing wrong with a manufacturer's maintenance recommendations–in fact, they are often quite good–the OEM doesn't know your operating environment and it doesn't know the consequences of failure. It tells all end-users to maintain the equipment in the same manner. But now companies can maintain assets in a smarter fashion by using the tools to get all the available information.

Where does one acquire such software tools?

While a couple of suites developed by Jardine's team have recently seen a push towards commercialization, you won't see any of these complex subroutines on the shelf at the local Future Shop.

The best bet may be to start networking at the second annual International Maintenance Excellence Conference (IMEC) on Nov. 1-3. This three-day meet is comprised of some of the world's top maintenance intellects. The conference is run by Jardine's condition-based monitoring lab and sponsored by its members. It promises two days of speakers covering topics in five main areas: optimization; maintenance tactics; continuous improvement; strategy and leadership; and process redesign. While the coffee break conversations would overwhelm and confound CEOs and shop-floor maintainers alike, a savvy maintenance manager with a desire to improve his team's decisions would fit right in. Indeed, to maintain the quality of these conversations IMEC has capped its attendance at this conference at 200 delegates, each one vetted for their relevance–no salesmen at this party.

It's the international flavour of this maintenance event that has Jardine sparkling. He claims delegates will visit from such exotic locales as Chile, South Africa, Australia and several European countries. He knows they are coming, because they have visited already.

The university runs an eight-day certificate course for maintenance professionals that's world-renowned. This course was the basis for IMEC's content and several past participants are speaking at the conference. As recently as this summer, the certificate course attracted professors from Chile and Australia who stayed on to continue research into several areas of evidence-building in maintenance.

Jardine says the program has firmly solidified Canada's place as a home for upper echelon maintenance theory.

"In terms of developing methodologies and tools that improve maintenance excellence globally, I don't think there is any doubt that in academia we are very highly respected," he says.

Finding answers

A new area of research developed in conjunction with the visiting scientists is now a main focus for the researchers at Jardine's CBM lab. Its aim is to predict inspection intervals of protective devices–usually pressure safety valves or similar gadgetry found in oil and gas and other process industries. These units act as a watchdog–if a problem occurs, you want the watchdog to work so you must check it periodically. The question is how often do you check them, especially when a plant could have hundreds?

"I have a research student working in that area. The professor from Chile collaborated closely with that student," says Jardine.

"This resulted in the development of mathematical models that determine how often a company should check such a unit, depending on many site-specific factors–you have to plug the data in to get the answer."

This is the essence of Jardine's work, and has been for many years–the development of formulae that crunch process data with other known values to produce an optimum result.

This type of research depends heavily on the dialogue between practitioners and researchers, which is the motivation behind the CBM consortium's bi-annual meetings to discuss its member's process conundrums.

"One of the reasons we have been successful is we collaborate with companies that want excellence in maintenance practices. They give us ideas, which drive the theoretical work to keep delivering top quality tools to consortium members–it's real world research," says Jardine,

"To try and make a good decision, we ask [the decision makers] what factors are important to them," he says. "Either they want to determine the best frequency to maximize availability, minimize total cost or maximize profit–once we know the goal we build the mathematical model."

With that model in hand, Jardine heads back to the company to plug-in the data.

"We build tools from the problem out to get a model that reflects the decision they want to optimize."

Jardine calls this approach evidence-based asset management, and he thinks we will be seeing more of this trend in the near future.

"Evidence-based maintenance decisions are what people are after now. It's easy to make decisions; companies are always making decisions about how they care for their assets. But they are collecting data in their corporate databases, they now have evidence that can justify whether the decisions they are making are the best or if they should be modified. That's going to become more important," he says.

The software tools Jardine has developed were made for specific problems but are inherently general in nature.

If you analyze a haul truck at Canadian diamond-mining company Diavik, for instance, the key measurements of that asset may be different from the same model of haul truck working in western Australia. But the mathematics behind the tool is the same. They can be applied in other companies with their own data.

Jardine thinks the flexibility of the new generation of maintenance tools being developed under his tutelage, when mixed with the prolific data-gathering of enterprise management systems, will change

Continued on page 28

Jardine, flanked by his condition-based monitoring team in one of two lecture halls for maintenance in engineering. The group consists of students, scientists, statisticians and an administrator.

Mathematical model citizen

Continued from page 27

the way maintenance is done.

"People are spending far too much money doing predictive maintenance. We should be spending more time trying to understand all these measurements," he says.

"In our collaboration with the CBM, when we analyze the condition-based maintenance, we find we don't need all the measurements taken to make good decisions. We [as an industry] tend to measure too frequently. We can have an impact on the bottom line when we don't waste money inspecting when it's not necessary."

These new maintenance theories are expected, at least by Jardine, to expand further in the process, mining, national defence and oil industries. There is one segment of the economy, however, that has been slow in coming along.

"We find that manufacturing does not have a lot of interest in the sort of things involved in maintenance excellence," says Jardine.

Indeed, at press time, none of the conference speakers or delegates worked at manufacturing companies.

"For some reason, I think maintenance has not gotten into the boardroom as being a high-cost area though it may represent 15% to 20% of their annual budgets. I know they do condition monitoring, but for some reason the type of work we do has just not gotten the attention of manufacturing. The sector will embrace the methodology of total productive maintenance, but when it comes to the methodologies of reliability-centred maintenance, for example, or using maintenance optimization models to make business decisions, I don't see it in that industry."

Not that Jardine's research group hasn't tried. He admits to making at least one overture to a Big 3 automotive manufacturer. It expressed interest at the time, but failed to pursue the matter.

Defining failure

"If you go to the defence department, they jump because half its budget is spent buying and maintaining assets," he says.

Manufacturing may still come around, however. For years the sector took advantage of a low Canadian dollar by hiring more people to improve output and profit. With that utopia gone–maybe for good–manufacturers are looking to reduce costs any way possible. Indeed, the environment may now be right for Jardine's maintenance theories to take hold.

While the auto company's failure to maintain contact with Jardine's research group was never explained, his young students, armed with strong statistical and mathematical acuity, took to their professor's challenge of defining failure with zeal.

"When we do predictive maintenance, we often try to predict failure," says Jardine. "But when we say that word people often think the machine simply doesn't work. That's not the case–it just doesn't operate up to specifications."

As for the definition of failure, it is still yet to be defined to Jardine's satisfaction. The complex, thoughtful and methodical answers his students submitted surprised the professor and inspired him to investigate the question further. Because that is what he and his researchers do.

Contact Mike Ouellette at mike.ouellette@plant.rogers.com.

WEBSITINGS

For more information on the IMEC conference visit **www.imec.ca.**
For more information on the CBM consortium, its members and its research, visit **www.mie.utoronto.ca/cbm**.