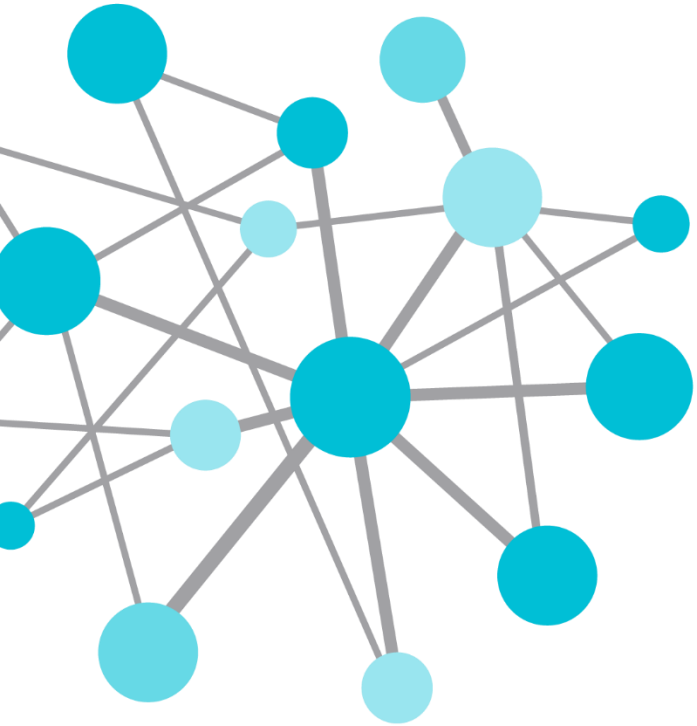

Mining Equipment Event Synthesis

Early Intervention for Increased Efficiency

Presented by **Kyle Gogolinski, Sr. Technical Lead**

Syncrude Canada Ltd.

Background

- Syncrude Canada Ltd. is a crude oil producer from the Athabasca Oil Sands deposit in northeast Alberta. We operate two large-scale surface mines (known as Mildred Lake and Aurora) 35 km apart.
- Syncrude uses a truck and shovel technique for bench mining of the oil sand deposit.
- Mining equipment uptime is a key factor in operating efficiency, driving both production cost and movement volumes.
- Optimized preventive maintenance programs and just-in-time intervention are key to minimizing major component failures requiring days or weeks to repair.
- A vast knowledgebase has been created at Syncrude since our inception of truck and shovel mining in the mid-1990s.

Challenge

Effectively leverage our reliability knowledgebase by transforming reactive, time intensive forensic data reviews into automated, near real-time event synthesis and creation to enable the next level of mining equipment efficiency in our harsh operating environment.

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Event Synthesis – Pilot

- With robust onboard data acquisition infrastructure already in place, raw equipment data are collected at a one second resolution.
- **Key hurdle:** Identify a technology to process very large volume of data without delay. Processing significantly faster than chronology is mandatory.
- PI Server in conjunction with PI ACE 2010 was thought to be a good fit for these needs. PI ACE 2010 brings significant performance improvements.
- An OSIsoft workshop was arranged under our EA relationship and delivered onsite to kickstart the pilot.
- Syncrude's largest truck fleet, the Caterpillar 797, was selected for the pilot, along with 21 use cases and algorithms required to accurately generate an early warning event and initiate intervention.

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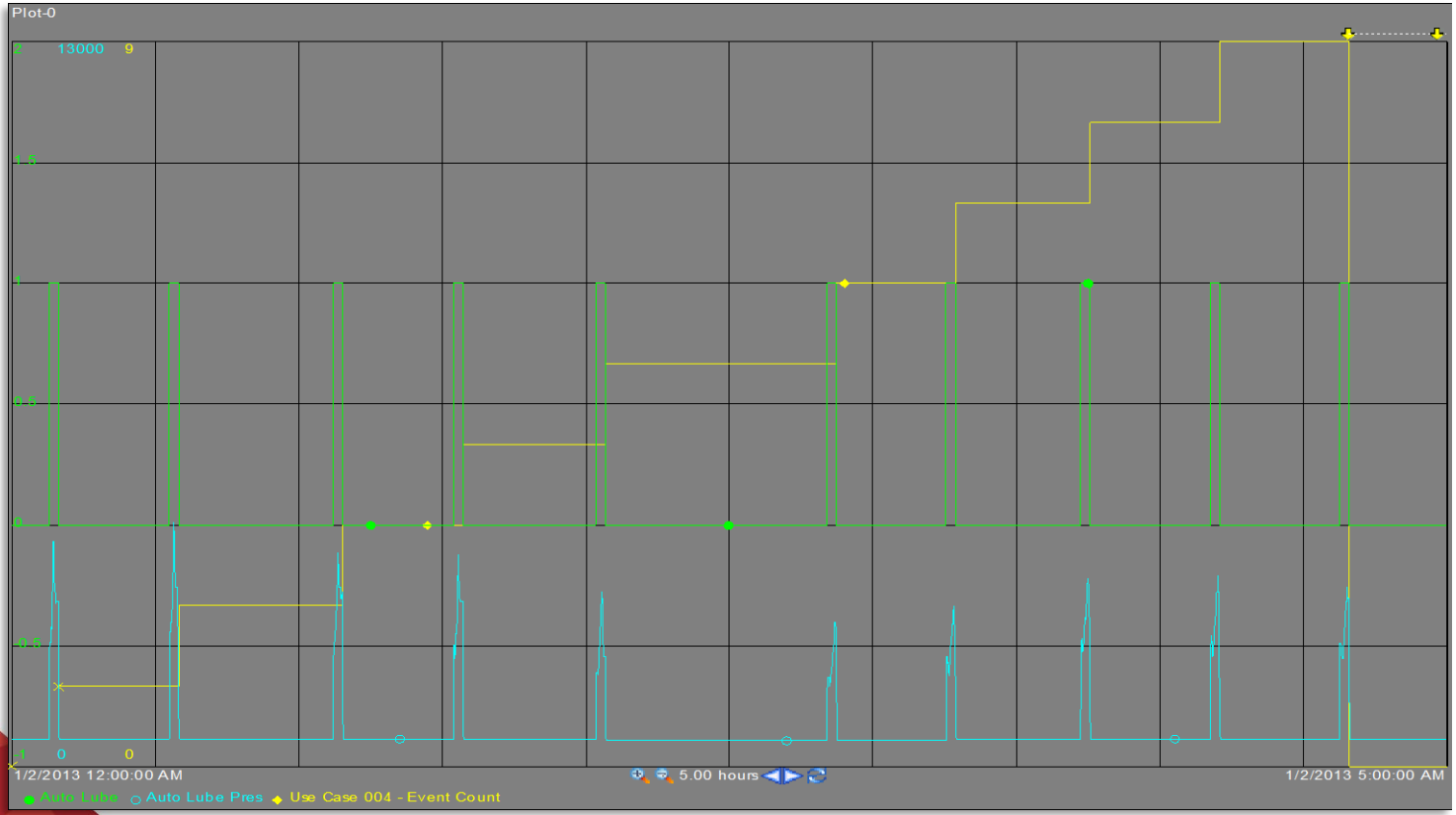
Event Synthesis – Use Cases

Type	Name	Calculation Complexity
General Monitoring	Out of Wireless Range	Minor
	Acquisition Offline	Minor
Power Train Management	Torque Convertor Overheat	Minor
Lubrication Management	Auto-lubrication Frequency	Minor
Engine Management	Throttle Position Condition	Minor
	Turbo Failure	Minor
	Injector Failure	Minor
	Engine Oil Dilution	Minor
	Coolant Temp Delta	Minor
Steering/Braking Management	Service Brake Applied at Speed	Minor
	Brake Overheat	Minor
	Steering Pumps Cycle	Major
	Braking Pumps Cycle	Major
Frame Management	Improper Strut Charge	Minor
	Strut Deflation	Minor
	Airborne	Minor
	Side Load	Minor
	Front Load	Minor
	Structural Force	Major
	Abusive Dumping	Minor
	Abusive Loading	Minor

Use Case Example – Auto Lube Cycle



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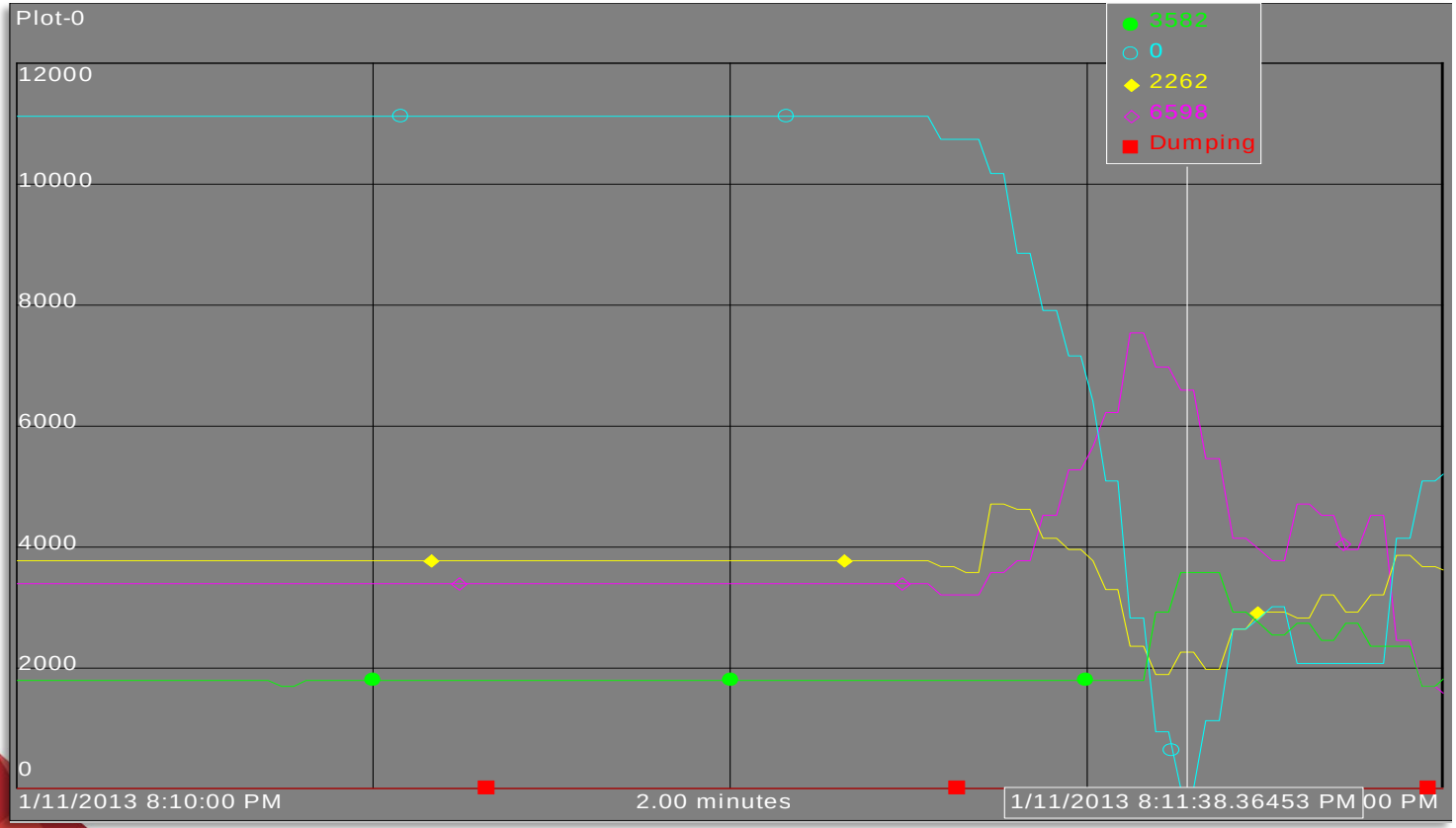
Use Case Example – Strut Deflation



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Event Synthesis – Obstacles

- Wireless data acquisition starts and stops as trucks move in and out of wireless coverage. Data is buffered on the truck to prevent data loss.
- Data acquisition subsystem status needs to be monitored to ensure data integrity
- Should not compute when missing data
- As data arrives, solution should resume computation
- Cannot create **gaps** in event computation due to data flow starts and stops

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Event Synthesis – Results

- All use cases were implemented successfully
- PI ACE processing load scaled across two schedulers is adequate to process regular data flow
- When load balanced, average CPU utilization ~25% for data flow from ~80 trucks
- When processing backlog, schedulers use 100% CPU
- Data from 44 tags per truck are used to calculate the use cases
- Some PI tags were created to store intermediate calculations
- Events, when raised, are inserted into a database table for pilot purposes

Event Synthesis – Results

- Business validation was performed on all use cases for correct logic implementation
- Continued monitoring and QA checks will be done to raise confidence in the results produced
- Business value will only be realized as confidence and trust increases
- Event data will need to be integrated into existing visualization platforms and operator care workflow before full adoption will be realized

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Next Steps

- A new project is underway to integrate event data into existing tools and workflow in our full production environment
- Continue to modify event trigger thresholds and conditions to avoid event “floods” and false positives. Tuning is critical to ensure events are “right-sized” for action.
- Assess if there are additional high value use cases that warrant implementation at this time
- Need to determine the value and effort involved to extend use cases to other fleets and manufacturers of trucks used in our mines

Conclusion

- We have successfully proven the PI ACE to be an effective platform for implementation of complex calculations using values from many PI tags
- The framework is highly scalable and maximizes multi-threading to execute in parallel as many calculations as possible
- The robust recovery and backlog processing logic provided by OSIsoft was instrumental in developing an effective solution
- Business value in downtime avoidance is easily demonstrated
- Plan to leverage and build on this success with future iterations of implementation projects

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Mobile Equipment Event Synthesis

Mining equipment uptime is a key factor in operating efficiency, driving both production cost and movement volumes.

Optimized preventive maintenance programs and just-in-time intervention are key to minimizing major component failures requiring days or weeks to repair.

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Business Challenge

- Leverage our reliability knowledgebase by using automated, near real-time event creation to enable the next level of mining equipment efficiency

Solution

- PI Server + PI ACE 2010
- OSIsoft workshop to kickstart pilot project
- Fully validated events generated in a fraction of the time

Results and Benefits

- Fast, highly scalable
- Blueprint for all future event generation initiatives
- Step-change in equipment maintenance efficiency

Kyle Gogolinski

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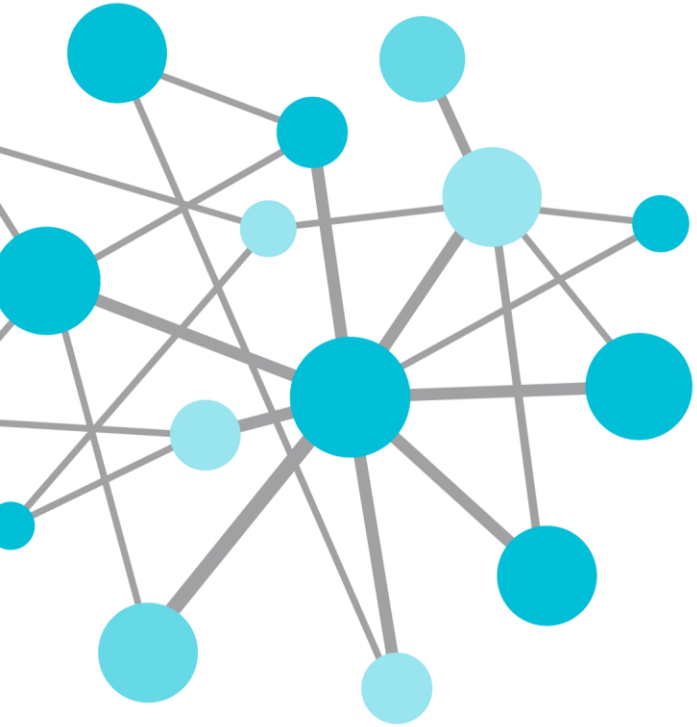
- Syncrude Canada Ltd.



THANK YOU

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