Improving Operational Scheduling

Increasing Reliability and Production Output

June 2007

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Agenda

- Who are these guys?
- Why did you come here today?
- What is scheduling and why is it important?
- How is scheduling usually done?
- Applying recent advances in optimization to scheduling
- Reliability management
- Demonstrations:
  - Reliability-driven maintenance/production scheduling
  - Rig scheduling
- The benefits of dynamic optimization and scheduling
- Further work

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Presenters

- Owen Plowman, Business Development
- Dr. Morten Irgens, CTO

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Who are these guys?

- Actenum develops schedule optimization solutions for people and equipment in the energy sector
- Benefits:
  - Right resource, right place, right time
  - Increased uptime and production
  - Improved efficiency in complex operating environments, where changing conditions and disruptions occur continually
  - Increased coordination between organizational units

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Why did you come here today?

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Let's talk about scheduling

- What is it?
- Scheduling is the assignment of resources to tasks in a way that satisfies sequencing and timing constraints
- A simple example: Drilling Rig A ***(resource)*** is assigned to Well 31 ***(task)*** for three months ***(timing),*** but must be moved to Well 68 by June 10th ***(sequencing)***
- Usually there are also various organization-specific policies and preferences that must be represented in schedules

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Why is scheduling important?

- It's important because it has substantial economic impact
  - Maximizes asset uptime
  - Maximizes production output
  - Maximizes crew availability and utility
  - Improves responsiveness to changes/disruptions
  - Aligns operations with organizational objectives

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How is scheduling usually done?

Over to you: How do ***you*** do it?

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Traditional approaches to scheduling

- Traditional Operations Research
- Manual or semi-manual
  - using spreadsheets, “scheduling tools”, whiteboards

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Traditional OR approaches imply …

- You need a mathematical model
- You are chasing optimality
- You have to run in batch mode
- You receive take-it-or-leave-it solutions

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Manual/semi manual approaches imply …

- You are the problem solver, but
- You don't know your "score", and
- You have more data than you can cope with, and
- You're drifting and need to reschedule quickly and effectively

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What if we apply recent advances in optimization technology to scheduling?

- You manage complexity
- You collaborate with the system
- You understand the consequences of your decisions
- You obtain practical, reliable solutions, quickly,
- You support operations
- You stay on course, and bridge strategy and operations
- You handle disruptions and opportunities smoothly and effectively

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Three examples

- Integrated production and maintenance planning
  - Increase "Operating Factor" and provide understanding of operating risk
  - Minimize disruption to production capacity
  - Enable collaboration by production and maintenance
  - Results: $32 million in savings after two weeks use; non-experts can produce low risk, high-value schedules
- Rig/well scheduling (Saudi Aramco)
  - Optimize the use of the world's largest drilling rig fleet (120+ rigs)
  - Provide operational support for daily rescheduling, based on planning/operational updates
  - Automatically maximize production volume/minimize fleet cost
- Defect reduction initiative scheduling
  - Provide automated support for scheduling defect reduction programs
  - Part of a large initiative to improve maintenance practices within our customer

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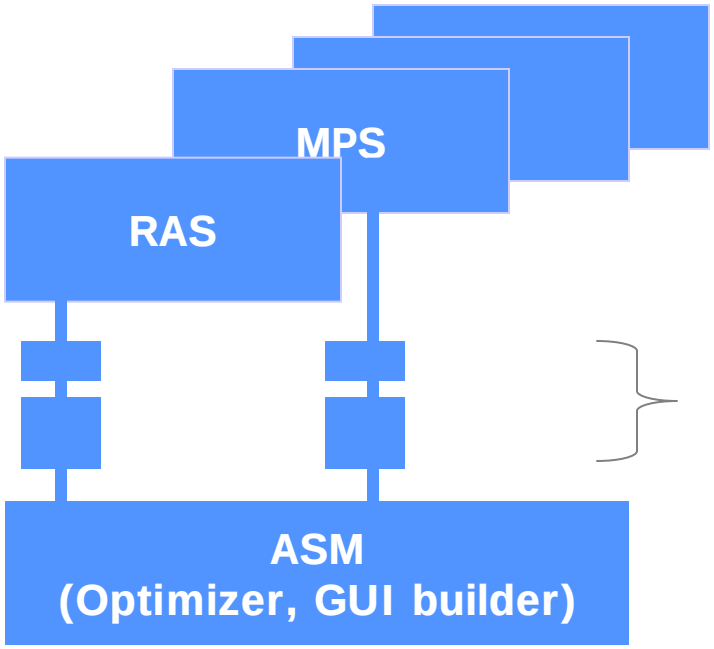
Technology Architecture



Applications

Core technology

1. MPS: Maintenance & Production Scheduler
2. RAS: Rig Activity Scheduler

Application-specific constraint model

ASM: Asset Scheduling Manager

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Demonstration: Maintenance and Production Scheduler

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Context: scheduling maintenance and production in the Oil Sands

- Reliability is critical to recovery and run length
- Approximately half the costs of bitumen production are maintenance-related
- Bitumen production systems are designed to operate at steady state
- Process variability from reliability incidents causes upset conditions and high recovery penalties
- Process effects on equipment aggravate reliability issues

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Key Reliability Concepts Related to Oilsands

- Reliability of components is necessary but not sufficient
- Reliability of an integrated system has interdependencies
- System matching reduces robustness & run length
- Fault modes, effects, and criticalities can be analyzed to identify reliability problems (and prioritize maintenance)
- Production and Maintenance are both responsible for reliable operations
- Failures are stochastic processes requiring probabilistic models (which can include risk) for decision making

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Demonstration: Rig Activity Scheduler

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Benefits of dynamic optimization and scheduling

- You manage complexity
- You collaborate with the system
- You understand the consequences of your decisions
- You obtain practical, reliable solutions, quickly,
- You support operations
- You stay on course, and bridge strategy and operations
- You handle disruptions and opportunities smoothly and effectively

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Actenum's approach provides:

- Fast, interactive scheduling,
- Significant, tangible return on investment
- Enhanced support for resource allocation decisions and operations recovery in uncertain conditions
- Reduction of the impact of unplanned events on activities already in progress
- Support for assessment of the possible outcomes of decision alternatives,
- Easily supports "what-if" investigations

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The bottom line

- Operational performance can be made more predictable and more closely linked to organizational strategy,
  - by accelerating the scheduling process and
  - showing the impact on key operational metrics
- Reliable, timely, and actionable scheduling decisions can better align the use of resources with those key operational metrics
- Automated decision support for scheduling can aid in smoothing out daily variances in operations, by improving response times and providing insight into the quality of scheduling decisions

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We're interested in research projects

- Heavy oil ***in situ*** operations
  - Production optimization
  - Maintenance optimization
- Environmental management
  - Balance environmental and sustainability issues with production needs
  - Provide real-time environmental management capabilities:
- Other …

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Examples for the energy sector

Energy consumption minimization, Asset utilization maximization, Oil spill management, Pipeline construction optimization, Water usage optimization Waste management,	Production planning with disposal management Water resources planning taking into account water quality constraints Evacuations Drilling impact reduction Land use planning, Emission minimized production.

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Further information

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