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Advanced And integrated maintenance tools for technical plants
Lease-Oriented Opportunistic Maintenance for Multi-Unit Leased Systems Under Product-Service Paradigm
With many industries increasingly relying on leased equipment and machinery, many original equipment manufacturers (OEMs) are turning to product-service packages where they deliver (typically lease) the physical assets.
A classic example being Rolls Royce power-by-the-hour aircraft engines
Interestingly enough, manufacturing industries are beginning to adopt the product-service paradigm. However, one of the unique aspects in manufacturing settings is that the leased system is often not a single asset but instead a multi-unit system (e.g., an entire production line).
We propose a leasing profit optimization (LPO) policy to adaptively compute optimal preventive maintenance (PM) schedules that capture the following dynamics:
(1) the structural dependencies of the multi-unit system,
(2) opportunistic maintenance of multiple system components, and
(3) leasing profit savings (LPS)
In this Case study, we consider a setting where multi-unit systems that consist of multiple machines are being leased. Machines are assumed to have different degradation rates, and therefore, exhibit different hazard rates and PM intervals. Preventive maintenance is assumed to bring back a machine to a better state, but not as good as new. In the event of an unexpected failure, minimal repair is performed to bring back the failed machine to its operational state.
However, minimal repair does not improve its hazard rate. We assume that PM are scheduled adaptively per machine. However, additional machines can be maintained in an opportunistic sense if it proves economical. A lease contract governs the dynamics between the lessor and the lessee and is considered binding.
It spells out the rights and obligations of both parties, e.g., lease period, machine rent, maintenance costs, cost of dispatching maintenance personnel, cost of unexpected failures, rates of depreciation of each machine, PM intervals, etc.

Without loss of generality, we consider a series system, i.e., a system where all the machines are critical and are arranged in series. Thus, the failure of one machine implies shutting down of the entire system.
In the lease-oriented opportunistic maintenance methodology, the lessor dynamically schedules PM actions and minimal repairs to provide service during the lease period. For individual machines, sequential PM intervals are scheduled according to diverse deteriorations by integrating internal factors (lessor’s maintenance effect) and external factors (lessee’s environmental condition).
By pulling original PM intervals, LPO (leasing profit optimization) policy dynamically optimizes real-time PM actions in the system level by achieving leasing profit savings at every opportunity. And LPO decisions will be fed back to the machine-level PM scheduling. This opportunistic maintenance methodology considers system structure interactivities, advanced maintenance opportunities, and leasing profit savings to achieve the profit maximization.
Questions?
1. How do you imagine the Objective Function (Leasing Profit Saving)?

Describe 2 or 3 variable
2. Describe some parameters that could influence Maintenance opportunity choice
3. How do you imagine the Real-time maintenance?

How could machine communicate their problems?

Describe some technical parts that needs to do it