

Reactive, preventive and predictive maintenance – which is the right solution

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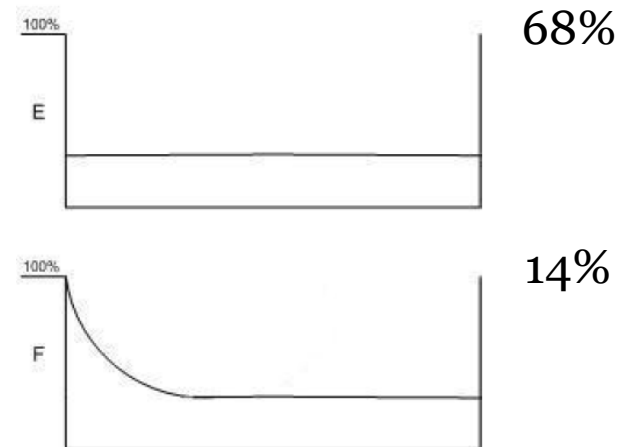
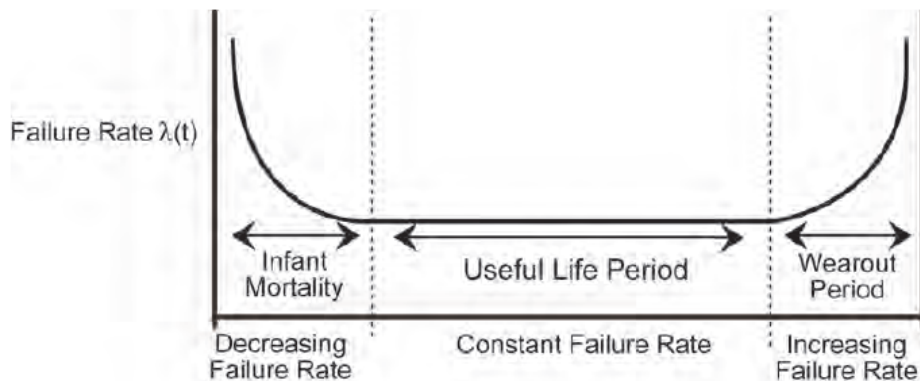
Presentation overview

- In O&G green field projects EPC follows tightly end user specifications
- Typically these specifications are not taking into account the maintenance strategies
- In this presentation we will walk through different maintenance strategies, their benefits and how easily we are able to ensure designed plant is ready for every maintenance strategy



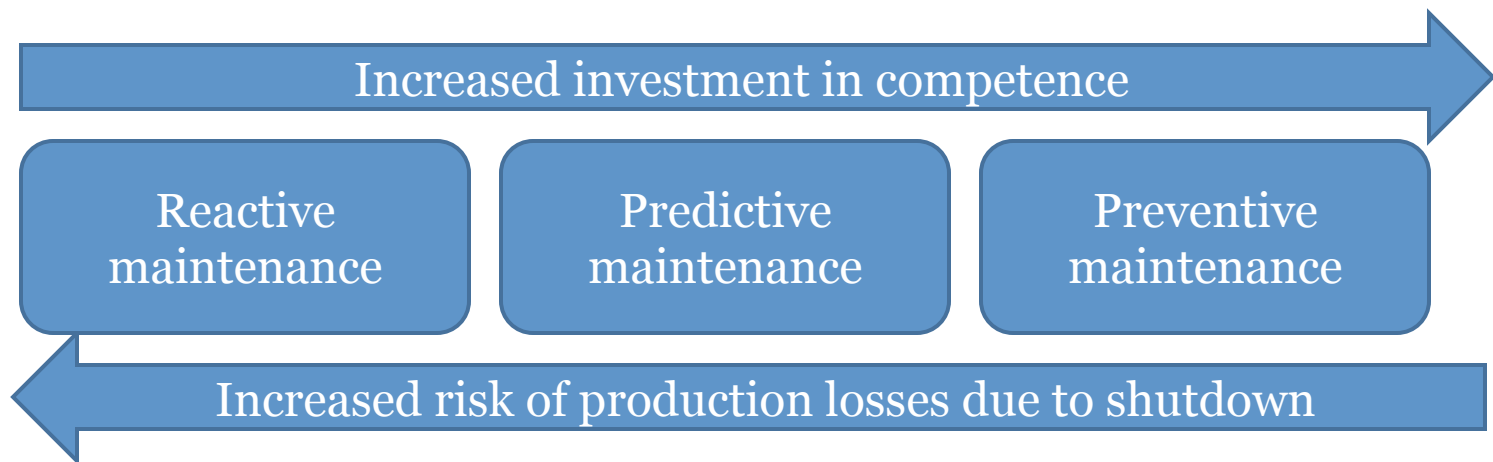
Maintenance in generally

- In simplest maintenance is ‘the work of keeping something in proper condition; upkeep’
- Most known failure mode is bathtub – but its not most common
 - Mechanism of failure is same, but units are more complex - ‘NASA’

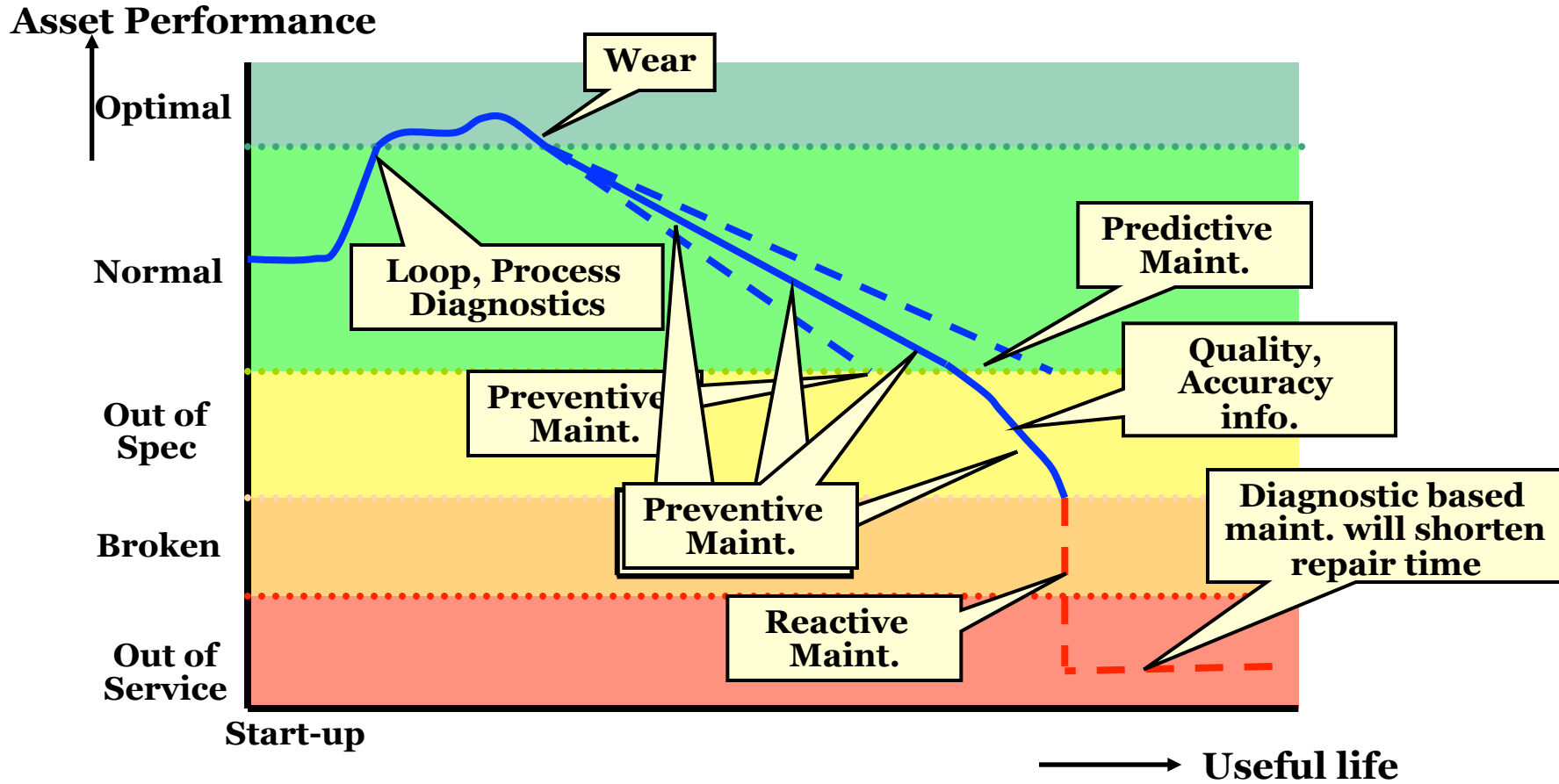


Reactive, preventive and predictive maintenance

- Reactive maintenance is basically the “run it till it breaks”
- Preventive maintenance is based on the calendar time
- Predictive utilizes diagnostics information for maintenance planning



Asset Lifecycle



Reliability Centered Maintenance – RCM

- RCM is a process used to determine the maintenance requirements of any physical asset in its operating context
- Assets are classified based on the criticality and maintenance strategy is selected accordingly

Reliability Centered Maintenance Hierarchy		
<i>Reactive</i> Element Applications	<i>Preventive</i> Element Applications	<i>Predictive</i> Element Applications
Small parts and equipment	Equipment subject to wear	Equipment with random failure patterns
Non-critical equipment	Consumable equipment	Critical equipment
Equipment unlikely to fail	Equipment with known failure patterns	Equipment not subject to wear
Redundant systems	Manufacturer recommendations	Systems which failure may be induced by incorrect preventive maintenance
10%	25-35%	45-55%

Comparison of different strategies

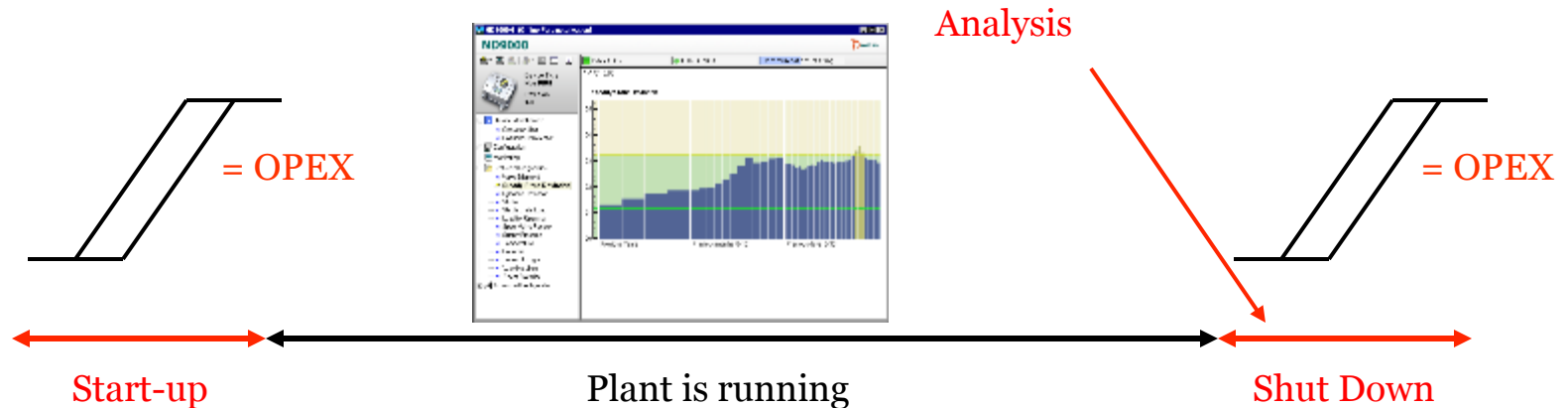
Positive feature	Reactive	Preventive	Predictive
Low capital cost	x	x	
Less maintenance people	x		x
Increased component life cycle		x	x
Energy savings		x	x
Increased plant up-time		x	x
Focused/optimized maintenance activities			x
Better product quality			x
Improved personnel safety			x

RCM has features of all mentioned strategies

- In predictive and RCM maintenance strategies saving potential is not readily seen by management due to startup costs
- Predictive and RCM can be enabled easily when selecting assets to be intelligent

Maintenance program	Description	Cost
Reactive maintenance	- Allow machinery to run to failure - Repair or replace equipment after failure	100%
Preventive maintenance	- Schedule maintenance at predefined time intervals - Repair or replace equipment before failure	72%
Predictive maintenance	- Schedule maintenance based on diagnostics - Repair or replace equipment before failure	50%
Reliability Centered Maintenance (RCM)	- Use all above techniques based on the asset's criticality	33%

Enabling predictive & RCM maintenance strategy

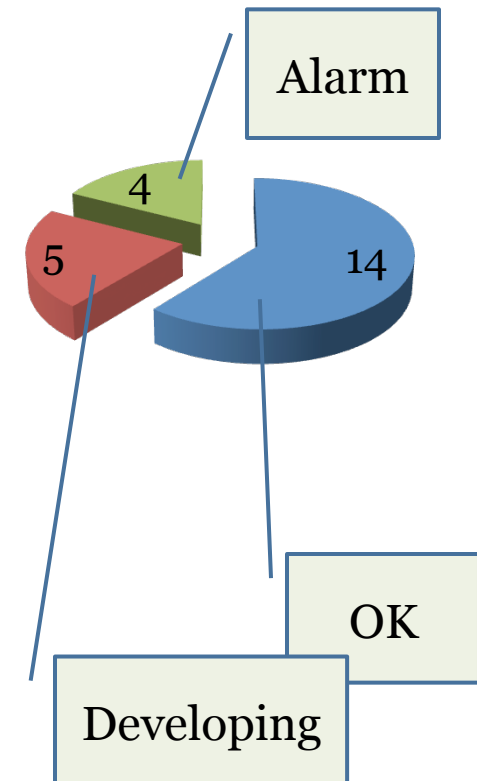


- Select assets capable of analysing and storing performance during the normal run time of the plant
 - Best possible sampling time & resolution
 - Performance is analyzed during the real operation condition
- No extra work needed to carry out tests – only to analyze results

Case story with refinery maintenance planning

Critical emergency shutdown valves

- Totally 23 ESD valves were analyzed based on the diagnostics
- All were taken into maintenance workshop and
 - 14 were ok as shown by diagnostics
 - 9 valves were maintained fully
- As a result customer achieved following benefits
 - Maintenance costs reduced by 58%
 - Maintenance shutdown time was kept on schedule



Summary

- End user can use different maintenance strategy in the plant
- Predictive & RCM strategies utilize diagnostics information
 - Cost efficiency with maintenance organization
 - Optimized availability with plant operation
- End user and EPC can enable higher level maintenance strategies
 - Smart / digital technology used with asset operation
 - Invest on asset management tool afterwards
- Digital technology gives benefits also to plant start-up