Towards Autonomous Operations

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Towards Autonomous Operations

- Definitions
  - Automation & Autonomation
  - Augmented Operations & Autonomous Operations
- Autonomous Operations Maturity Level Measurement
- A Pragmatic Implementation Strategy for Autonomous Operations
- Summary and the Way Ahead!

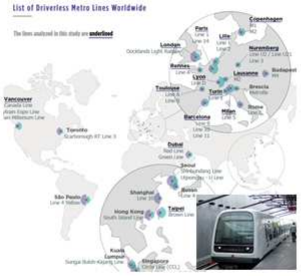
Towards Autonomous Operations

Airplanes/Drones (Military)

General Atomics MQ-9

IAI Heron

Driverless metros



Sources: Wavestone research and analysis, UN data, UITP

Warehouse robots

Amazon Robotics
(formerly Kiva Systems)

Cars

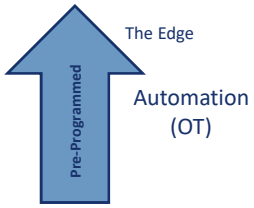
Google's self-driving car

Autonomous Systems are appearing in various industries

1] The Autonomous Industrial Plant – Future of Process Engineering, Operations and Maintenance [ABB DECRC: Thomas Gamer, Mario Hoernicke, Benjamin Kloepper, Reinhard Bauer & Alf J. Isaksson]

Automation

An automation system typically performs precisely defined instructions within a limited scope of operation. A classical control loop can be broken down into the phases of sense, analyze and act. For example, a motor is running too fast (sense), the controller decides to reduce the speed (analyze) and reduces the current to the motor (act) [1]



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Autonomation

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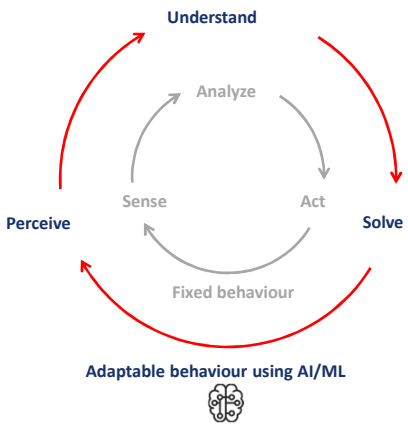
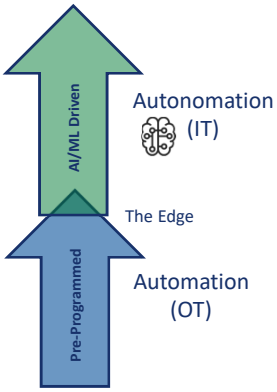
An autonomous system feedback loop adds another shell, applying the same principle but on a more complex level, dealing also with what is not known or foreseen. A self-driving vehicle identifies an obstruction (perceive), recognizes that a potentially dangerous situation may arise (understand) and takes corrective action by modifying the speed and trajectory of the vehicle (solve) [1]





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Towards Autonomous Operations

- Manual start
- No brake / steering servo
- Manual windows
- Manual gearbox

- Electric start
- Brake / steering servo
- Electric windows
- Automatic gearbox
- Cruise control (also adaptive)
- ABS brakes / traction control
- Emergency braking

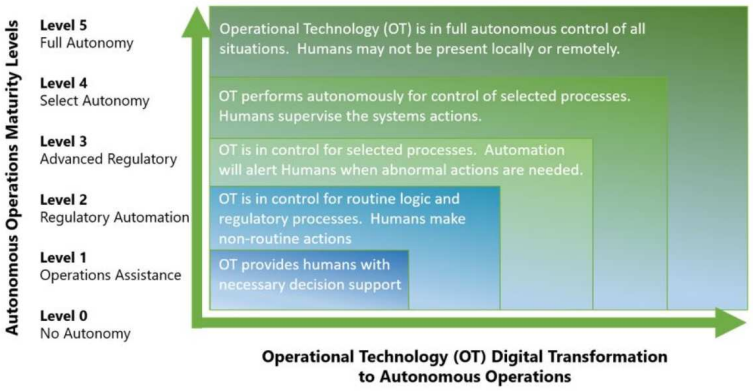
- Self parking
- Self driving (different levels)
- Autonomous route planning and execution
- Traffic optimization – no traffic lights and collision avoidance by car-to-car communication

Autonomation in Vehicles

	SAE LEVEL 0™	SAE LEVEL 1™	SAE LEVEL 2™	SAE LEVEL 3™	SAE LEVEL 4™	SAE LEVEL 5™
What does the human in the driver's seat have to do?	**You are driving** whenever these driver support features are engaged – even if your feet are off the pedals and you are not steering			**You are not driving** when these automated driving features are engaged – even if you are seated in "the driver's seat"		
	You must constantly supervise these support features; you must steer, brake or accelerate as needed to maintain safety			When the feature requests, you must drive	These automated driving features will not require you to take over driving	
	These are driver support features			**These are automated driving features**		
What do these features do?	These features are limited to providing warnings and momentary assistance	These features provide steering **OR** brake/ acceleration support to the driver	These features provide steering **AND** brake/ acceleration support to the driver	These features can drive the vehicle under limited conditions and will not operate unless all required conditions are met		This feature can drive the vehicle under all conditions
Example Features	• automatic emergency braking • blind spot warning • lane departure warning	• lane centering **OR** • adaptive cruise control	• lane centering **AND** • adaptive cruise control at the same time	• traffic jam chauffeur	• local driverless taxi • pedals/ steering wheel may or may not be installed	• same as level 4, but feature can drive everywhere in all conditions

Source: SAE International - SAE J3016TM Levels of Driving Automation™

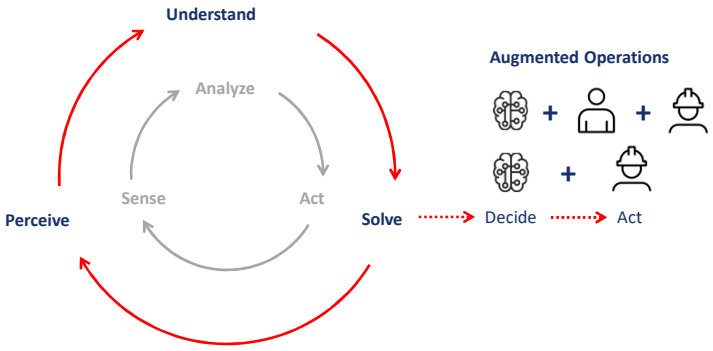
Autonomation in Process Industries



Source: https://www.arcweb.com/blog/what-autonomous-operations

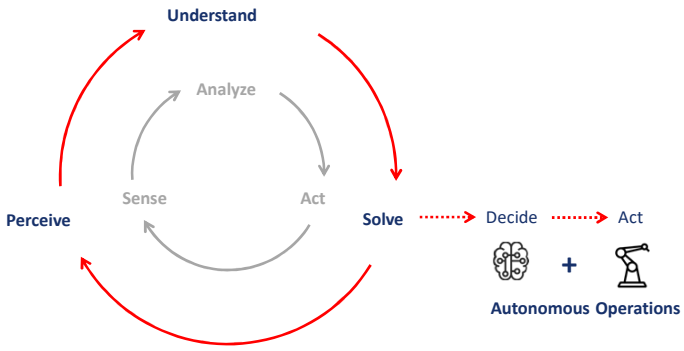
Augmented Operations

If human intervention is required to perform the solving in some way (taking the decision or performing the action) then we refer to this as an Augmented Operation

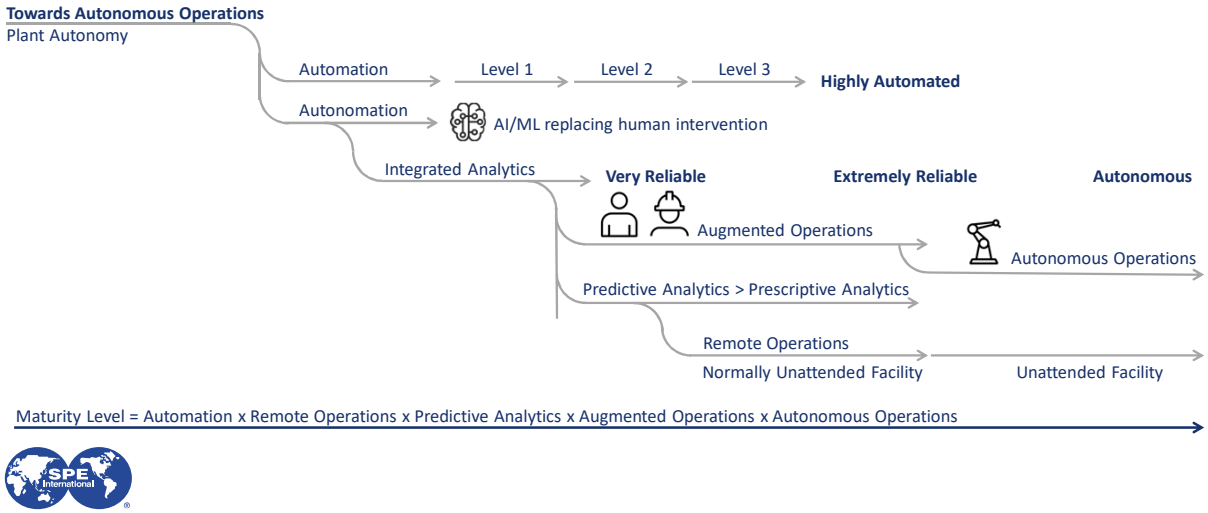


Autonomous Operations

If human intervention is not required and the solving is performed automatically, either by a modification to the underlying automation system, for example a setpoint modification or is performed by a robot (replacing a faulty part) then we refer to this as an Autonomous Operation



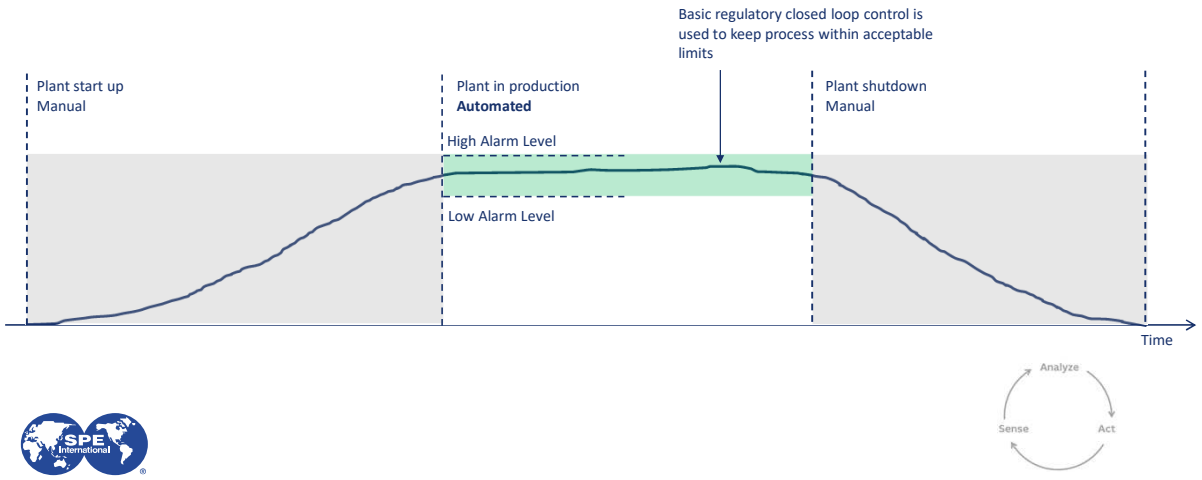
Maturity Level Measurement



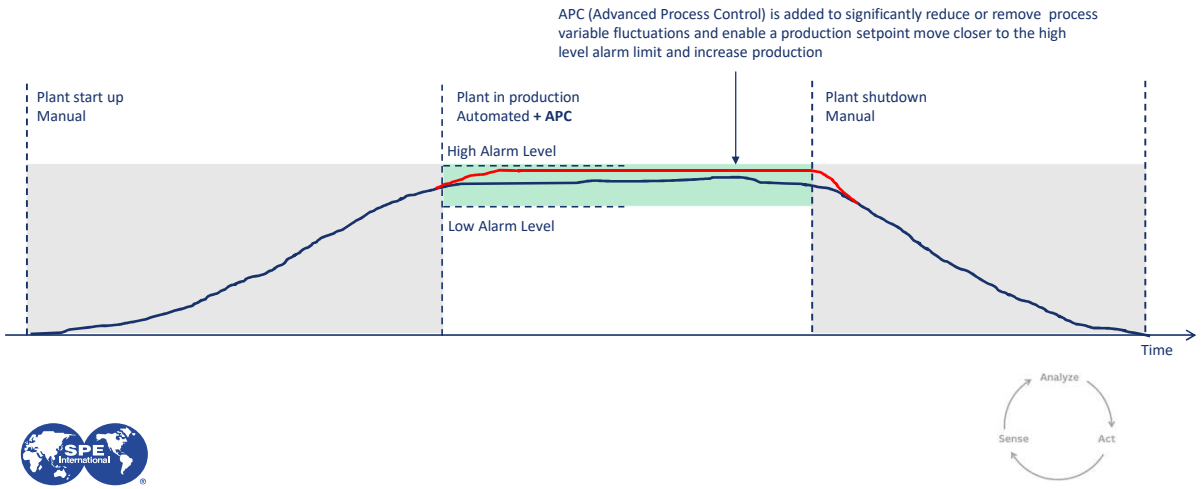
An Implementation Strategy

- Maximize the automation!

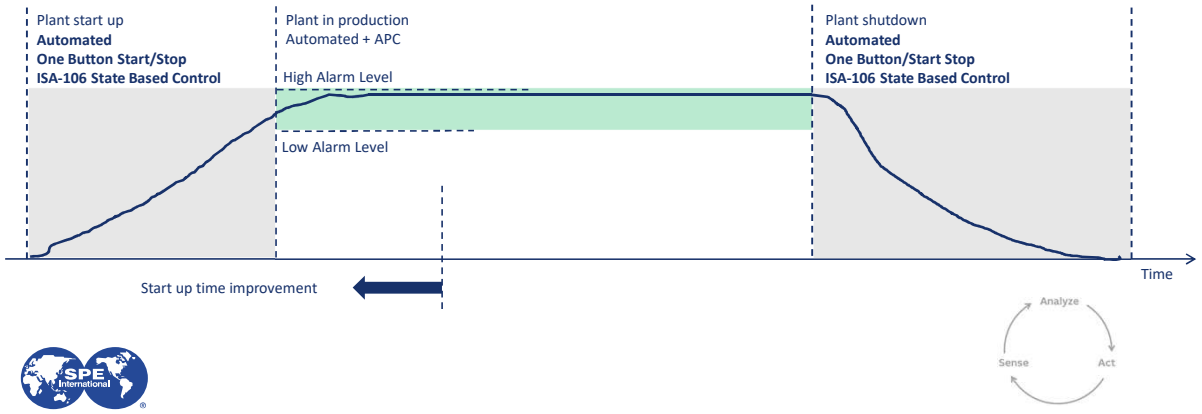
Automation – Level 1



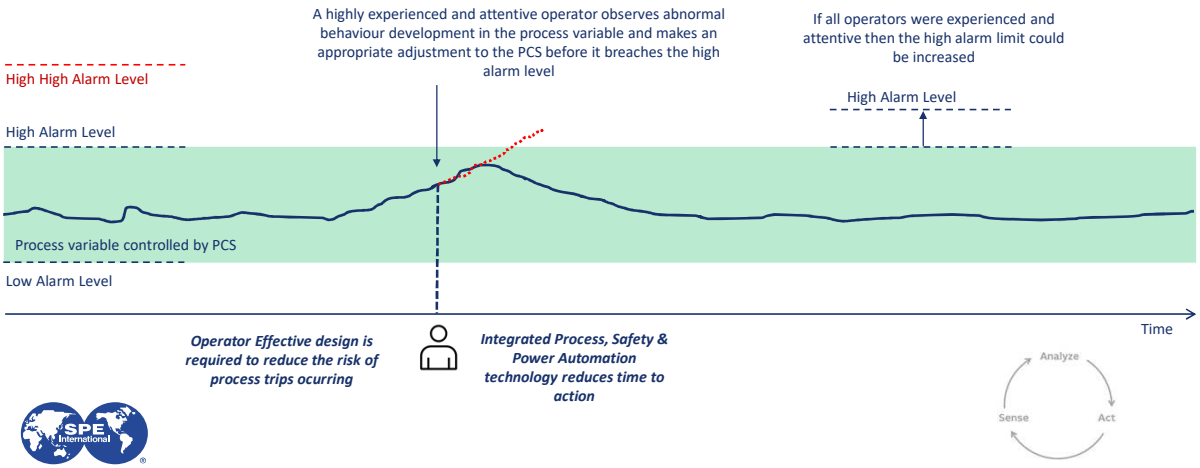
Automation – Level 2



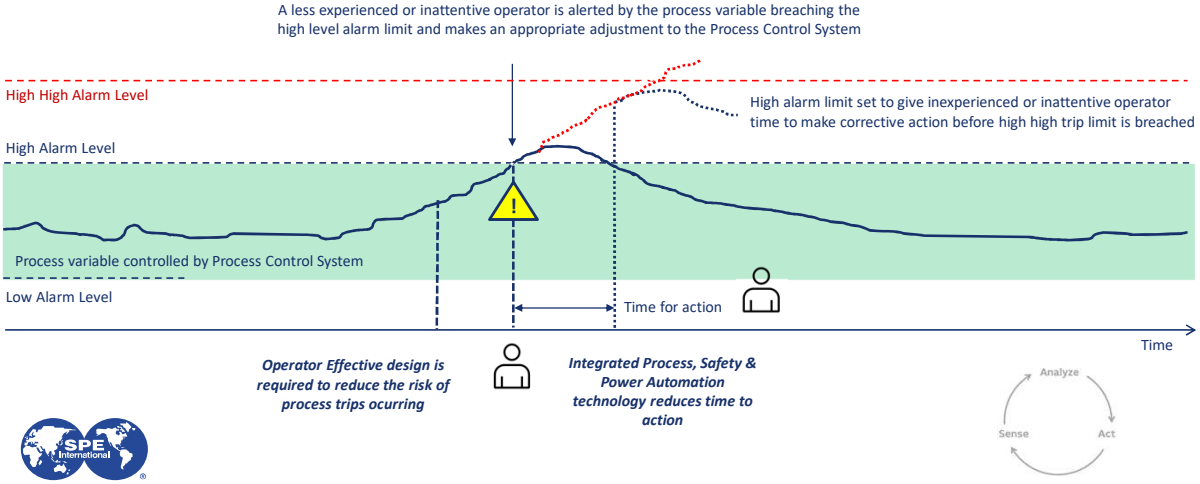
Automation – Level 3



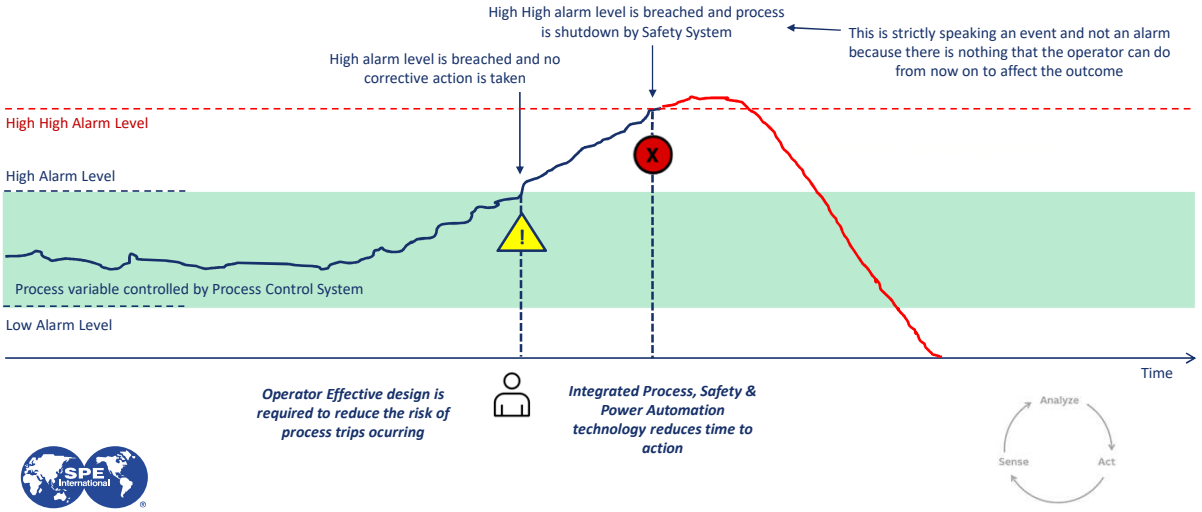
Human Intervention



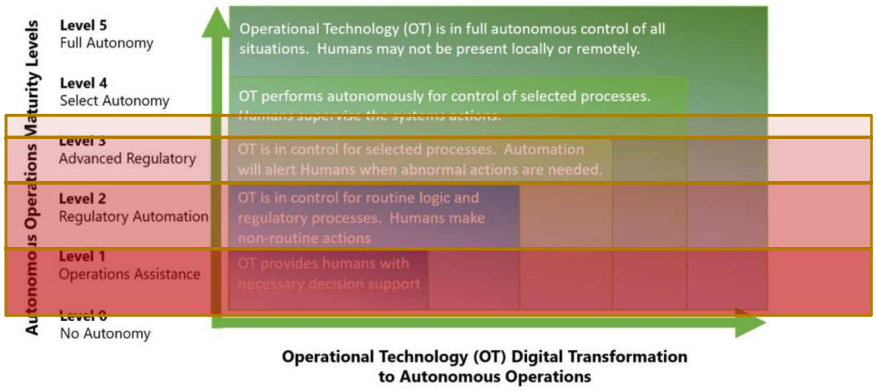
Human Intervention



Human Intervention



Autonomation in Oil & Gas



Source: https://www.arcweb.com/blog/what-autonomous-operations

Human Intervention

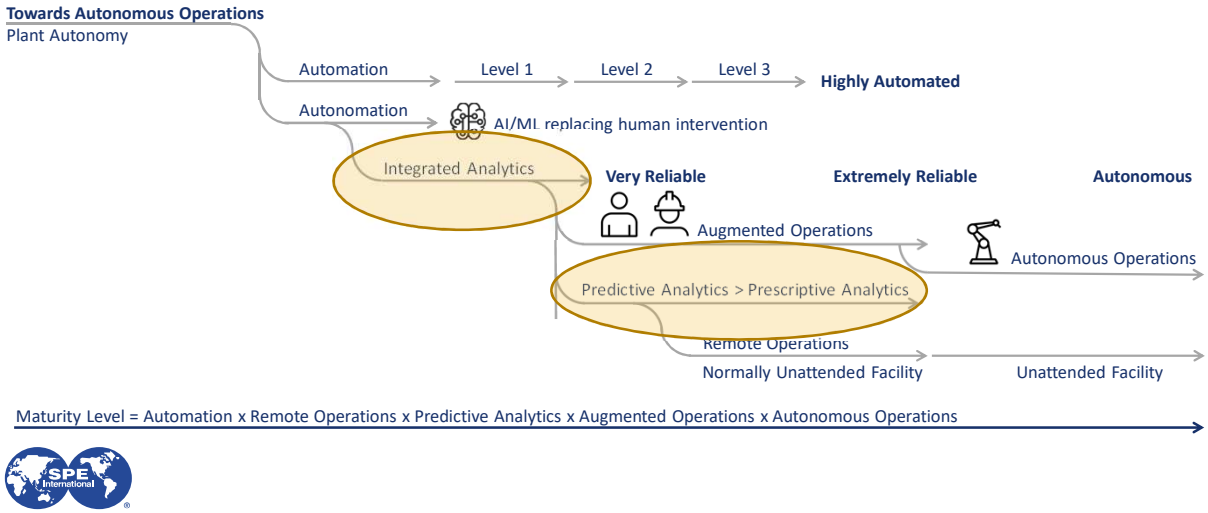
In reality, an Operator can only attend to a relatively small number of I/O signals at any one time……

A typical oil & gas plant automation system solution may have 40,000-50,000 I/O signals and 20,000 to 25,000 alarms

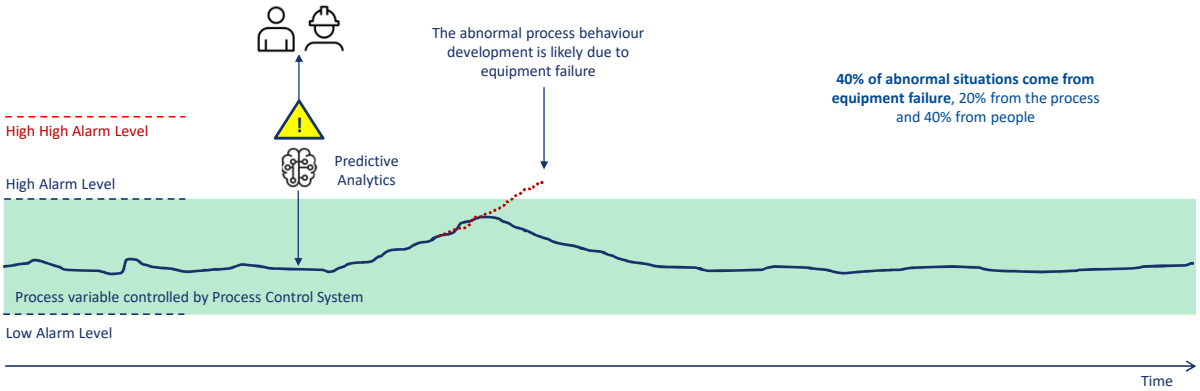
40% of abnormal situations come from equipment failure
20% from the process
40% from people

What can we do?

An Implementation Strategy

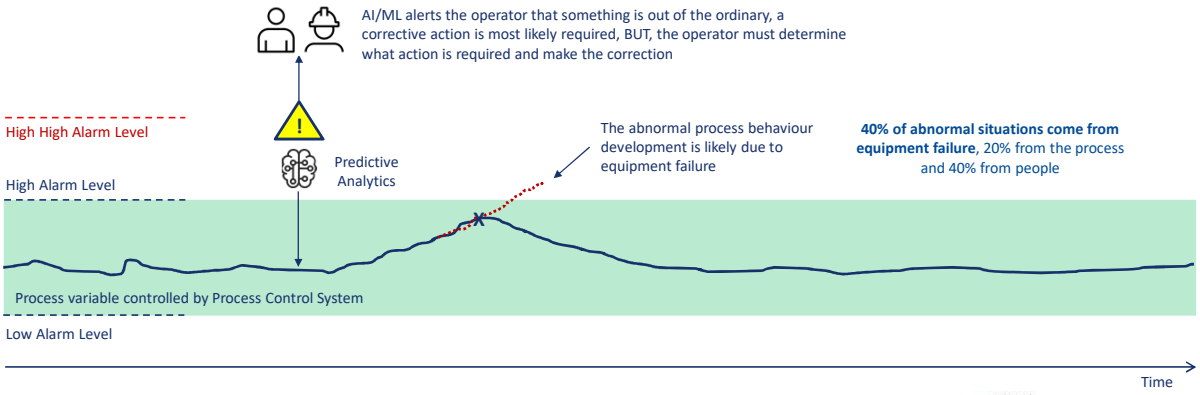


Integrated Analytics

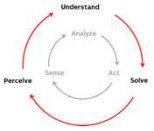


A move from a reactive to a predictive maintenance regime is essential for a move towards remote and autonomous operations

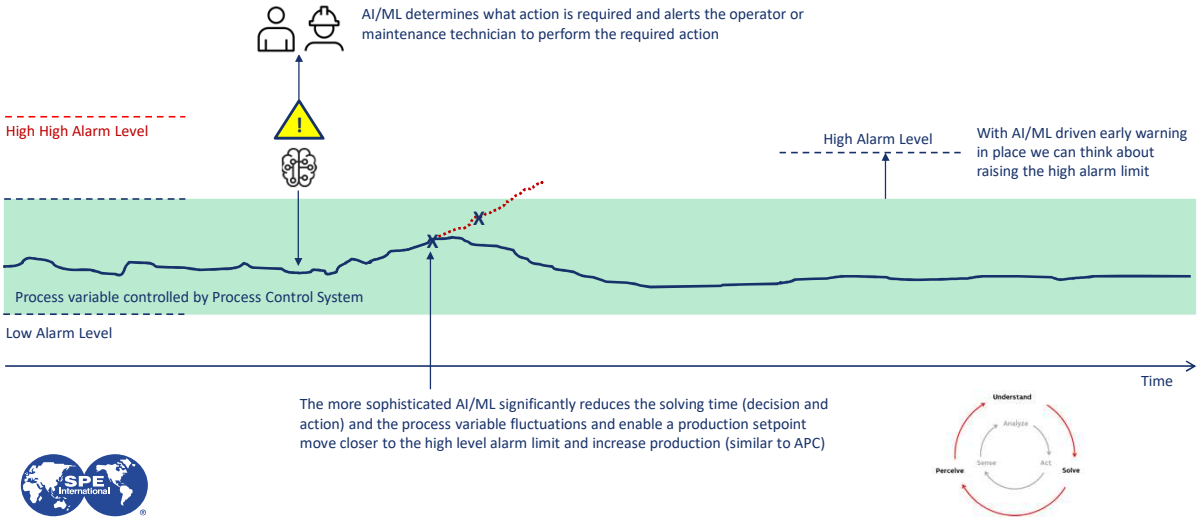
Integrated Predictive Analytics



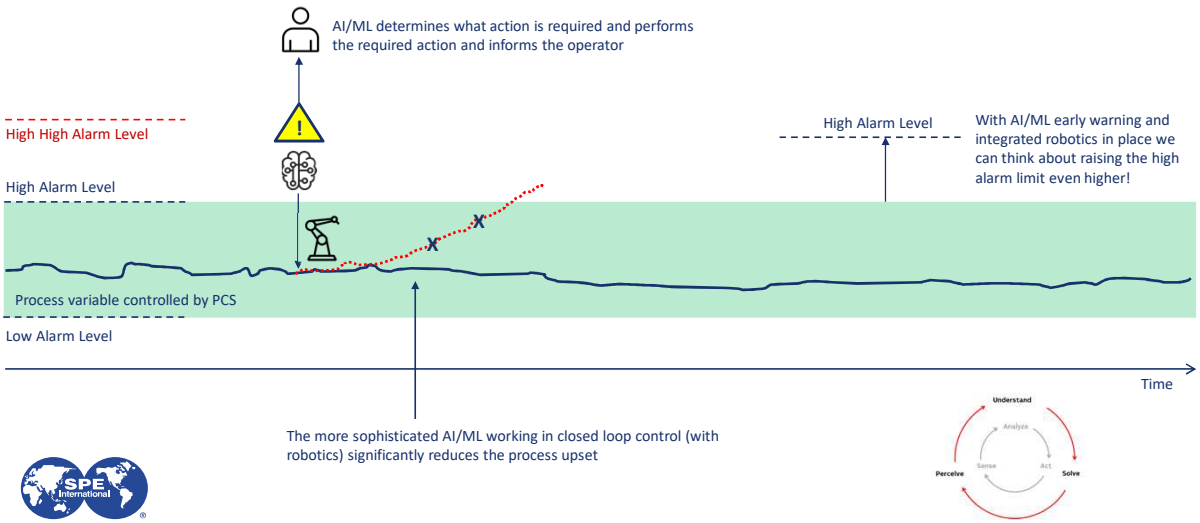
A move from a reactive to a predictive maintenance regime is essential for a move towards remote and autonomous operations



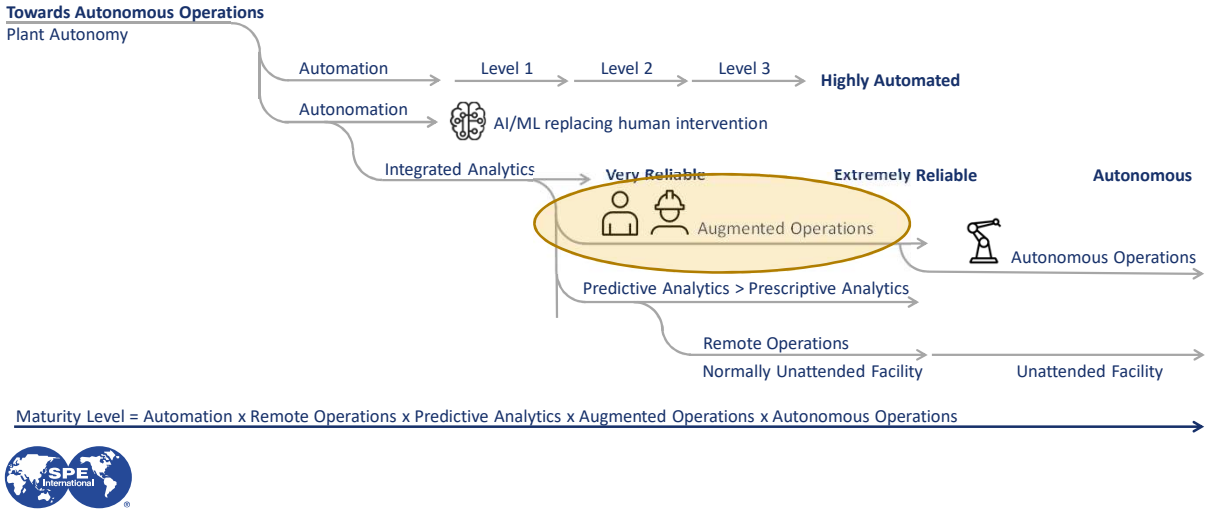
Integrated Prescriptive Analytics



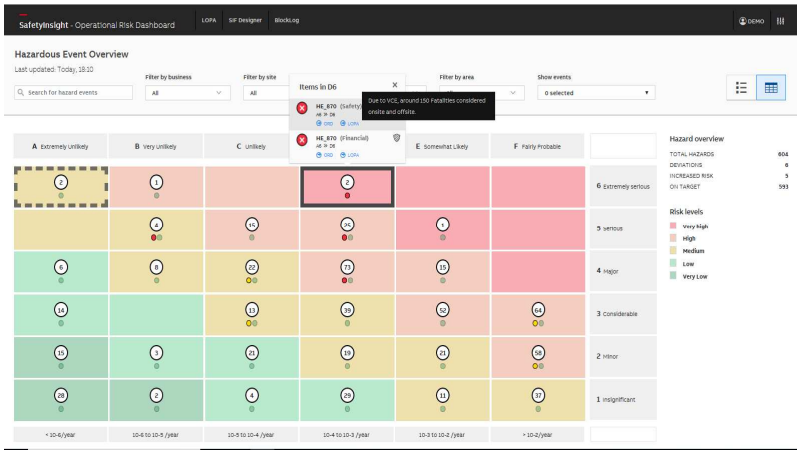
Integrated Robotics



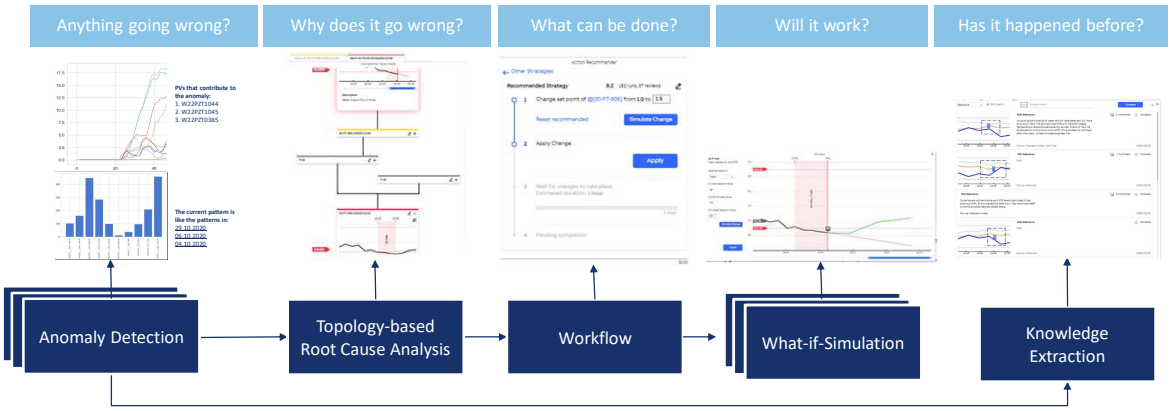
An Implementation Strategy



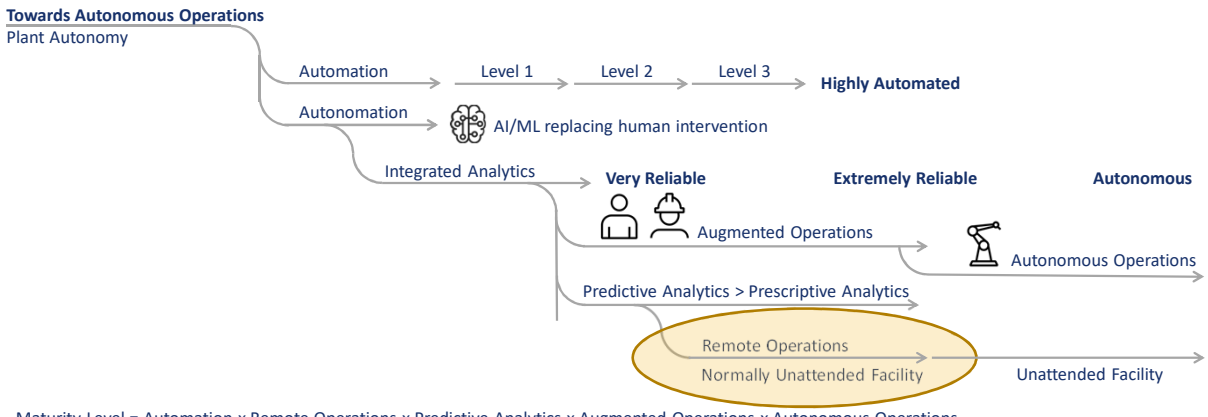
Augmented Operations I Generation



Augmented Operations II Generation



An Implementation Strategy



Remote Operations

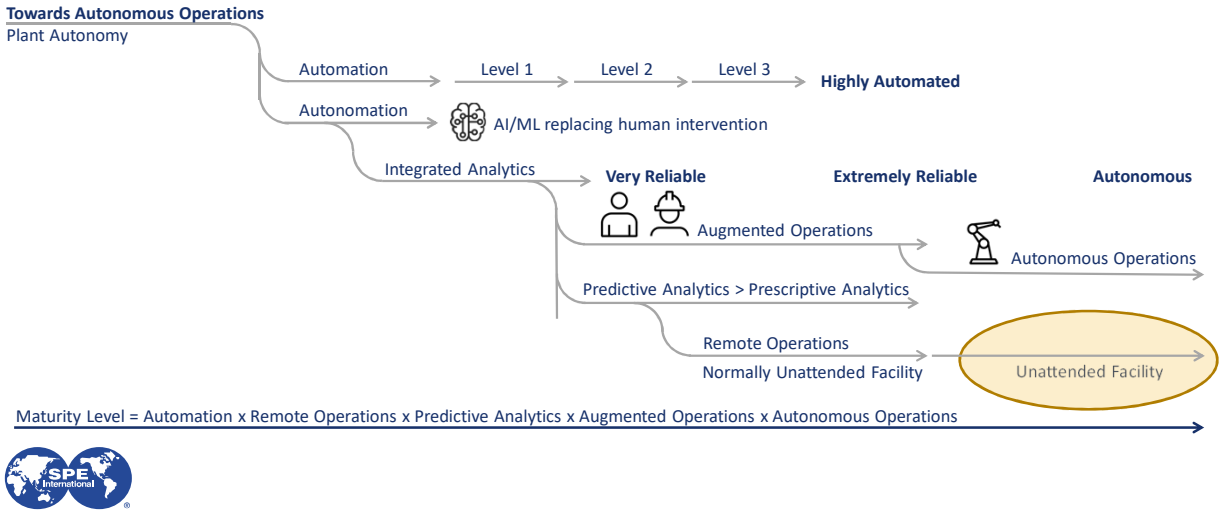
A move towards Normally Unattended Facilities (Remote Operations) is also a move Towards Autonomous Operations

All Electric Plant, Power from Shore, Subsea Electrification
Asset Performance Management for Rotating & Electrical etc.
[*40% of abnormal situations come from equipment failure*]

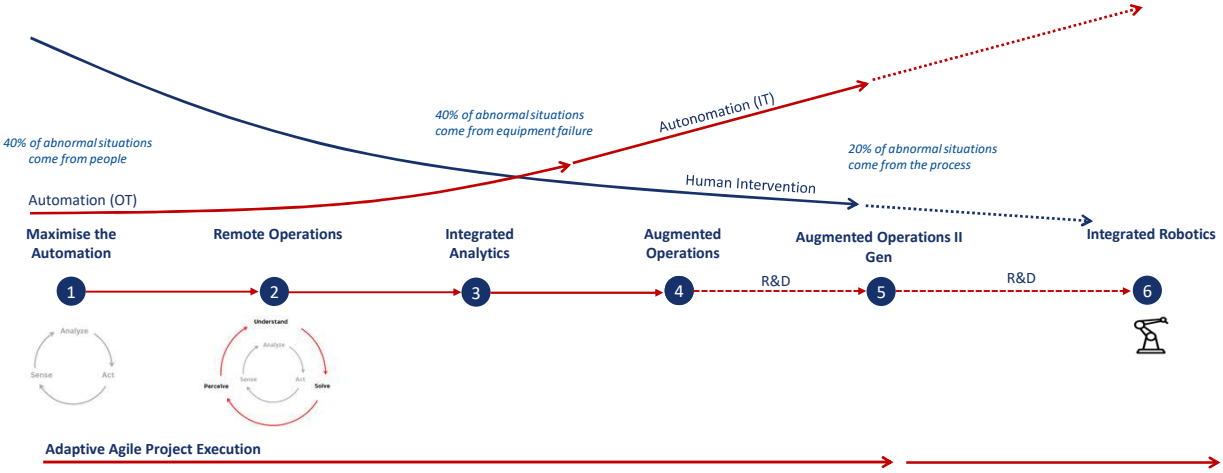
Multi-Purpose Dynamic Simulator (Digital Twin)
[*40% of abnormal situations come from people*]

Augmented Operations
[*20% of abnormal situations come from the process*]

An Implementation Strategy



Summary & the Way Ahead!



Autonomous (Operations):

Denoting or performed by a device (system) capable of operating without direct human control (intervention)

Thank You & Questions!