WIB Autonomous Operations

End User View on Autonomous Operations

Productie Proces Automatisering

25 januari 2024 | Van der Valk Hotel, Vianen

Even voorstellen

Ruud Litjens

- Regional Process Control and Automation Engineer @ Cargill Helping the world thrive
- Chairman of WIB Autonomous Operations Working Group
- linkedin.com/in/ruudlitjens

WIB

- www.wib.nl
- WIB – Process Automation User's Association
  Regus The Hague Central Station
  Koningin Juliana Plein 10
  2595AA, The Hague
- Phone: +31653934236
  E-Mail: consultant@wib.nl or chairman@wib.nl

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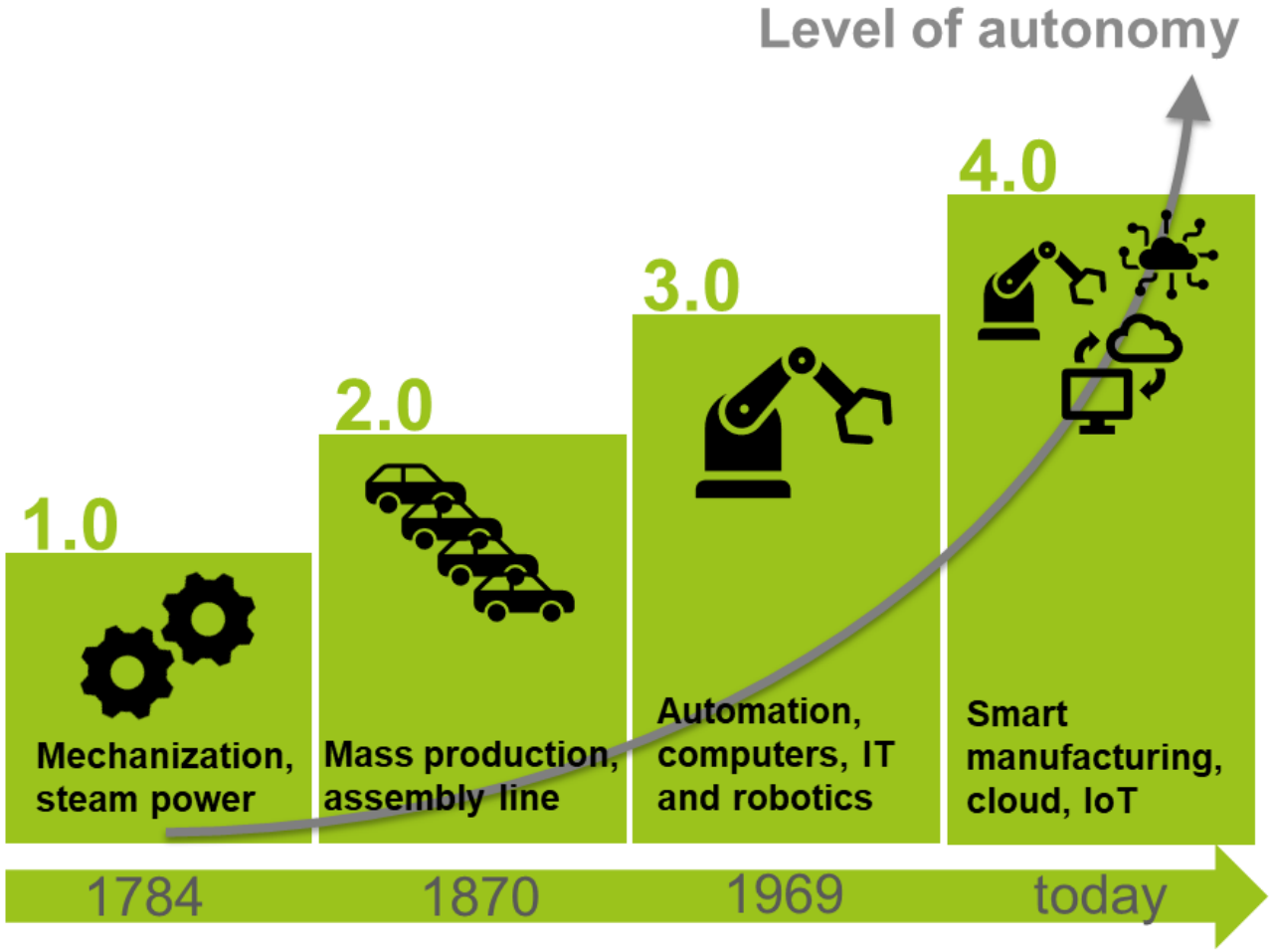
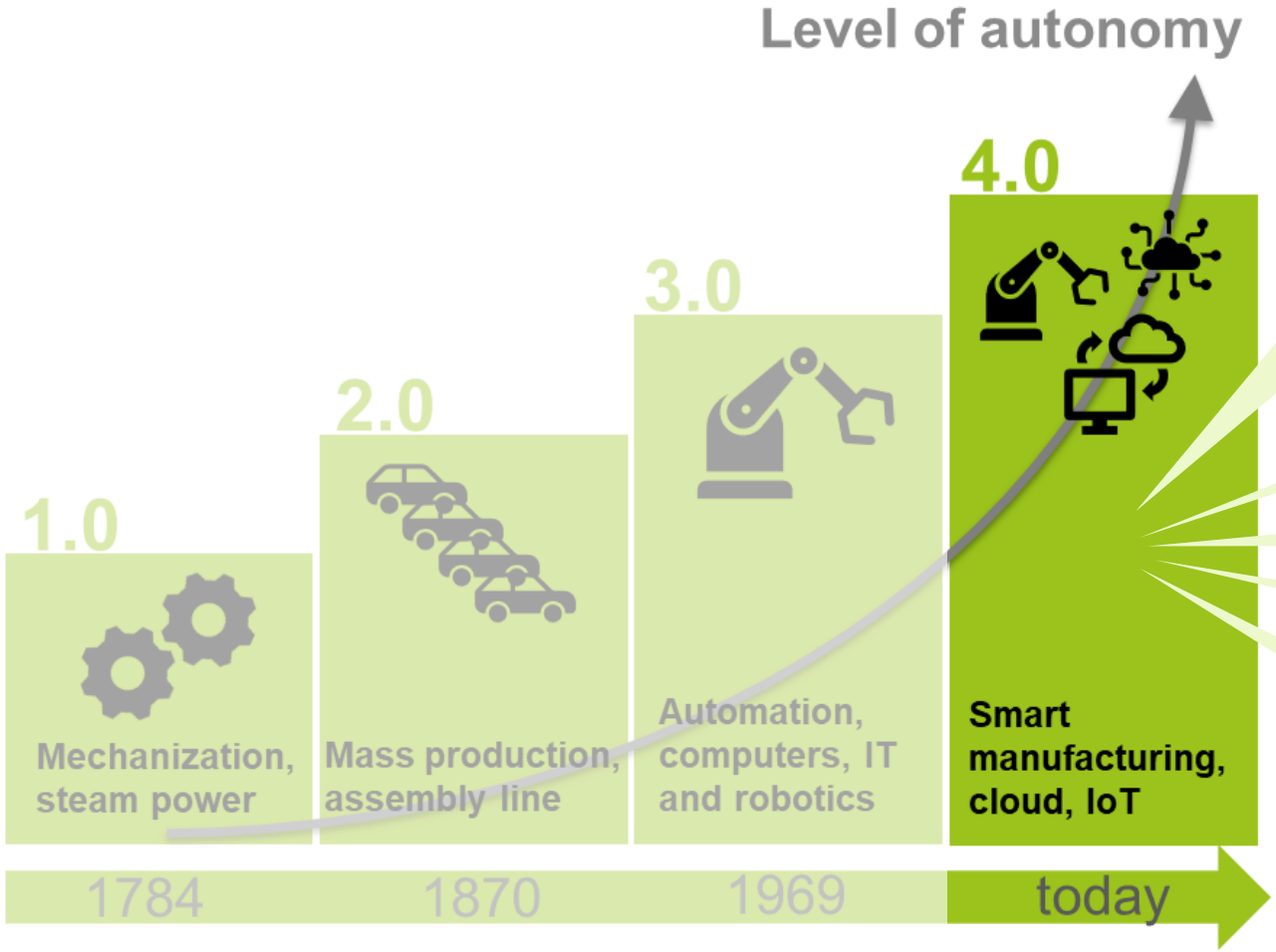
Industrial revolution vs digitalization vs autonomy

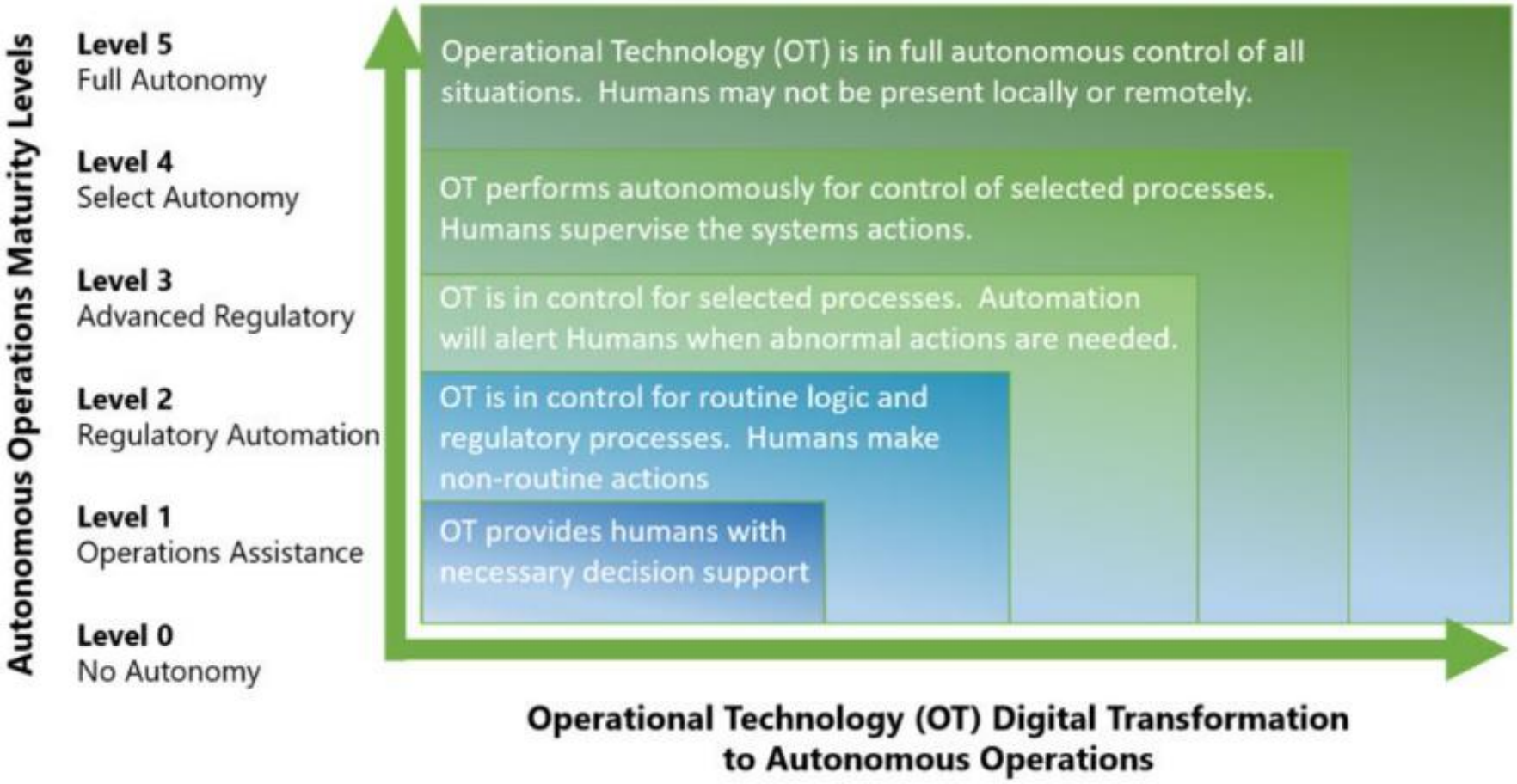


Industrial revolution vs digitalization vs autonomy

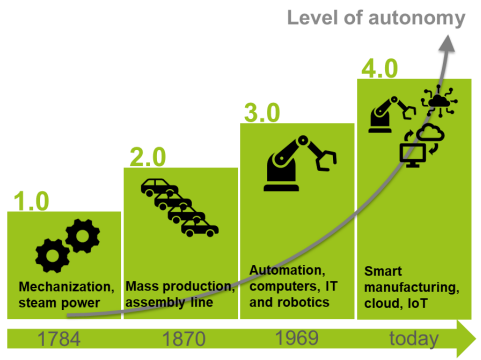


- Digitalisation
- Integration
- Automation
- Fading boundaries
- Workforce

Autonomous Operations: ARC Maturity levels



Source: ARC

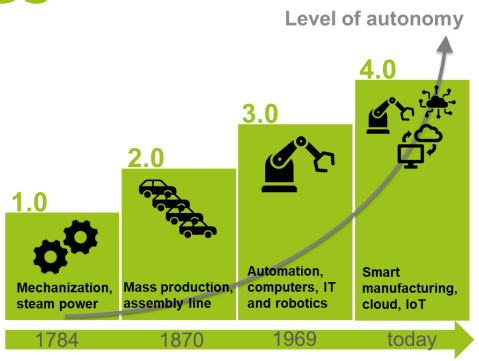


Autonomous Operations: WIB/NAMUR interpretation

- **Level 1 & 2 deemed foundational, are not considered in the matrix**
- **Level 3** *Advanced Regulatory / Predictive* - Selected process units are semi-autonomous, human interventions are required when outside defined operating conditions.
- **Level 4** *Select Autonomy / Prescriptive* - Selected process units are autonomous between planned shutdowns that allow for replacements, upgrades and expansions. Human interactions are limited to non- or semi-autonomous process units. Unexpected shutdowns due to equipment breakdown are exceptional and minimized.
- **Level 5** *Autonomous* - All process units are autonomous between planned shutdowns that allow for replacements, upgrades, and expansions. Human interactions are maintenance centered during planned shutdowns.
  No unexpected plant stops due to equipment breakdown.

Level 3: focus on frequent routine activities (daily … weekly)

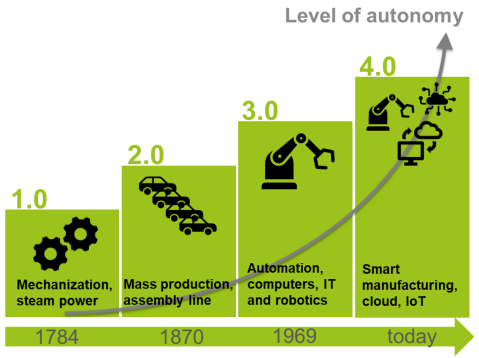
Level 4: focus on infrequent routine activities (weekly … monthly)



Autonomous Operations: value creation

The value creation is in the enablers:

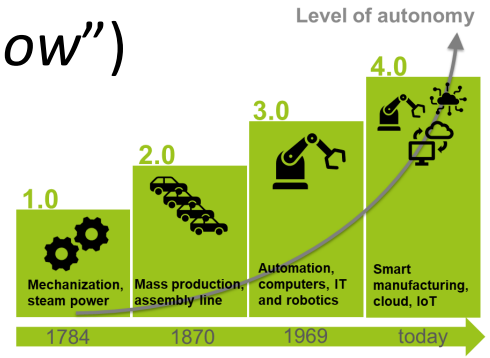
- Increased process efficiency -> monetary / environmental benefits
- Interconnectivity of many applications / functions -> holistic advisory and control
- Keeps people away from hazardous areas
- Enables reduction nightshift: work-life balance / health aspects / attractivity of the job
- Less human dependency: standardized and reproducible operation / less mistakes
- … etc …



Autonomous Operations: domains, states, transitions

- 3 different domains were defined
  - *Production Management*
  - *Process Management*
  - *Asset Management*

- Within each domain AO levels are defined as ***States*** (“*what*”)
- ***Transitions*** describe what is needed to move to a next AO State (“*how*”)

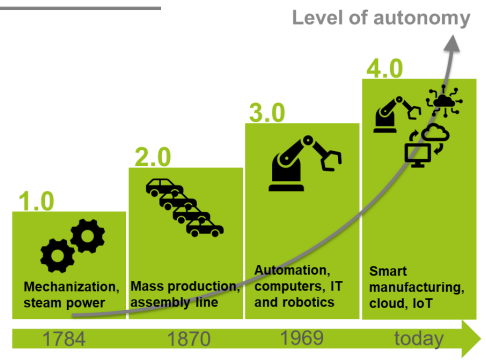


Autonomous Operations: building maturity

Process management	Detail Back to NAVIGATION	Transition Level 2-->3	Level3 Predictive	Transition Level 3-->4	Level 4 Prescriptive
Process execution	State based control	Apply a state based and modular design to all aspects of the process automation solution to cover routine activities.	The process automation solution is state based, modular and equiped with sensors and actors at a level that frequent routine (like CIP, trip-restart) activities do not require any intervention.	Extend the state based design to all aspects of process automation to cover also frequent non-routine activities.	The process automation sc based, modular and equip sensors and actors at a le - Frequent routine (like CIF activities do not require a intervention. - Frequent non routine acti uire any intervention.
		Define asset integration into the state based concept (the so called "Asset interface").	Standardized Asset interface for state based control is integrated.	D th	s fully integrate
		Start design HMI for module Units compliant with ISA101 or equivalent guideline by using displays/graphics.	HMI aligned with state based and modular design. Process states visualized.	Fully integrate HM based design and compliant with ISA101 or equivalent guideline by using displays/graphics.	One Screen overview for o available. Drill down from lower levels, Simulation s for OTS (Operator Training

Definition of transition: what activities are required to progress in maturity (How)

Definition of steady states (What)



Autonomous Operations: domains are related

Asset Management

Detail Back to Navigation	Transition Level 2-->3	Level3 Predictive	Transition Level 3-->4	Level 4 Prescriptive	Transition Level 4-->5
Digital available asset information for maintenance	Make asset documentation digital available.	Human knowledge, documentation, asset documentation is accessable by maintenance service people.	Prepare operator assistant tools for field usage.	Asset information for relevant maintenance task in OAT available with supporting UI	Continue with program

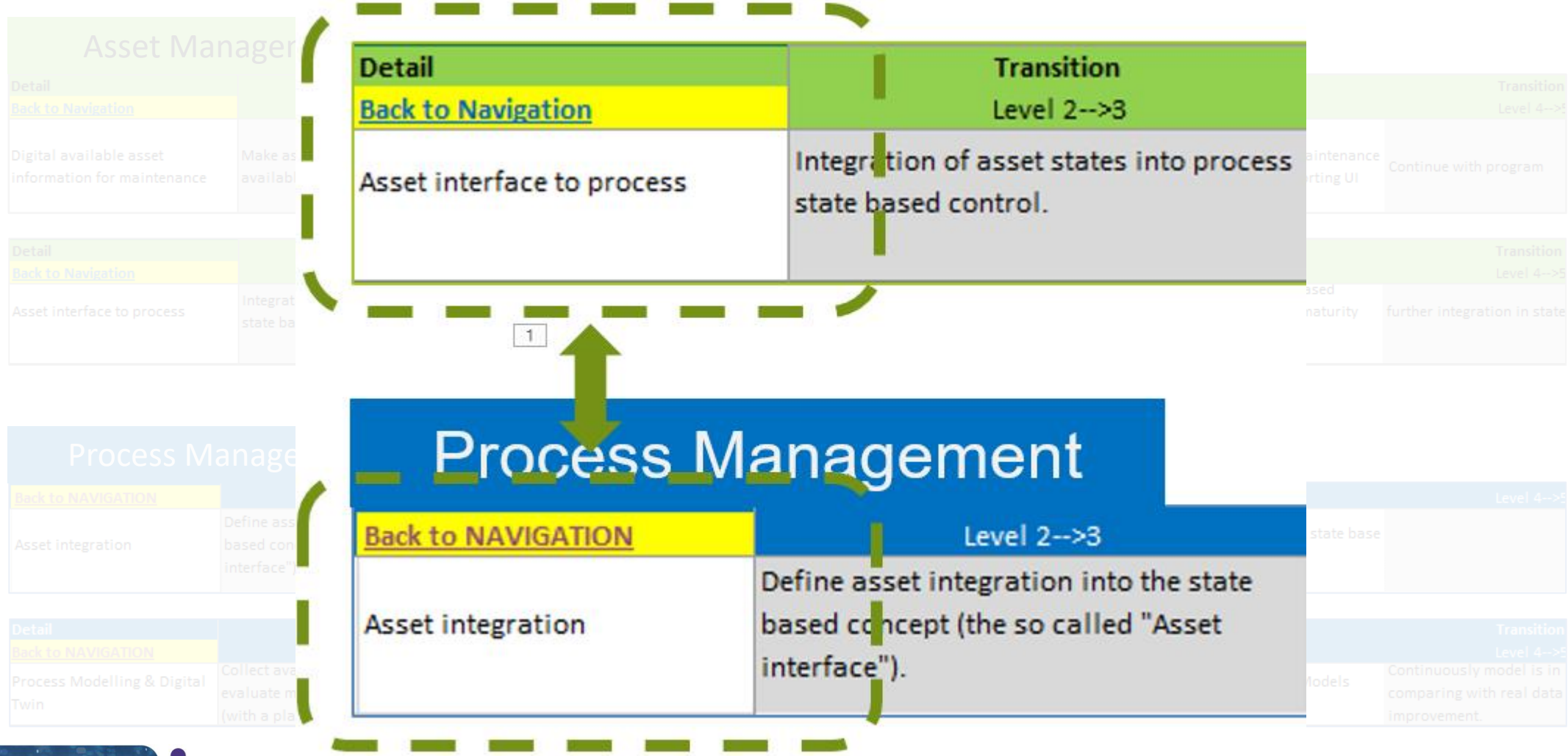
Detail Back to Navigation	Transition Level 2-->3	Level3 Predictive	Transition Level 3-->4	Level 4 Prescriptive	Transition Level 4-->5
Asset interface to process	Integration of asset states into process state based control.	Asset state transferred to state based control in process management maturity level 3.	Enhance integration of asset states into process stage based control.	Asset state transferred to state based control in process management maturity level 4.	further integration in state

Process Management

Back to NAVIGATION	Level 2-->3	Predictive	Level 3-->4	Prescriptive	Level 4-->5
Asset integration	Define asset integration into the state based concept (the so called "Asset interface").	Standardized Asset interface for state based control is integrated.	Define asset states and incorporate these fully into state based control.	Asset states fully integrated in state base control.	

Detail Back to NAVIGATION	Transition Level 2-->3	Level3 Predictive	Transition Level 3-->4	Level 4 Prescriptive	Transition Level 4-->5
Process Modelling & Digital Twin	Collect available rigid models and evaluate machine lear.ning (ML) activites (with a platform)	Digital Twin (DT) for major modues ready and in operation (see OTS) [steady state] for state run.	build models for load change, ramp up and down [quasi steady state models].	for main functional modules Models available.	Continuously model is in comparing with real data improvement.

Autonomous Operations: domains are related



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Autonomous Operations: application example (pump)

- Pump operation is safeguarded by system intervention (process)
- Relevant measures for maintenance are automatically prepared

Level 5 *autonomous*

- Pump operation deviation detection
- Digital twin for pumps is available

Level 4 *prescriptive*

- Relevant condition and process data available
- continuously monitoring and alarming

Level 3 *predictive*

- Make maintenance task execution fully available on OAT
- Prepare tasks to react on alerts
- Gather tools, permits, LoTo, work instructions
- Only planned preventive or reactive maintenance strategy
- Alignment of process and asset data
- Implement embedded analytics
- Get the urgency: how many days? (P/F Interval)
- Improve prediction accuracy by using Human asset expert
- make OAT Systems available

Level 2 *Ready for Condition Monitoring*

- Full integration of process and asset operation
- No human intervention necessary

- Transition manual to automatic asset condition monitoring
- Start with a digital twin for assets
- Upgrade critical assets for high resilience

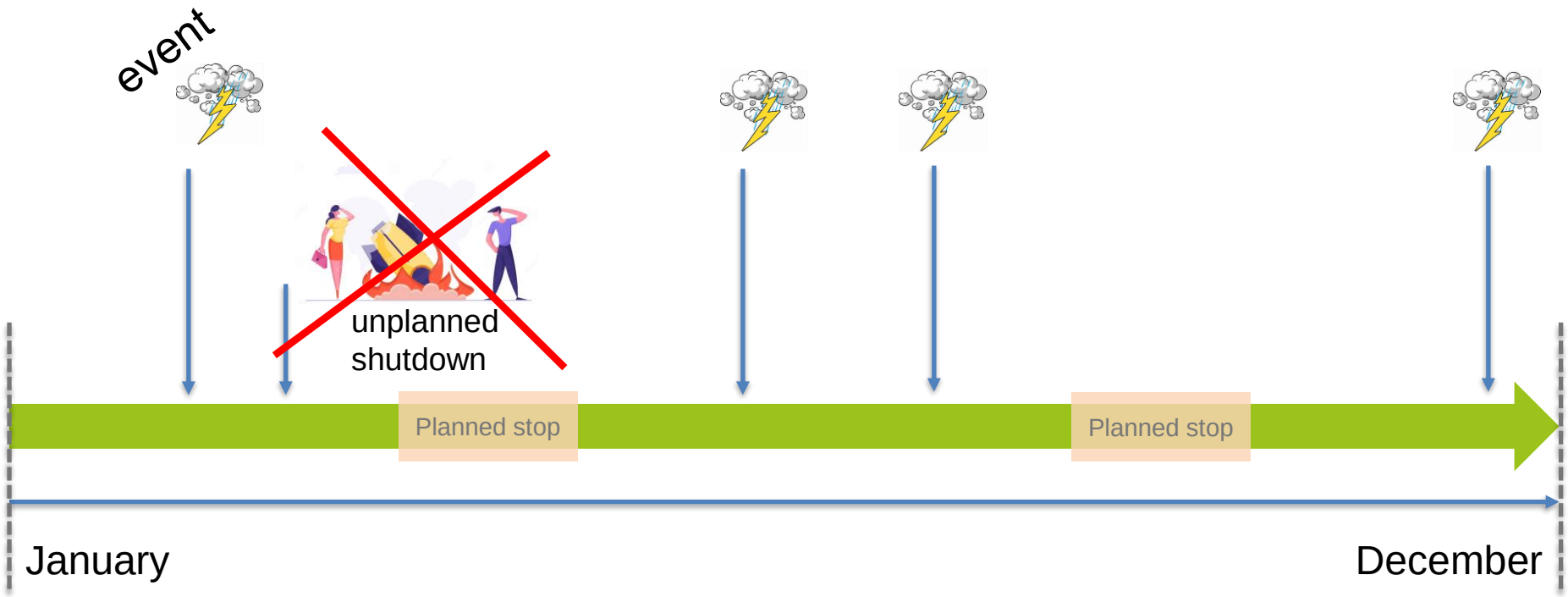
Today!

- Criticality ranking of assets
- Adding more sensors (Vibration, audio etc.)

Transition Stages

OAT: Operator Assistant Tools

Autonomous Operations: getting rid of surprises



Targets:
- Amount
- Quality
- Consistency
- Costs
- …

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Background on Maturity Model development + next steps

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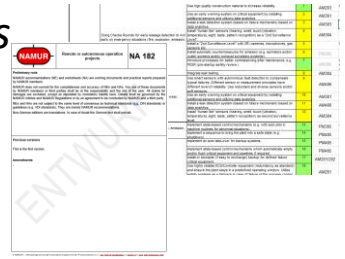
WIB Autonomous Ops Maturity Matrix: a joint effort

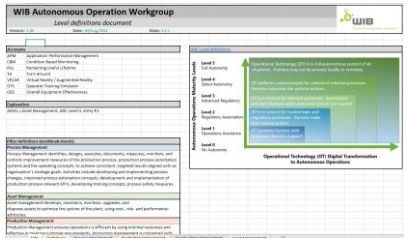
NAMUR AK4.20
Remote and Autonomous Operations

NE161 / Beitrag AK-Praxis:
"guidance regarding the practical aspects for implementation of remote and autonomous operation"



WIB Taskforce
Autonomous Operations

Fundamental approach based on
ARCs Autonomous Operations
Maturity Levels



WIB / NAMUR alignment (v1.0) presented at
NAMUR General Assembly 2021

Further development in a joint working group: v2.0
established in October 2023

Contributing end users

Our intention with the model + next steps

1. Help end user to develop steps to reach desired level of autonomy.
2. Use matrix as framework to have discussions with suppliers on required functionality. With a clearer end-state in mind it’s much easier to explain our goals and discuss requirements to fulfill this journey.
3. Creating exposure:
    - FHI/WIB Workshop in November 2023
    - PPA 2024
    - Explore joining collaborative initiatives like with the Duurzaamheidsfabriek (Asset Administration Shell and Industrial Data Sharing (+ Aut. Ops?)
4. Further development within WIB and NAMUR -> use expertise of all working groups to add or refine required functions.
5. Develop next version of the maturity matrix.

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