

Modular Maintenance

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Why do we perform maintenance?

Cost



- Production loss
- Cost-effective activities
- Resources and materials

Safety



- Hazardous work
- Failures and accidents

Environment



- Emissions/discharge due to shutdowns
- Transport of personnel and materials
- Failures and accidents

Why maintain? Why is it important?

Brakes on car?



Particle filter in exhaust?

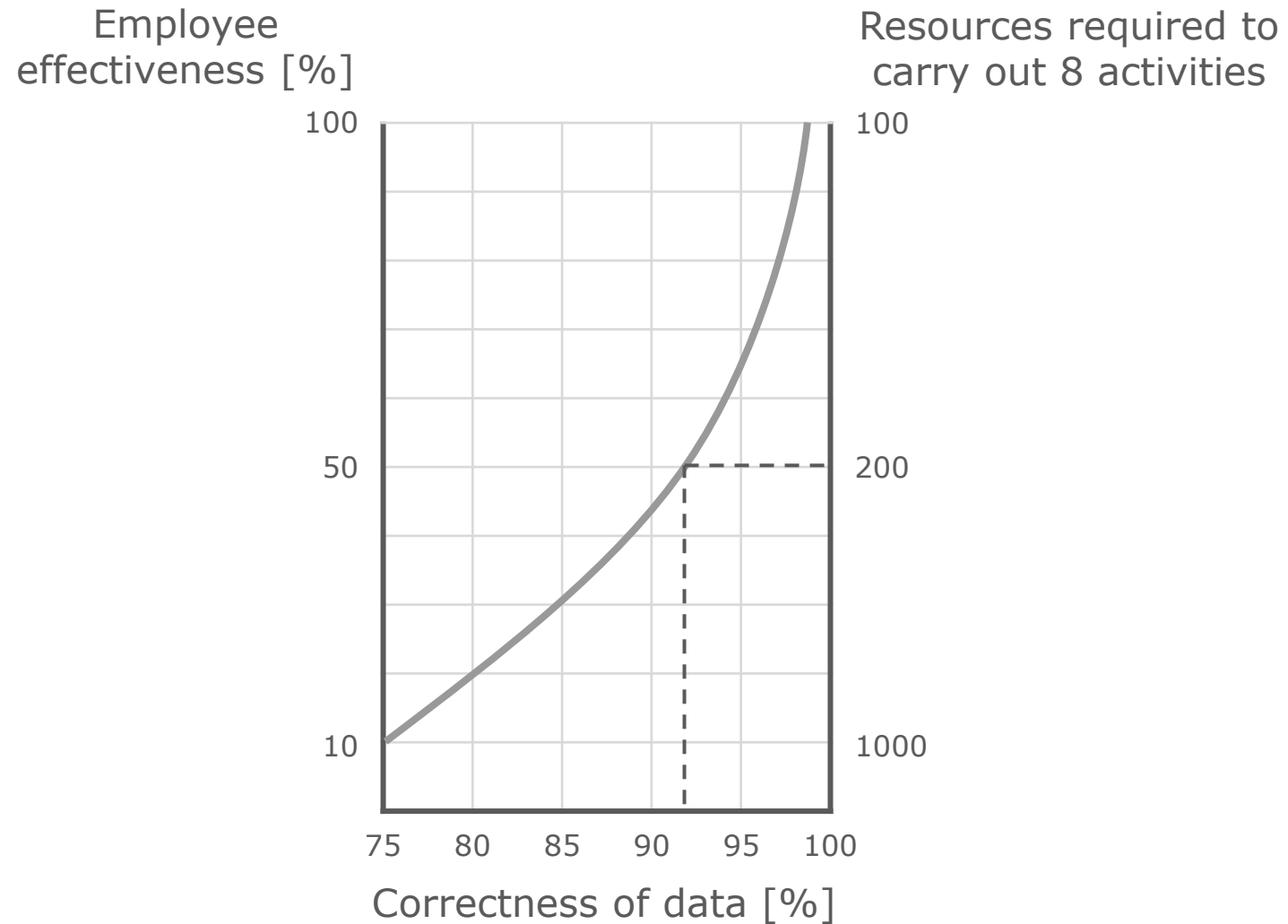


Power lines?



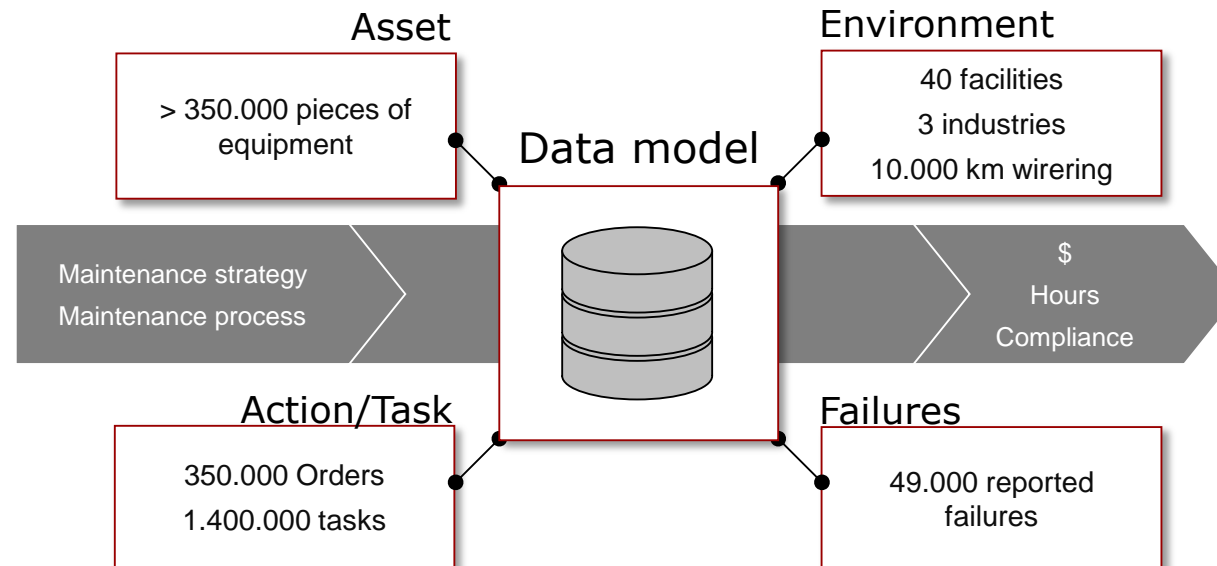
It is often a combination of cost, safety and environment

The impact of errors on resources

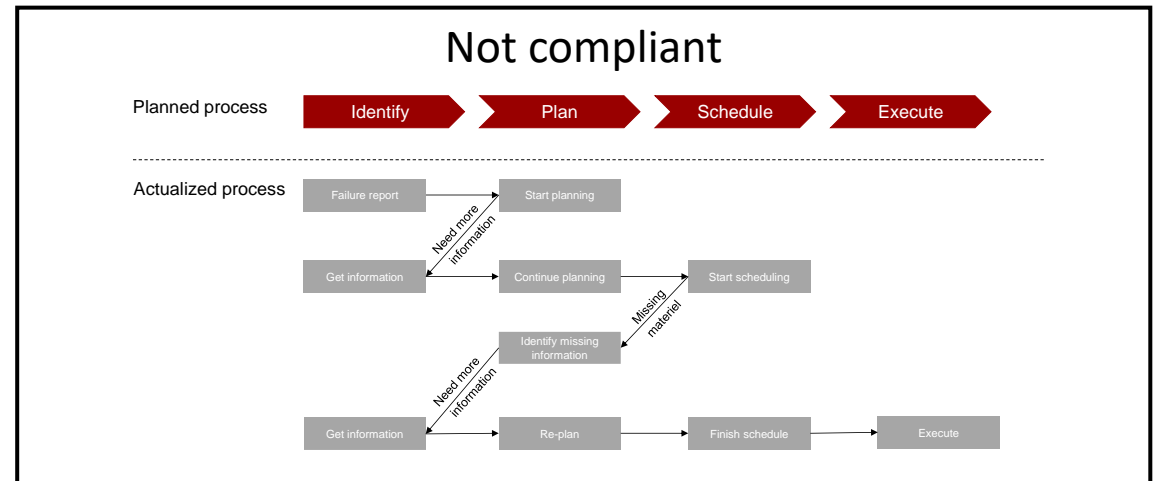
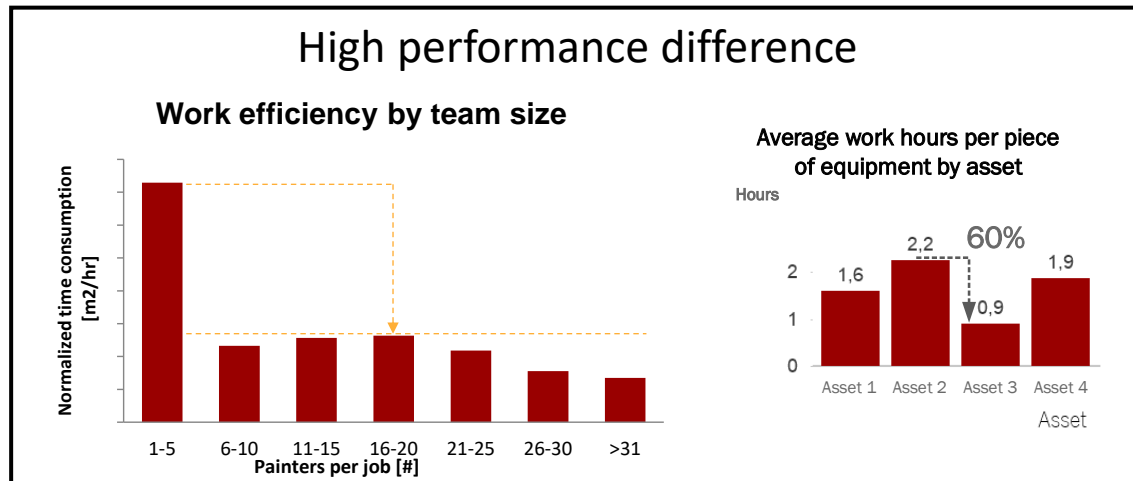
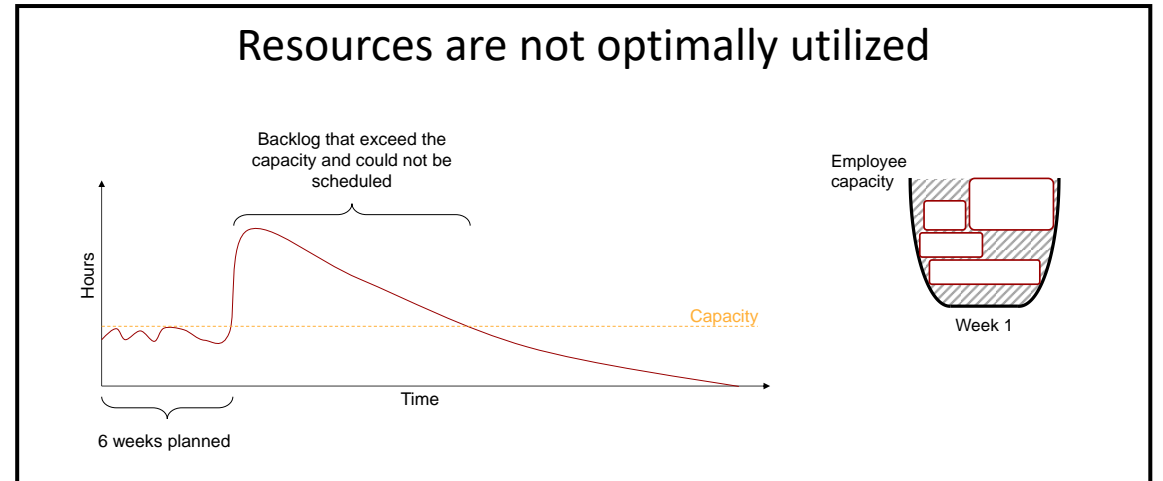
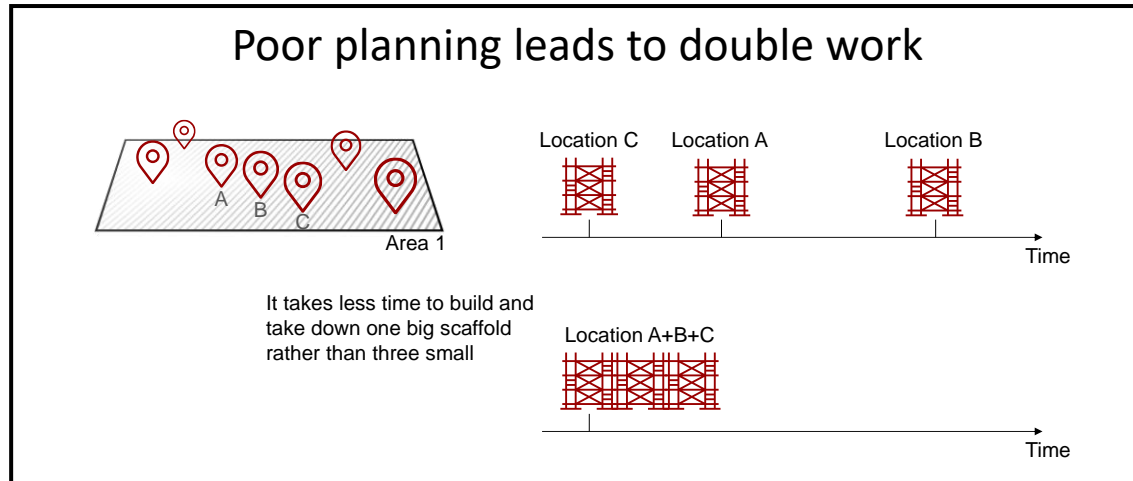


Our background - Where can we smell the money in maintenance

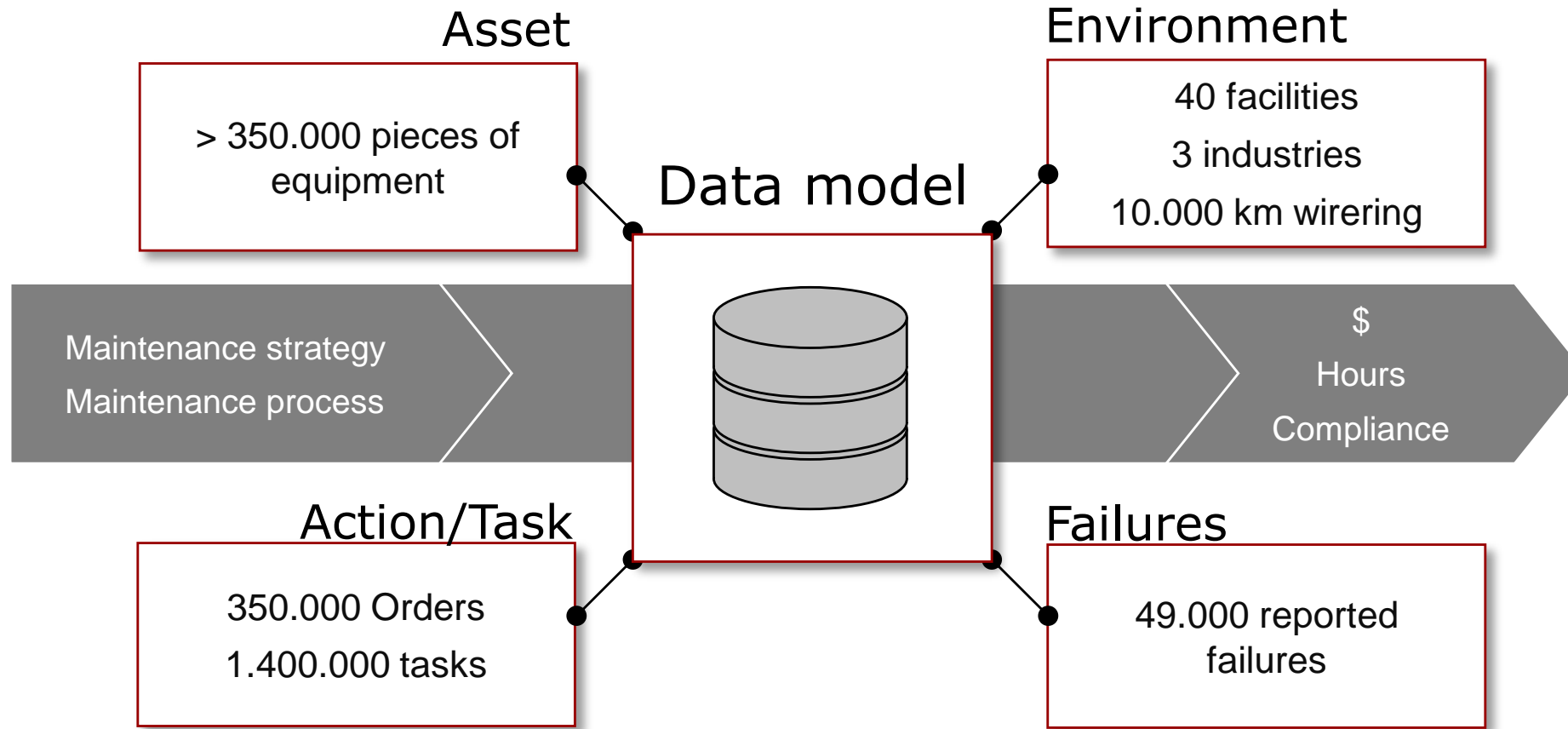
We have built a unique competence on structuring historical large maintenance data sets on complex assets to be used for improving availability and work efficiency



Are we good at Maintenance

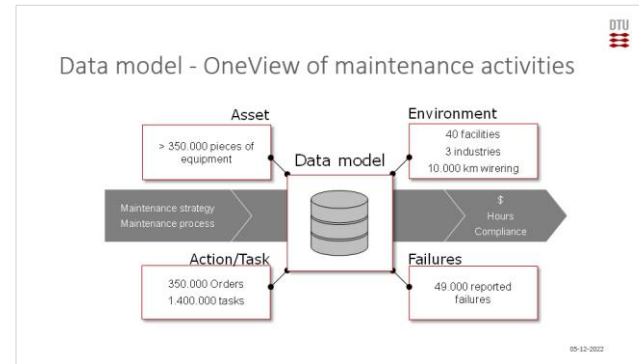


Data model - OneView of maintenance activities



What can we do

Data model



Clustering

What do we mean by clustering?

Case Dan F November 2020

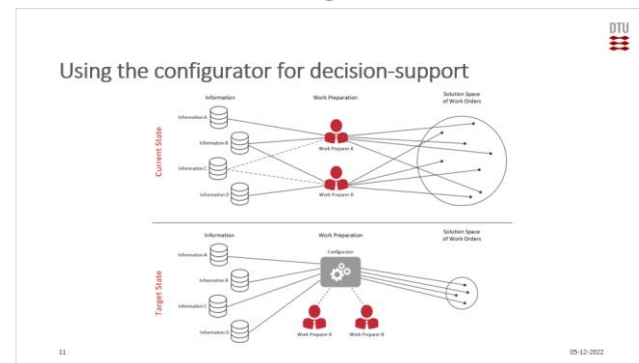
Savings

- 3.4% of remaining work hours
- 3.3% of operations

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Configurator



Scheduling algorithm

Proposed computer algorithm

How the maintenance scheduling algorithm works

Inputs

- ✓ User
- ✓ Status
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- ✓ Priority
- ✓ Required Work
- ✓ Scheduling sequence

Computer Algorithm

Outputs

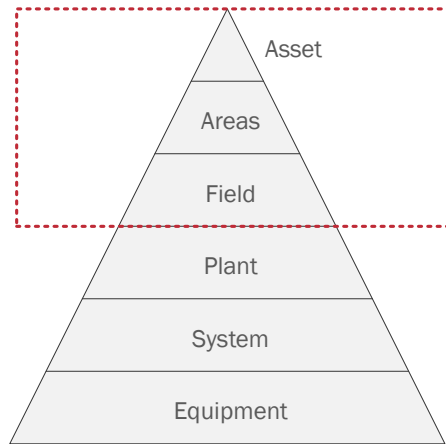
- ✓ Start Date
- ✓ Finish Date
- ✓ Assigned Work
- ✓ Capacity Levelled

Proposed Schedule

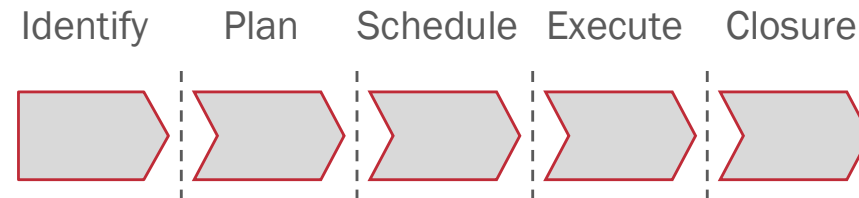
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Why this data model

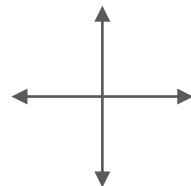
Physical dimension



Operation dimension

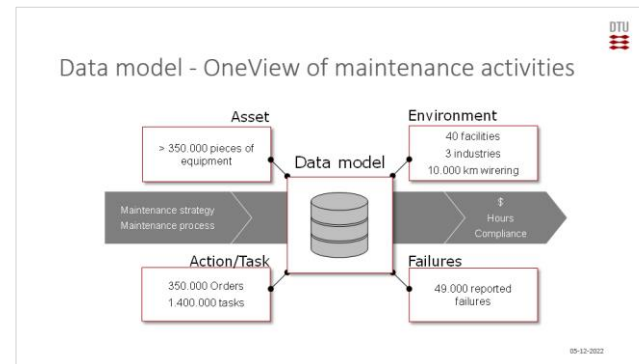


How we can navigate in the data model



What can we do

Data model



Clustering

What do we mean by clustering?

Case Dan F November 2020

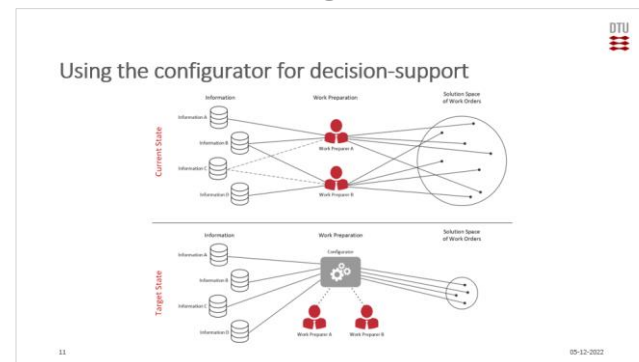
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Computer Algorithm

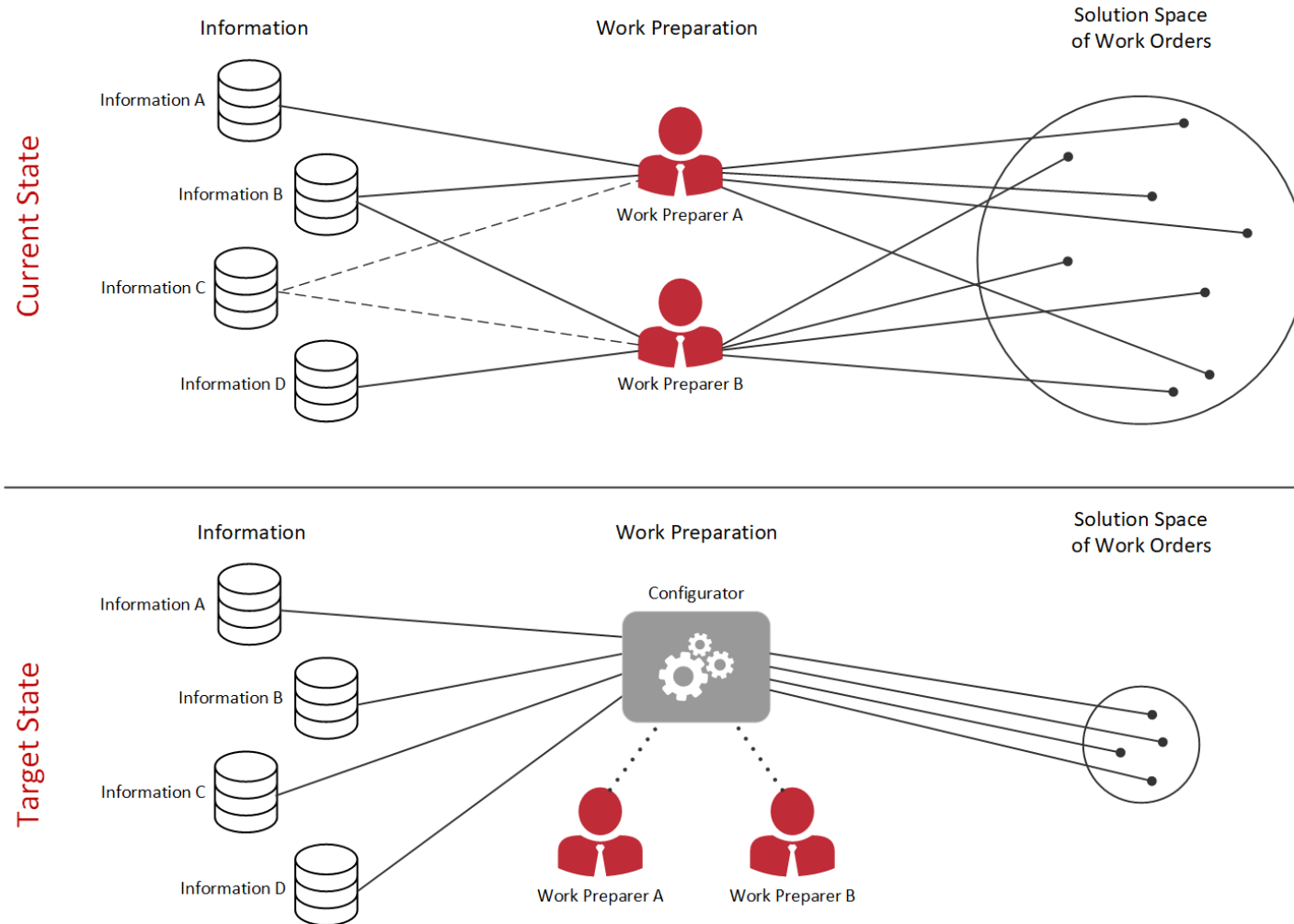
Proposed Schedule

Outputs

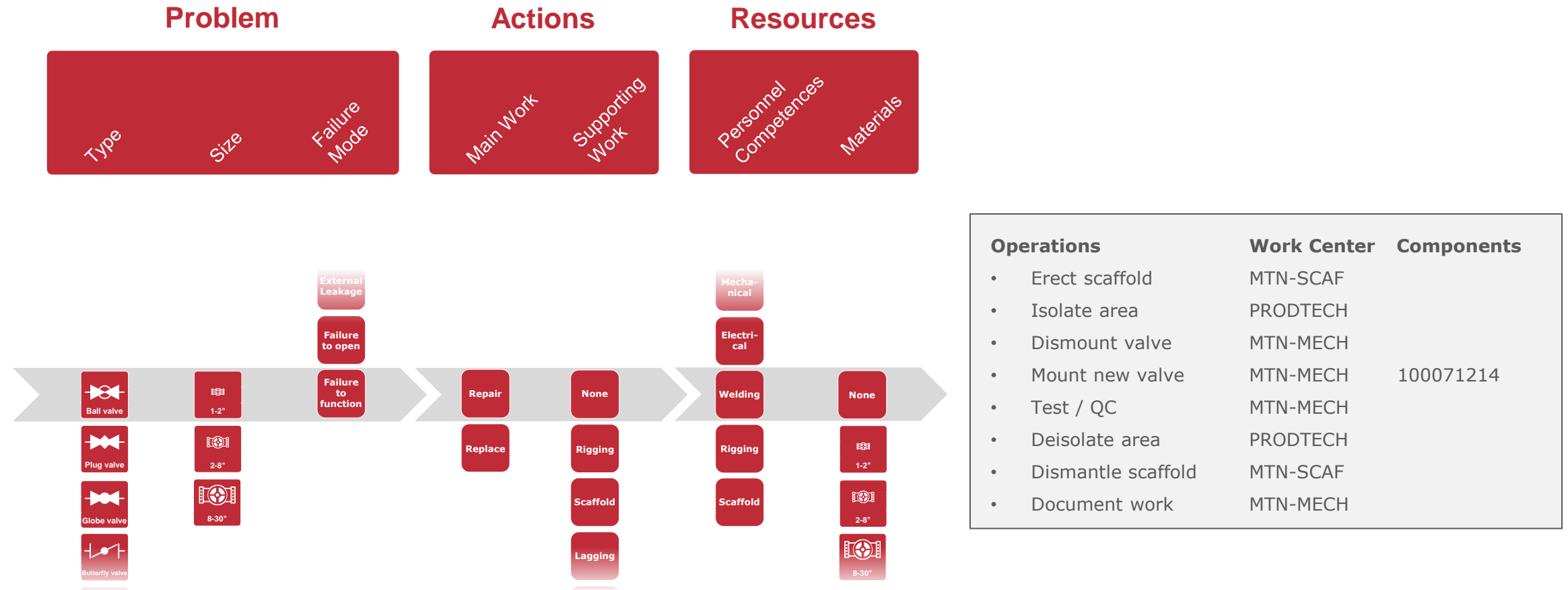
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Using the configurator for decision-support



So how does this configuration concept work?



The configurator!

In daily use despite being a prototype.

31 employees given access to the configurator

The screenshot displays the 'Work Order Configurator' interface, which is divided into three main sections: Equipment, Work, and Operations.

- Equipment Section:** This section allows users to define equipment parameters. It includes fields for 'Work Order', 'Functional Location', 'From Notification', 'Object', 'Damage', 'Main WorkCY', 'From Equipment Master', 'Class', 'Class Description', 'Catalog Profile', 'Start-up Date', 'Height', 'Size/Dimensions', 'Main WorkCY', and 'ONE-SHIFT Data on Tag No.'. It also features a 'SuperClass' list, a 'Class' list, and a 'Catalog Profile' list.
- Work Section:** This section is used to define work tasks. It includes 'Repair or Replace?' (with a dropdown for 'Repair'), 'Main Work', 'Replace Equip. (MS/MS/MS)', 'Replace Equip. (one part)', 'Replace Equipment', 'Align', 'Alignments', 'Calibrate', 'Check', 'Clean', 'Clean + Accessible', 'Oil change', 'Optional', 'All part of (select)', 'Recondition of (select)', and 'Change'. It also includes 'Object Part' (with a dropdown for 'Actuator'), 'Object SubPart', 'Secondary Work', 'Object SubPart', 'Term. Equipment', 'Optional Operations', and 'Supporting Work'.
- Operations Section:** This section is used to generate and update operations. It includes a 'Generate / Update Operations' button, an 'Adjust hours with new sum' button, and an 'Upload Operations to Work Order (SAP)' button. Below these buttons is a table showing the generated operations.

Activity	Work Center / Operation	Hours	No. of People	Material Req.
0010	WPH-SAP	4.0	1	
0010	PRODOTCH	2.0	1	
0010	WPH-BAE	2.0	1	
0010	WPH-MEC	4.0	1	
0010	WPH-MEC	4.0	1	
0010	WPH-SAP	2.0	1	
0010	PRODOTCH	2.0	1	
0010	WPH-SAP	4.0	1	

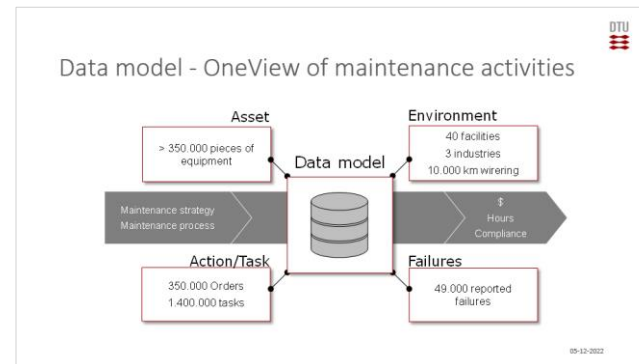
Can configure >70% of equipment

Can configure >80% of work

Integrated with SAP and other IT-systems

What can we do

Data model



Clustering

What do we mean by clustering?

Case Dan F November 2020

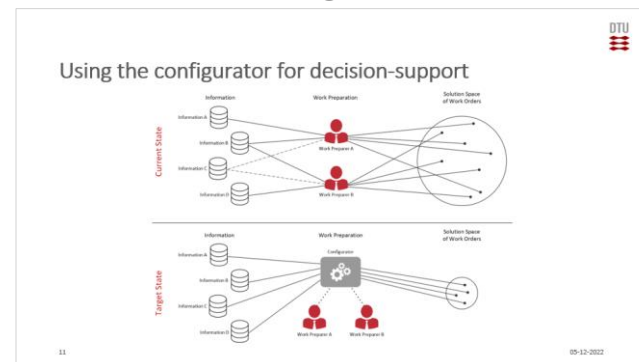
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Computer Algorithm

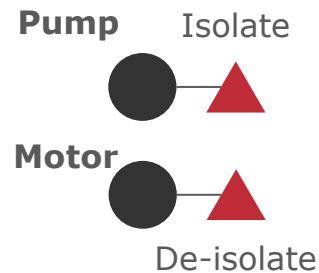
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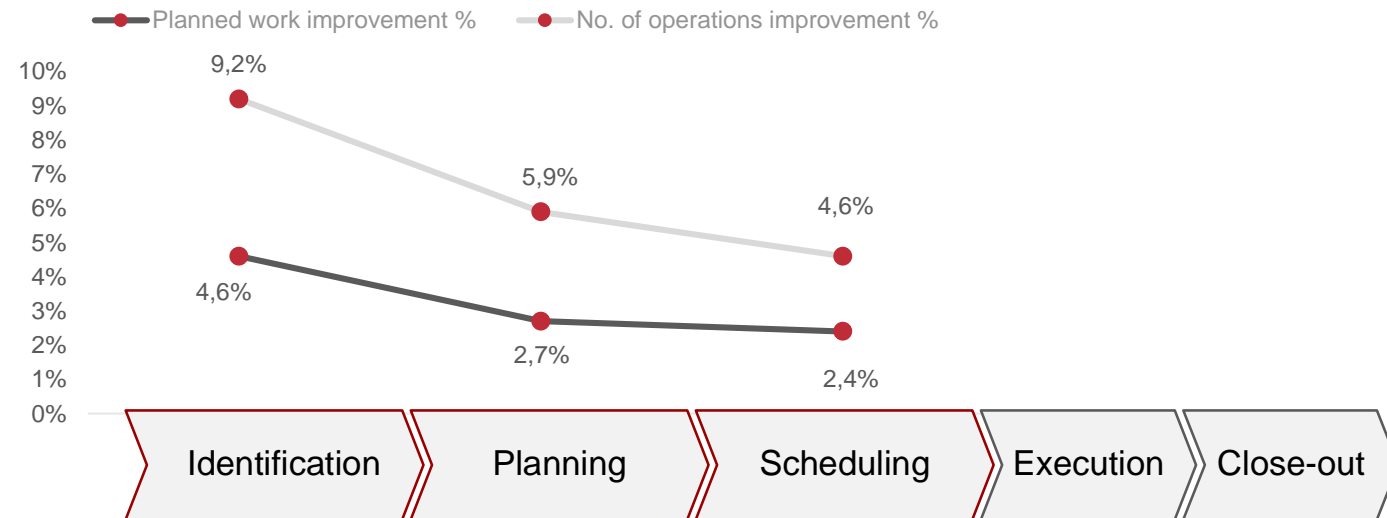
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					20 L3 Replace the systems pulsation damper	3	MTN-MECH	07-12-2020	17-03-2018
					30 L3 Dismantle P-3921	3	MTN-MECH	07-12-2020	17-03-2018
					40 L3 Dismantle PM-3921	3	MTN-ELEC	07-12-2020	17-03-2018
					50 L2 Install P-3921	3	MTN-MECH	07-12-2020	17-03-2018
					60 L2 Install PM-3921	3	MTN-ELEC	07-12-2020	17-03-2018
					70 L3 De Isolate PM 3921 + P 3921	2	PRODTECH	08-12-2020	17-03-2018
					80 L3 Test of equipment	1	MTN-MECH	08-12-2020	17-03-2018
			DF /B /75/DFBA-P-3921	2100024104	10 L3 Isolation of demul pump	3	PRODTECH	21-12-2020	27-03-2019
			20 L2 Replace demulsifier pump		0	MTN-MECH	21-12-2020	27-03-2019	
				30 L3 De-Isolation/test demul pump	3	PRODTECH	21-12-2020	27-03-2019	

The timing of the decision

Case study results show improvement from early clustering



Proposed computer algorithm

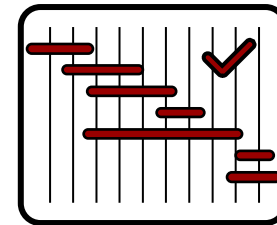
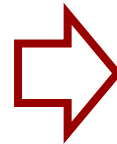
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Computer Algorithm



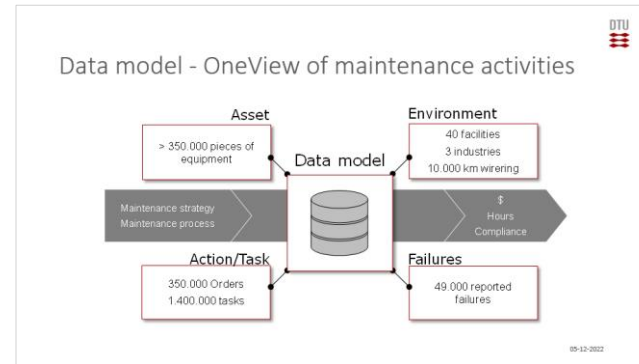
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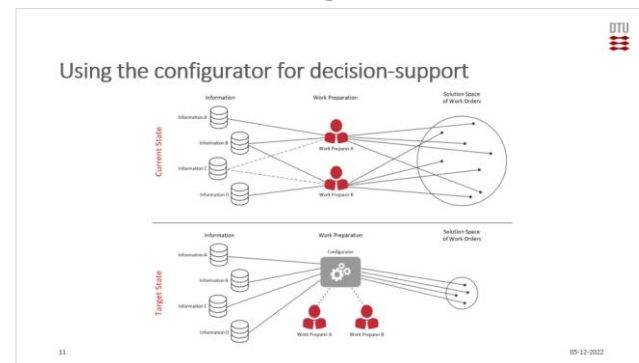
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➔

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Proposed Schedule

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General requirements for scheduling maintenance jobs

<p>a) Management of resource allocation (limited to maximum capacity)</p>		<p>e) Management of start date</p>	
<p>b) Management of offshore resources on board (limited to maximum capacity)</p>		<p>f) Management of material</p>	
<p>c) Management of risk for delaying the maintenance work</p>		<p>g) Grouping of similar works</p>	
<p>d) Management of dependencies among operations</p>		<p>Legend WC = Work Center POB = People on board LAFD = Latest allowable finish date Opr. = Operation SS = Start – Start relation (Preceding operation starts with the succeeding operation) FS = Finish – Start relation (Succeeding operation starts when the preceding is finished) EASD = Earliest allowable start date</p>	

The Team



Niels Henrik Mortensen



Jingrui Ge



Kristoffer W. Sigsgaard



Kasper B. Hansen



Simon Didriksen



Julie K. Agergaard



Christian B. Jespersen

Meet us at the Meeting Place

