De weg naar Operational Excellence

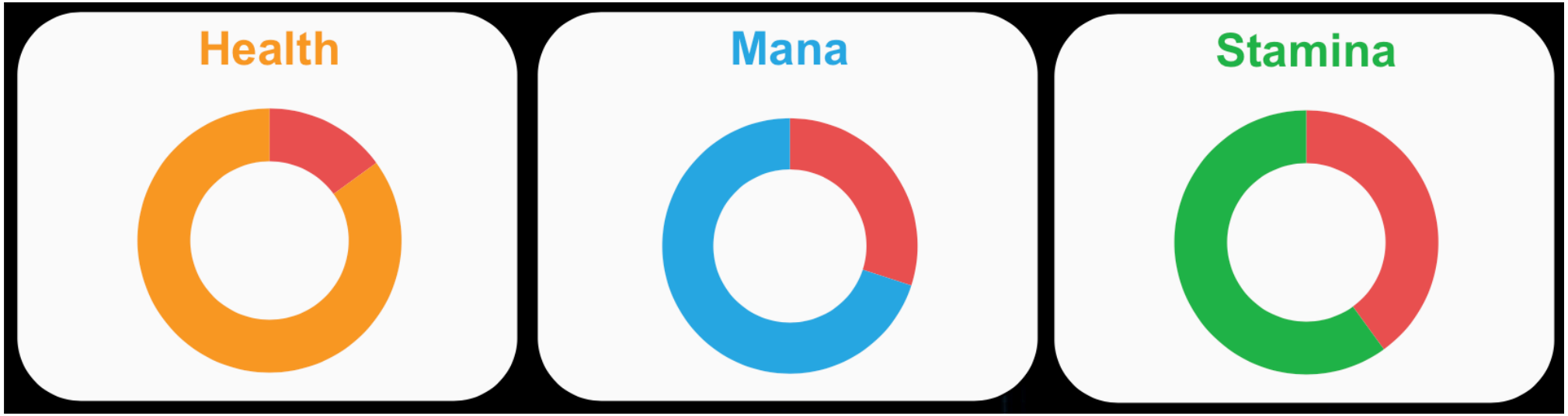
Industrial Analytics met Machine Learning

Wiek Wijnands

duurzaam heids fabriek

Asset Health & Industrial Analytics

Asset Health Monitor



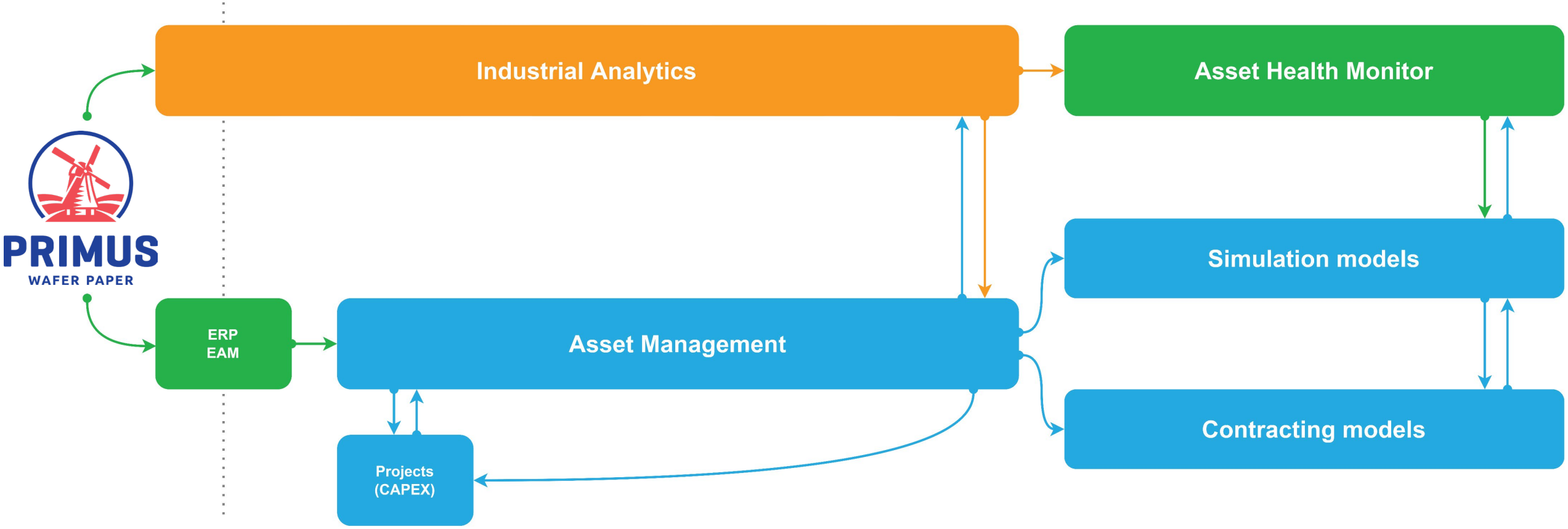
33%
Higher machine availability

18%
Product/process quality improvement

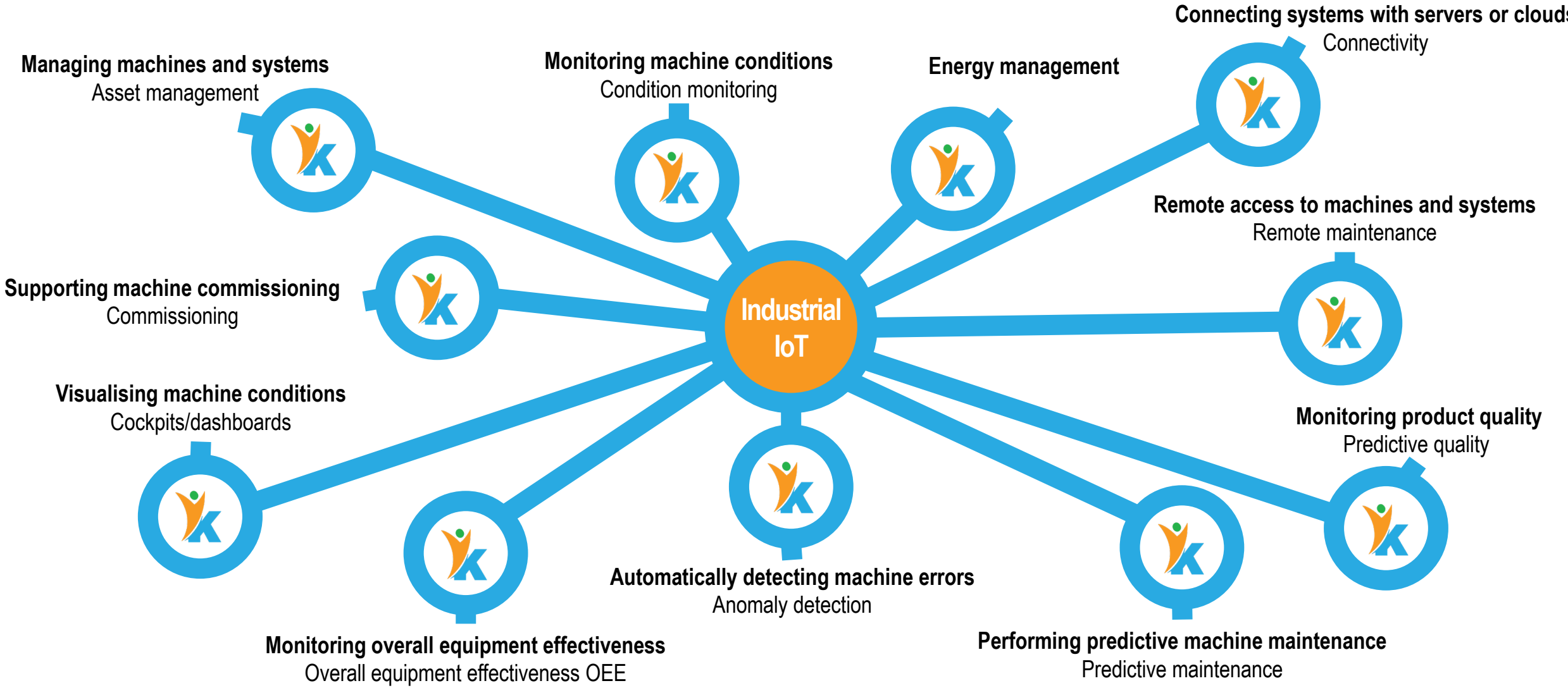
21%
Maintenance cost reduction

Average results from machine builders and operators

Predictive Maintenance & Asset Health



How do you benefit from Industrial IoT?



The primary project objectives

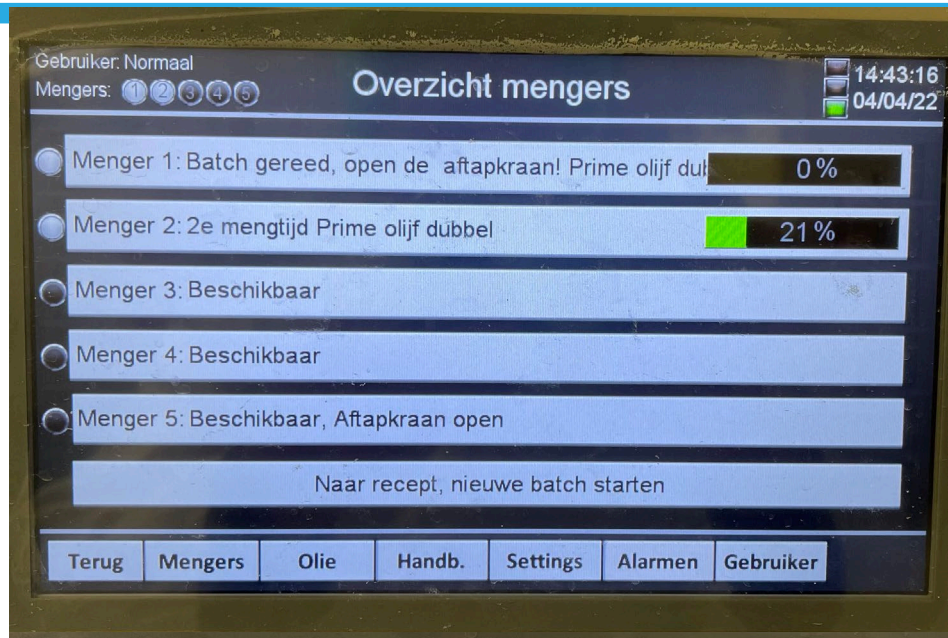
- Solve limitation of the aged automation system
- New and flexible recipes should be possible
- Shift from 24-5 to 24-7 operation

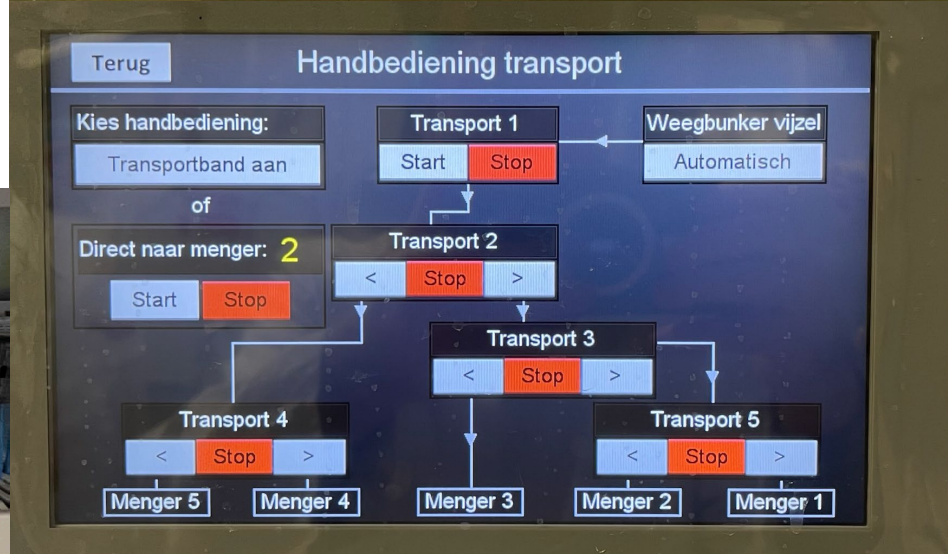
Latent needs

- Remote maintenance
- Data analytics (IIoT en ML) for future improvement and production growth

What did we do

- Define functional requirements with involvement of operations
- New process controller (PLC) and HMI
- Rebuild process automation with reliable PLC with remote service possibilities
- Implementation of a new recipe



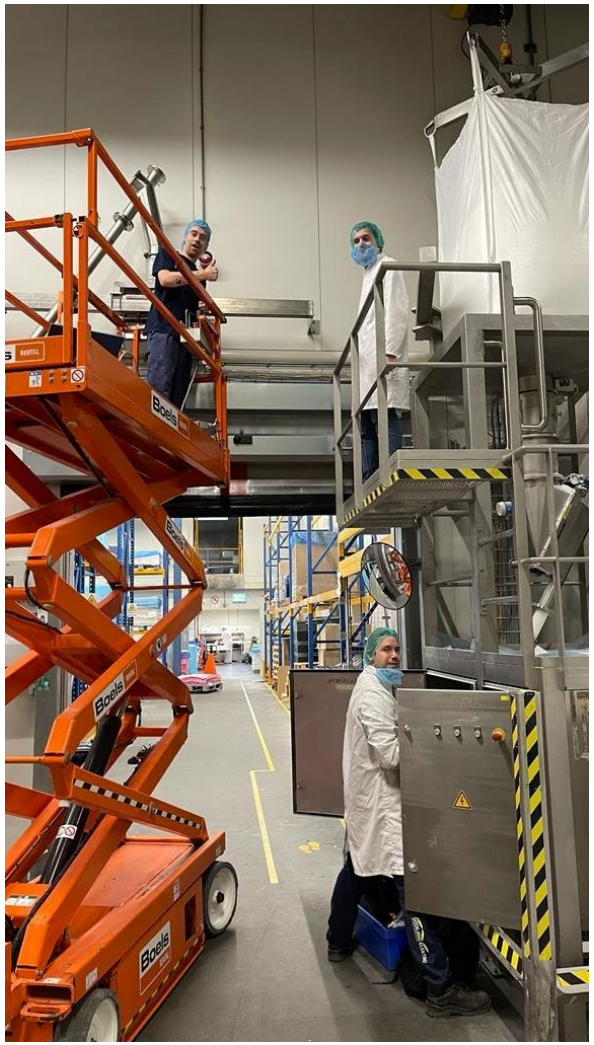


Increased production capacity

- Increased production volume
  - Due to process automation
  - Easy way to work and plan ahead (start multiple batches)
- Easy way to test and implement new recipes
  - Implementation of several new recipes

Reduced downtime and stagnation

- Remote service Maintenance
- Remote Trouble Shooting
  - Electrical Peak loads
  - Solving failures during the weekend after cleaning activities

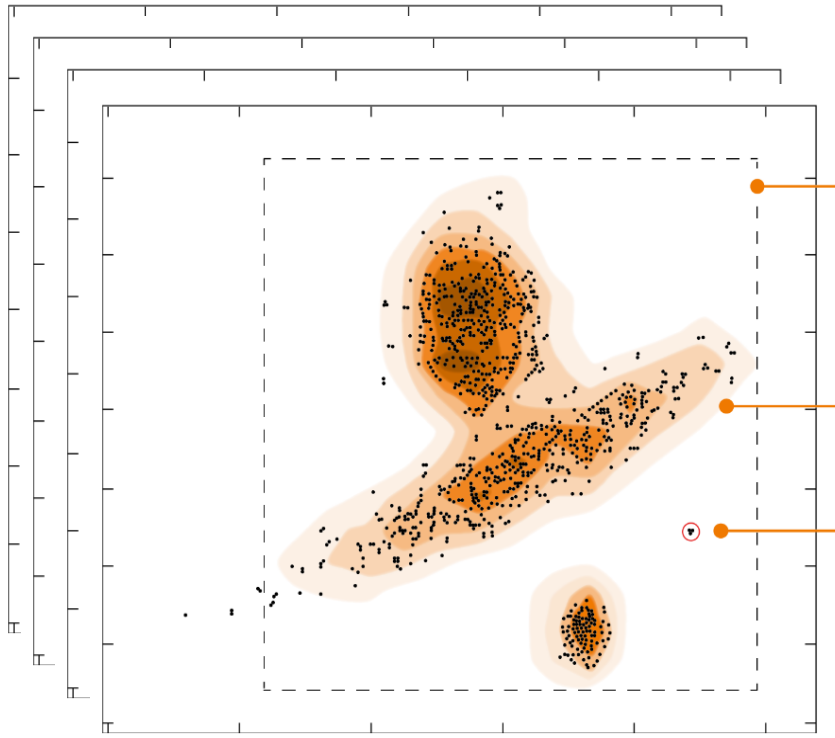


Increased quality and (food) safety

- 35% Less customer complains
- Detailed overview of problems and alarms
  - Improved local HMI and dashboard
  - Improved system status
  - More detailed alarm levels
- 50% reduction of critical and expensive ingredients
  - Proof of correlation between temperature and humidity in production facility and the use of sunflower or olive oil
  - Longer expiring dates possible
- Integration of QA elements
  - Batch registration of produced dough
  - Batch registration of raw materials

Automation Solutions vs. Machine Learning

Identify anomalies easier & faster with ML-methods



Rule-based thresholds

Machine learned, model-based boundaries

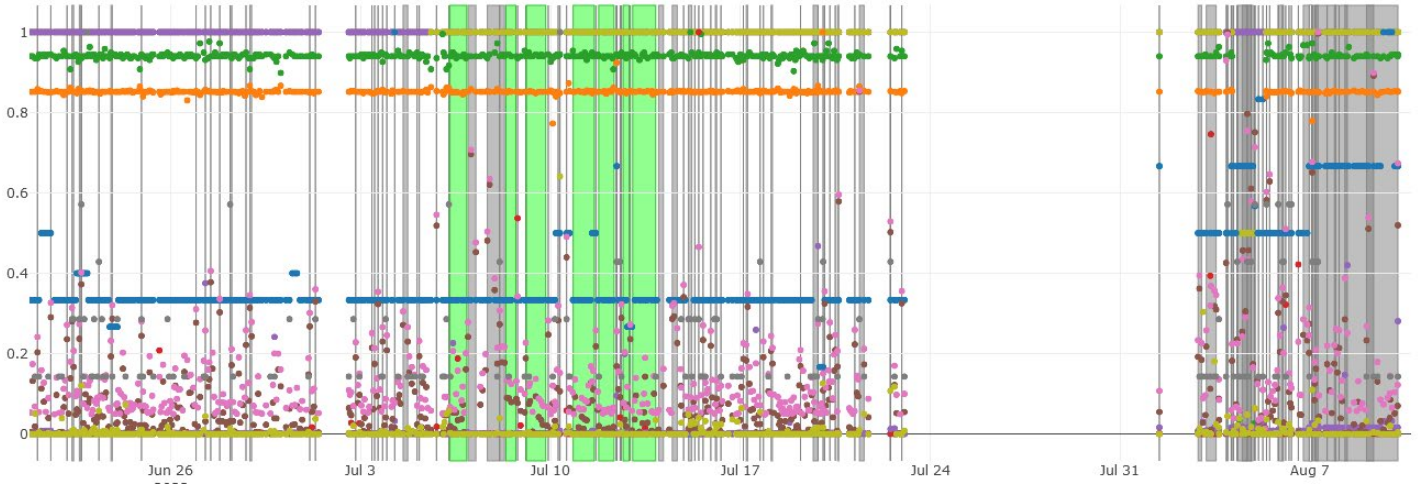
Anomaly missed by rule-based approach

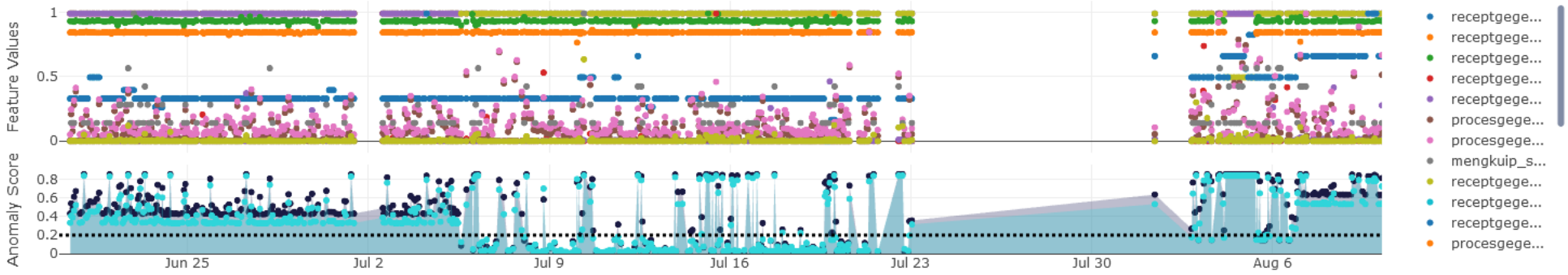
Machine Learning approach allows …

- handling of multi-dimensional input space
- automatic learning of monitoring rules (decision boundaries)
- identification of correlations among involved sensor signals
- identification of root-causes
- new insights into machine behaviour

Industrial Analytics

- Anomaly detection
- Anomaly score

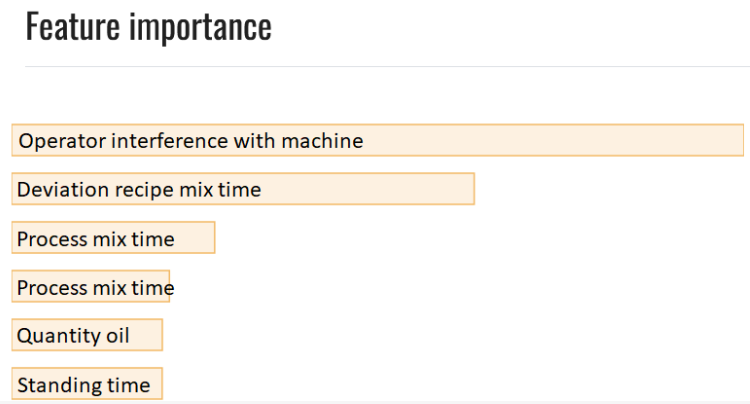




Machine Learning Models

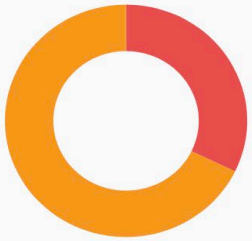
- Feature importance
- Model archetypes

Early Warning System (EWS)

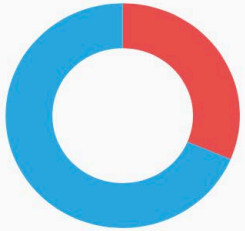


Model	↓ AD rate	False alarm rate	Selected Features	Generated Features	Training duration	Execution duration	
Ada Autoencoder	**89 %**	7 %	20	41	7.82 s	0.107 ms	Feature importance
Marie Nearest Neighbors	83 %	**2 %**	20	25	552 ms	0.101 ms	Feature importance
Albert Support Vector Machine	56 %	13 %	20	25	**499 ms**	**0.014 ms**	Feature importance
Isaac Optimized Support Vector Machine	44 %	5 %	20	41	1.72 s	0.015 ms	Feature importance
Archimedis Random Forest	44 %	**2 %**	20	25	801 ms	0.105 ms	Feature importance
Galileo Optimized Random Forest	4 %	5 %	20	41	25.83 s	0.276 ms	Feature importance
Margaret Optimized Nearest Neighbors	-	-	-	-	-	-	

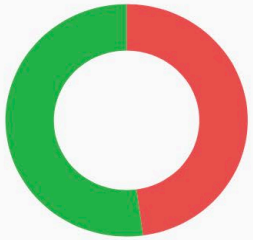
Health

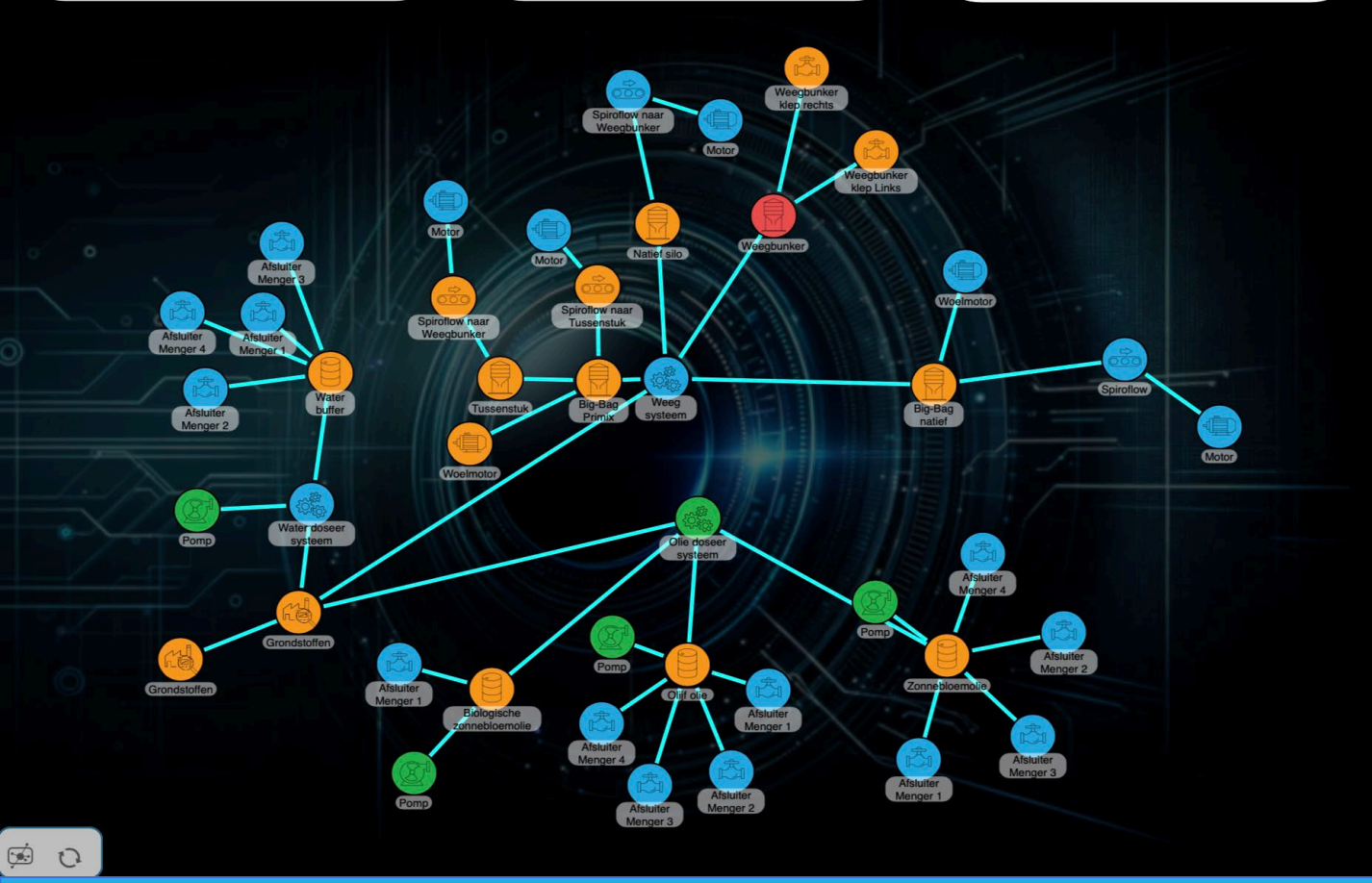


Mana



Stamina



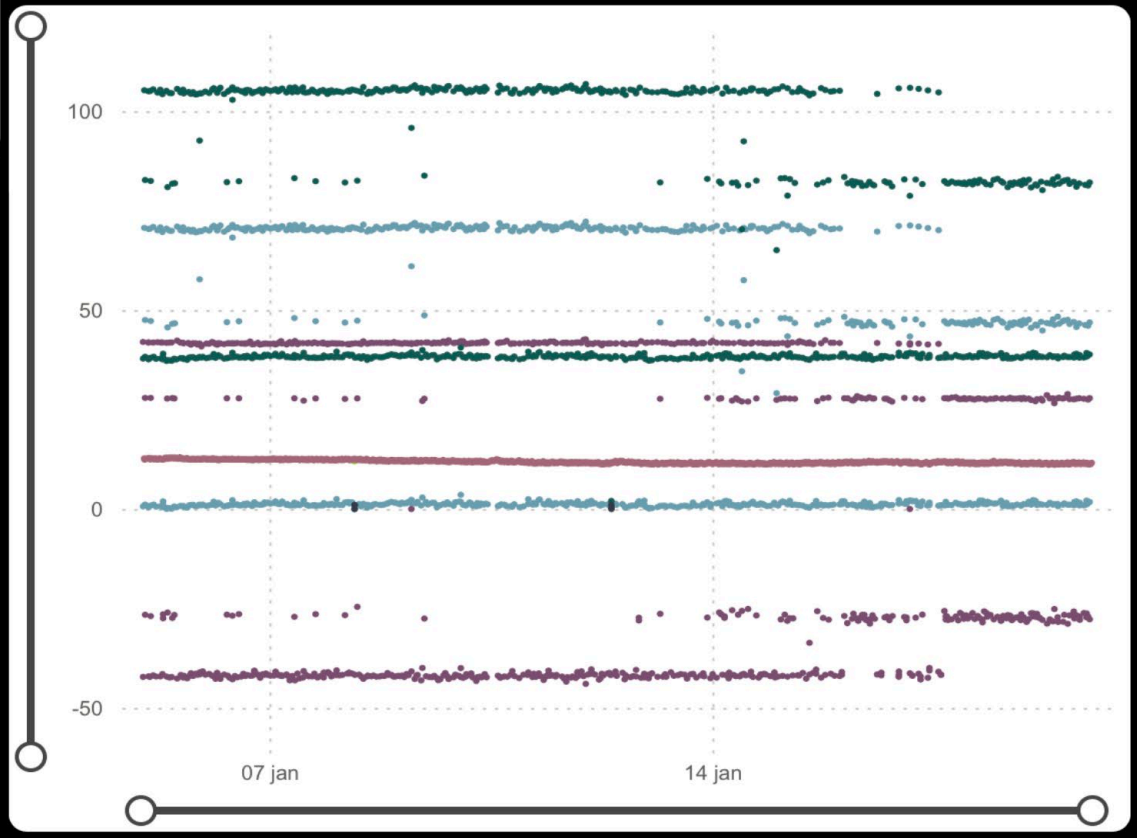


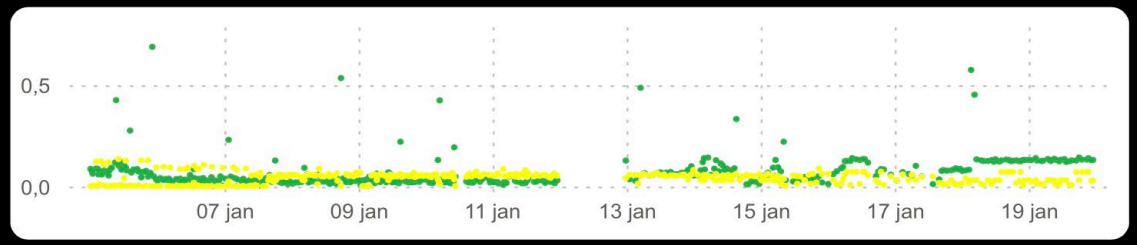
Select values

Sensor

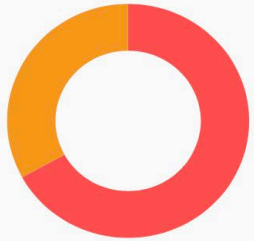
5-1-2024

19-1-2024

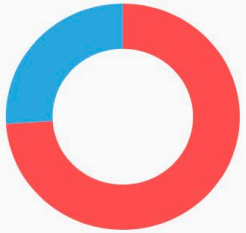




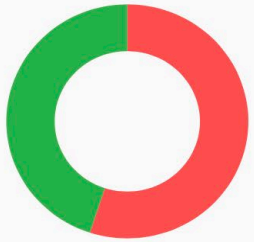
Health

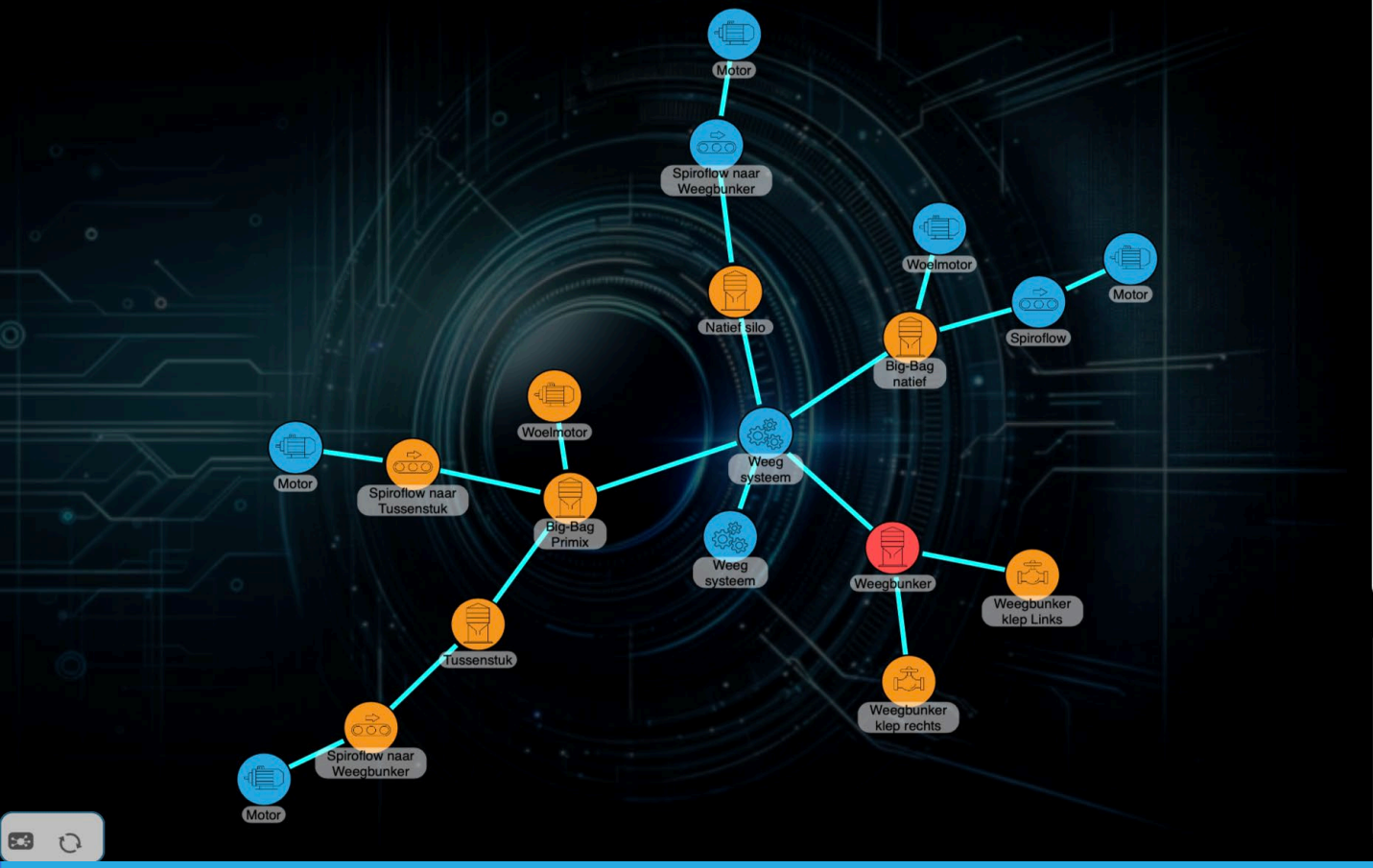


Mana



Stamina





Select values

Meerdere selecties

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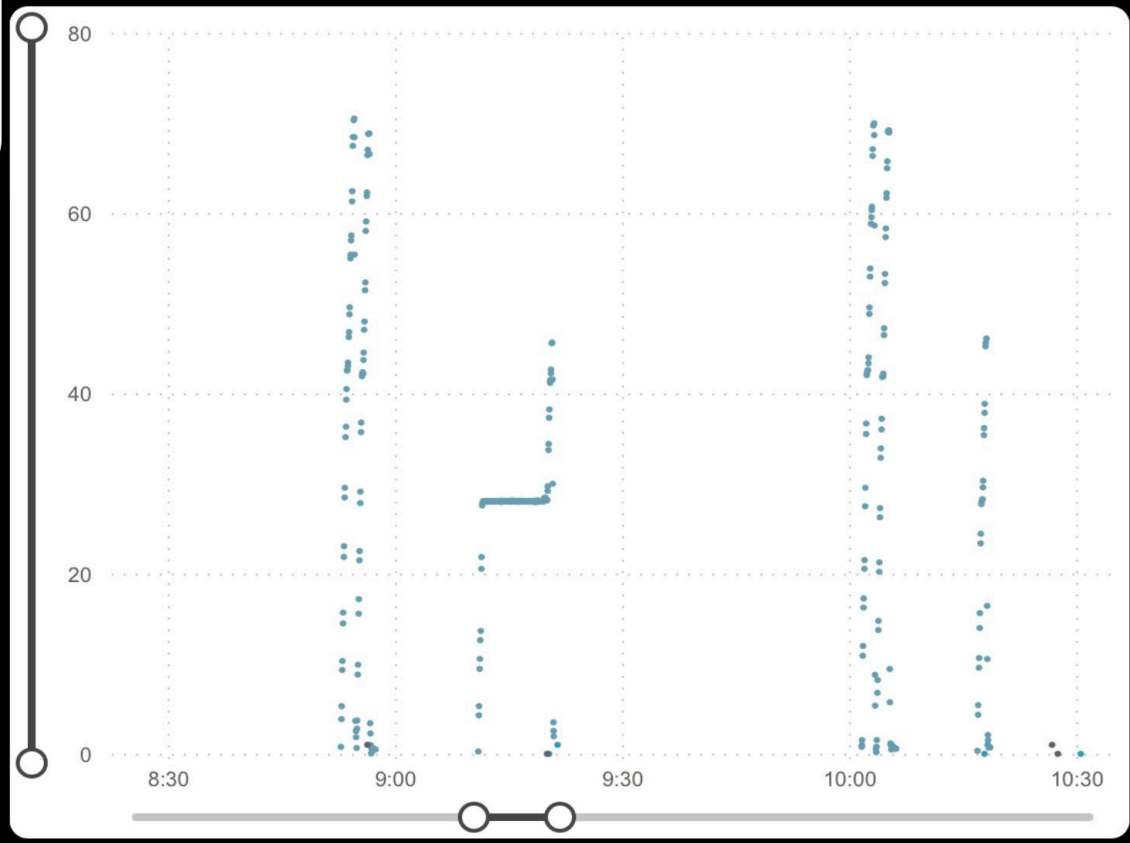

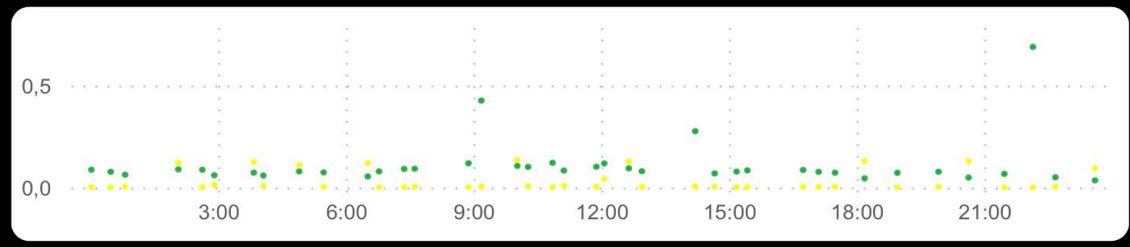

Operational Excellence and a future proof factory

- Less actions required by operators
  - -1 operator per shift
- Operator involvement and commitment
  - Due to more insight in de process details
- 50% less use of critical ingredient
- Remote analysing and solving problems
  - Example weighing unit
- Easy optimisation of process steps ingredients
  - Flexible implementation and use of ingredients
  - Flexible adjustment of recipes

Time for your own Asset Health Monitor

Contact us !

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Thanks to:

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