



**KAPERNIKOV**

Data & industry 4.0

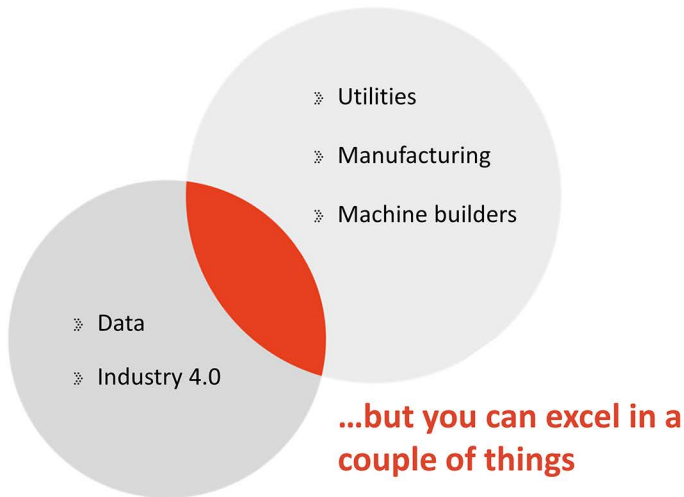


# Our Commitment

We turn data into correct information at that time and place where value will be created



# You can't focus on everything





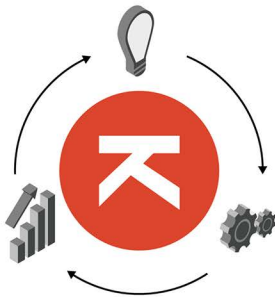
# You can find the right experts



We're not tied to any technology vendor. We can adapt to your environment.



Our people are versatile: an engineer, who implements a solution, must also understand your business.



We like to evaluate an idea, get feedback and improve. Being agile brings better solutions.



We take on the full scope of your challenges. Even if it requires going to the technical installations of the factory floor.



# Kapernikov

12  
YEARS



Big enough to matter,  
small enough to care:  
we're about 35 consultants.



We work as a team.  
Our internal competence centers  
support your projects.



We cherish a modern  
company culture.



# A great company to work with

FLUXYS 

  
ATRIAS

  
elia  
Powering a world in progress

  
ArcelorMittal

INFRABEL  
*Right On Track*

 umec

 BEKAERT  
better together

umicore 

 optimum  
SORTING

 Vlaanderen  
is mobiliteit &  
openbare werken



# Our Competence

A selection



# We are passionate about technology

Gold  
Microsoft  
Partner



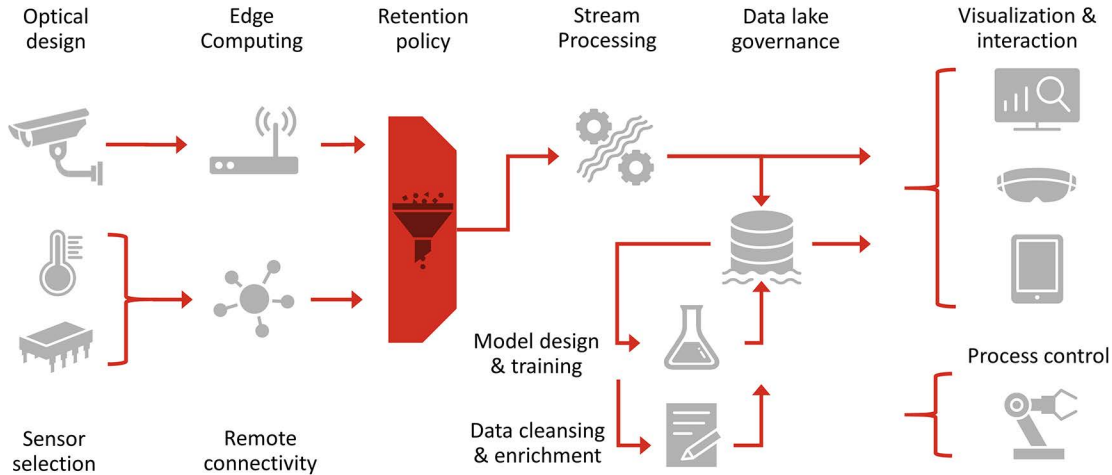
**HALCON**







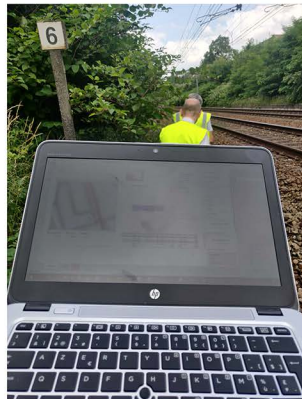
# Though how is data turned into value?





# By understanding your domain

We support good decision taking  
by being the translator between  
business and technology.



*"You have to really understand the business context before you can ask the project owners the right questions to design correct data models. 'Generalistic' data analysts are not worth much."*

Rick Van der Lans at the Datawarehousing & BI Summit 2020

# Our Cases

Recent cases





# Centralized use of worldwide machine data

## Situation

Machines are designed and manufactured in Belgium to produce in plants worldwide. The design team is often contacted to diagnose malfunctioning because they have the best knowledge of the machine construction. Only they had to rely on incomplete explanations from local operators, often second-hand due to time zone differences.

## Task

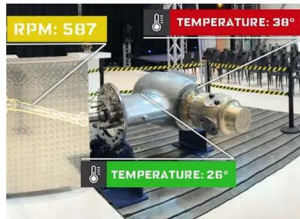
Bring machine data incl. virtual sensor states with minimal latency to a central data storage. Setup access control on a need to know basis. Allow design engineers to perform analytics without the help of IT.

## Action

Setup of Microsoft edge gateway in remote plants to upstream machine states to IoT Hub. Created a central data lake on Azure Private Cloud. Setup the infrastructure and API's for seamless historic and real-time data access. Train mechanical and electrical engineers to run algorithms on their machine data.

## Result

Customizable BI dashboards for **effective remote condition monitoring**. Batch processing to generate insights from history.





# Vegetation detection from LiDAR data

## Situation

In order to send pruning teams, Infrabel needs to know where the vegetation comes close to the trains.

## Issue

Manual inspections identify the pruning zones.

## Target

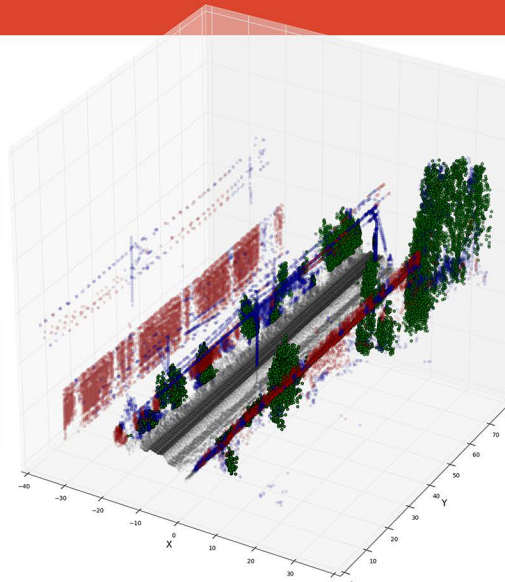
Eliminate the need to manually inspect camera images.

## Our Role

Prove feasibility, create an approach, implement a solution in the field.  
Kapernikov created an algorithm that classifies every point in the point cloud as being part of a linear, planar or volumetric segment.

## Result

**Infrabel has a Power BI dashboard to monitor the presence of vegetation along the tracks nationally.**



# VEGETATION



# OVERHEAD CONTACT LINE









# Predict vegetation growth over time

## Situation

Twice a year, a measurement train records a point cloud of the railway network using a laser scanner (LiDAR). A GPS+encoder also records the position of the train, but with limited accuracy.

## Causes

Infrabel wants to use the data to manage the vegetation around the tracks. However, growth rate differs greatly between different plant species.

## Target

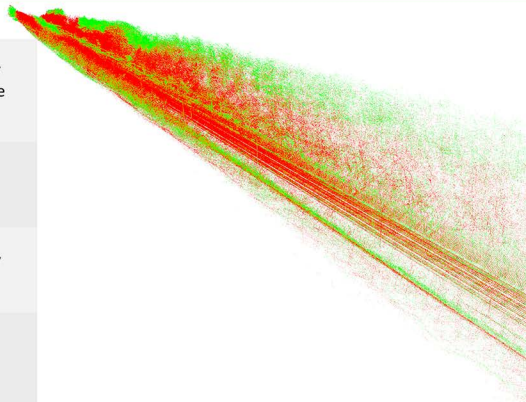
**Predict dangerous situations where signs and signals get occluded** by modelling the evolution of vegetation growth over time.

## Our Role

Develop an algorithm that matches the point clouds generated by different measurement campaigns exactly. Standard registration algorithms are not suitable because the different point clouds vary greatly over time.

## Result

**The planning for maintenance teams at Infrabel can be optimized nationally.**





# Mobile operational intelligence

## Situation

Operators are unable to analyze all the data and production batches are lost.

## Causes

In a production process involving chemical reactions, the link between dopations and their future effect is too complex.

## Target

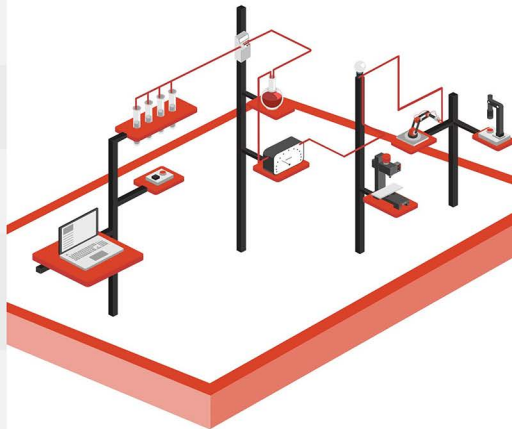
**Model based predictions** in the hands of the operators.  
**Complex event processing** to detect relations.

## Our Role

Kapernikov reused the Matlab® models from the design of the process and **embedded those models to predict the effect of operator decisions**.  
We created a mobile application for use in production.

## Result

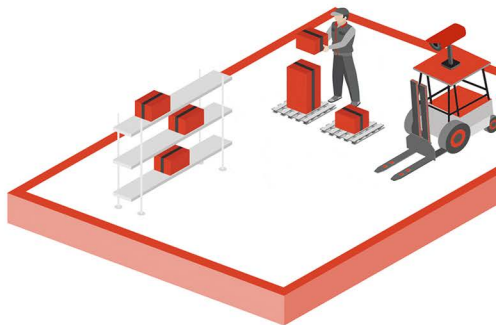
**Reducing scrap by optimal process control** of a complex metallurgic production line.





# Object tracking from moving robot

<b>Situation</b>	Successful pick-up rate of Autonomous Guided Vehicles equipped with a robotic arm below expectations.
<b>Causes</b>	Low precision of indoor positioning system. Dynamic behavior under load.
<b>Target</b>	Increase precision and speed with a profitable ROI.
<b>Our Role</b>	Kapernikov created a smart system with only one 2D camera. Sensor fusion with other robot sensors allowed <b>dynamic closed loop velocity control</b> . <b>Deep learning</b> is applied to cope with unconditioned light.
<b>Result</b>	<ul style="list-style-type: none"><li>• <b>Avoiding standstill</b> by detect infeasible picks.</li><li>• <b>Approach the exact stop position at higher speed.</b></li><li>• <b>Overall successful pick rate has increased.</b></li></ul>





# Inline 3D profile measurement

## Situation

During the production of coiled products, winding errors occur. As a result, the end customer is unable to unwind the coil in a tension free way.

## Issue

Poor adjustment of the winding device results in unequal wirepack diameters. This leads to breakage when unwinding.

## Target

Automatically detect common winding errors.

## Our Role

Hardware selection: camera, lens system and optical filters.  
Design and realize algorithm to process images.  
**Stretch the limits to reduce hardware cost.**

## Result

Automatic classification of winding error modes.





# DevOps for laser sorting machine builder

## Situation

Optimum Sorting designs and builds optical sorting machines for the food industry. They have a **huge variety in machine designs installed worldwide**. Software versioning is challenging.

## Task

Setup a software development and deployment process to assure quality and traceability of versions.

## Action

Created a containerized build system for all target platforms in use.  
Setup Continuous Integration (CI) pipeline to create a reproducible build for every commit, even when working at the customer's site.  
Create software tests to ensure that updates don't break existing features.

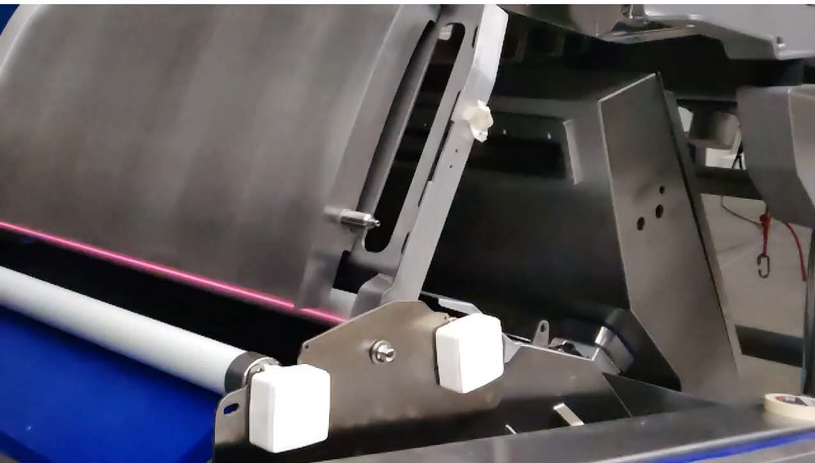
## Result

Optimum Sorting can deliver software versions when and where needed.  
**On-site commissioning and machine diagnose is effective.**





# Software engineering for laser sorting





# Machine learning for laser sorting

## Situation

Optimum Sorting designs and builds optical sorting machines for the food industry. Each of their customers have their own particular products to sort.

## Task

Introduce state-of-the-art machine learning.  
Allow the end user to tune the sorting process on an offline machine.

## Action

- Developed a combined novelty detection and classification algorithm, optimized for hard real-time use.
- Introduced an easy way to adjust the sensitivity of the multidimensional model without having to annotate additional images.

## Result

Optimum Sorting's customers can **set up their machines quickly** for new sorting tasks and adjust the classifier during production, so **downtime is reduced to the minimum**.





# 3D Dynamic safety zone guarding

**Situation** Autonomous Guided Vehicles sometimes miss moving obstacle.

**Causes** Safety curtain formed by a pair of LiDAR sensors is open from the sides, so crossing vehicles or persons can enter.

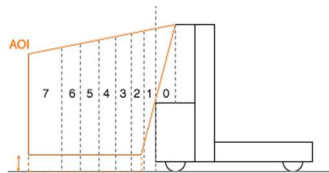
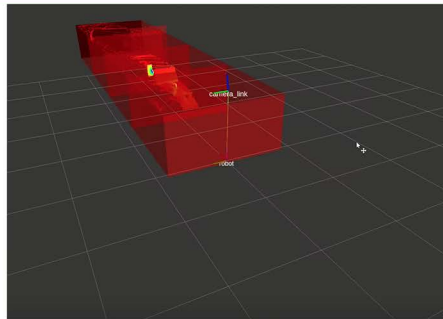
**Target**

- Avoid collisions with crossing vehicles or persons.
- Obstacle detection in 3D Area-of-Interest
- On the fly parameterization over CANopen interface

**Our Role** **Build a smart sensor** based on a Time-of-Flight camera to monitor path ahead.

**Result**

- **Increasing safety and acceptance of AGVs on a production floor**
- Avoiding downtime and damage







# Measure PBM usage





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