



SAFE AND EFFICIENT POWER PLANT

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NORDIC LEAD, IOT

TAMPERE 25.5.2017

DIGITAL POWER PLANT CHANGES THE WAY HOW YOU RUN YOUR BUSINESS



DIGITAL ASSETS

Managing the asset data efficiently and changing the way how assets are maintained



DIGITAL WORKERS

Keeping the worker Safe and helping him perform



DIGITAL OPERATIONS

Ensuring agile operations at the plant, taking into account what is happening inside and outside the company

DIGITAL ASSETS

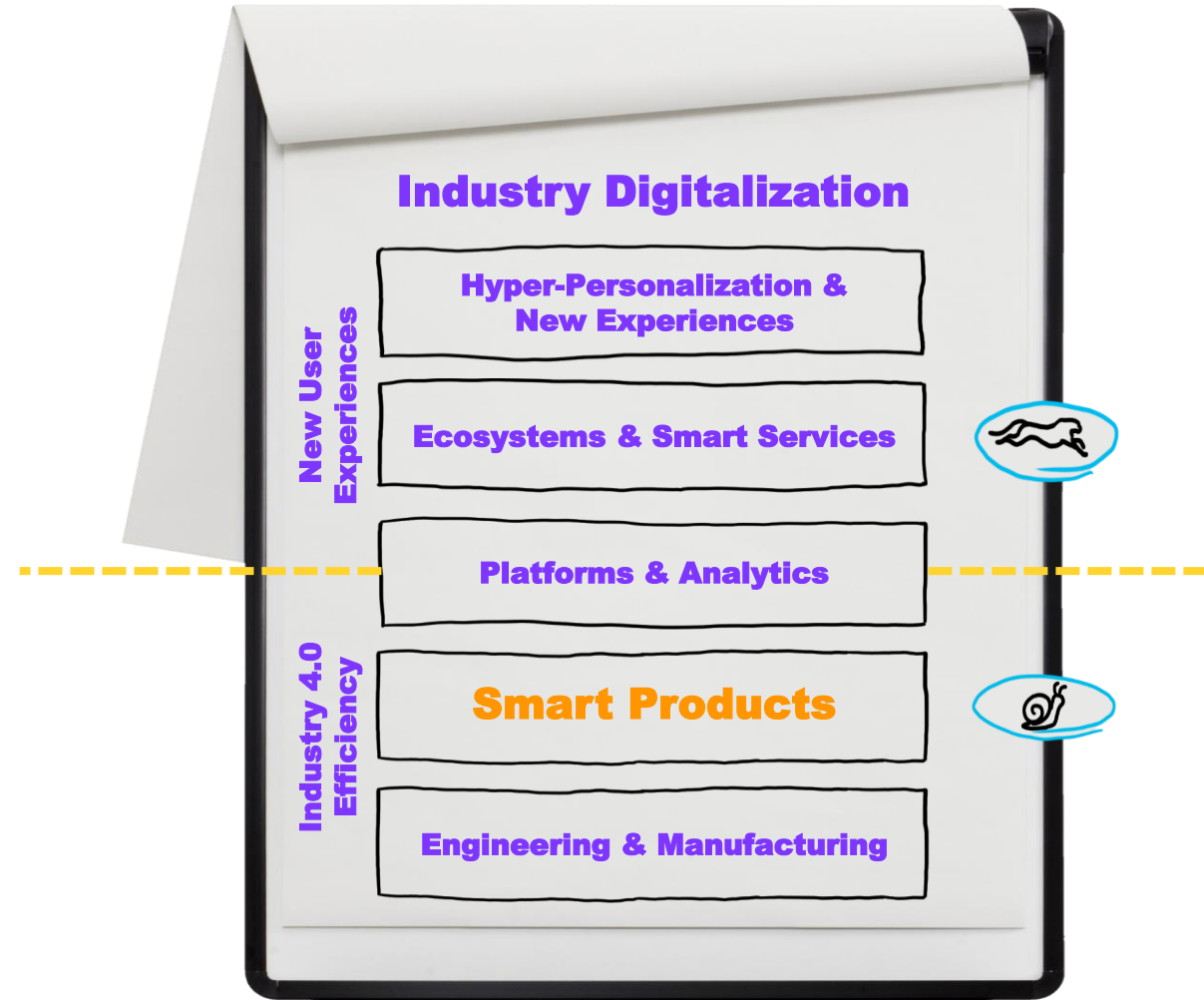
FRAMEWORK FOR INDUSTRY DIGITALIZATION

NEW REVENUE STREAMS

New hyper-personalized and context specific user experiences are created through the connection of “Smart Products” with platform-based services utilizing the power of broad ecosystems. This change will be fast, disruptive and redefine the rules of competitiveness.

NEW PRODUCTIVITY

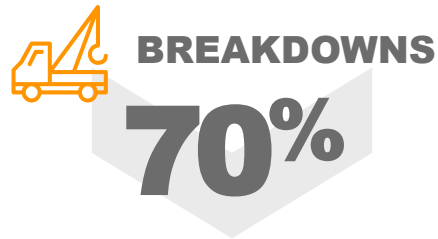
Connected “Smart Products” in smart spaces allow the exploitation of the potential for efficiency and flexibility in engineering & manufacturing. This change can be disruptive through the use of new technologies. Investment upgrades in “legacy” typically slows down progress.



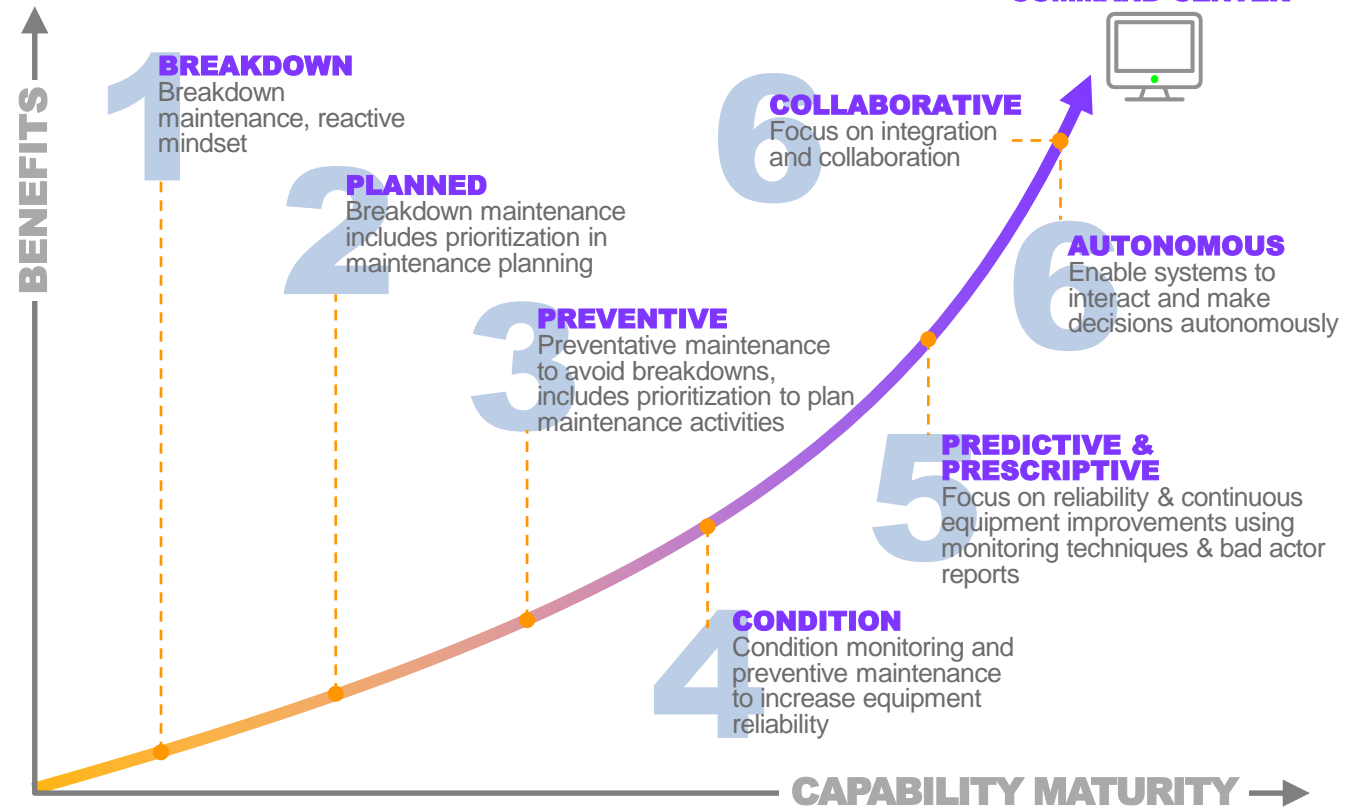
CONNECT YOUR ASSETS

FOCUS ON THE EVOLUTION OF OPTIMUM ASSET AND OPERATIONAL PERFORMANCE

Deploying predictive analytics alone can reduce



CONNECTED ASSET JOURNEY



Woodside - Predictive analytics applied for improving the reliability of critical equipment's
(<https://www.accenture.com/us-en/insight-perspectives-energy-woodside-predicts-the-future>)

DIGITAL WILL DISRUPT THE MAINTENANCE MANAGEMENT PROCESS

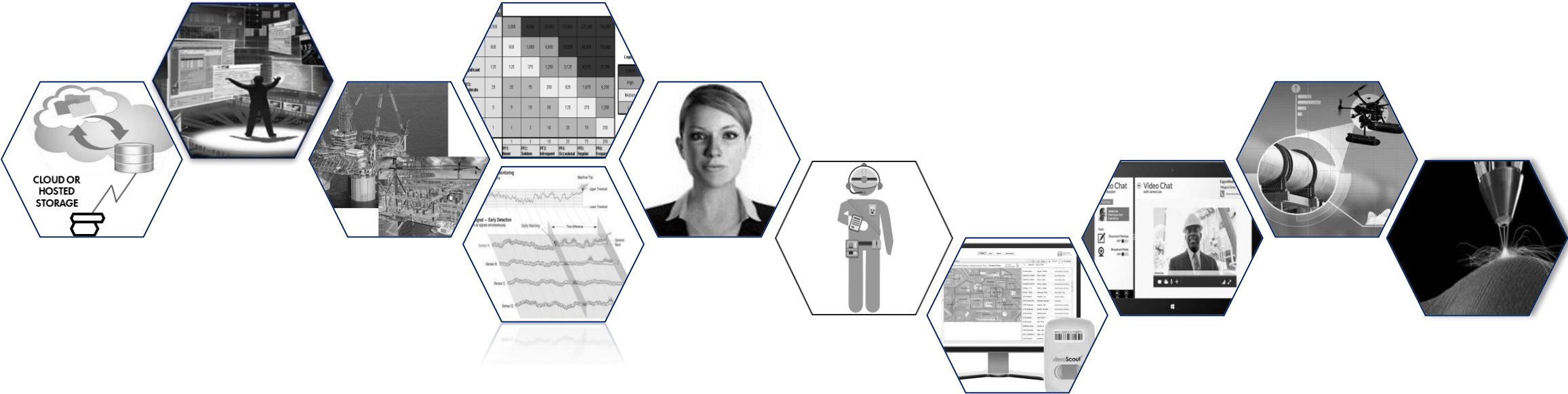
THE FUTURE OF ASSET MAINTENANCE

Intelligent Asset Management

Digital Maintenance Execution

- Predictive Asset Analytics
- Integrated risk and health Models
- Machine Learning and Artificial Intelligence
- Integrated Asset Information Management
- Digital Plant Refreshment Service and 3D models

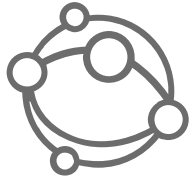
- The Digital Field Worker
- Industrial Mobility
- Digital Tracking
- Robotics
- 3D Printing



DIGITAL WORKERS

DIGITAL FIELD WORK IN THE NEW

THREE INEVITABLE FORCES ARE TRANSFORMING FIELD SERVICES OPERATIONS



SMART PRODUCTS

The combination of “Smart Products, Services and New Experiences” creates disruptive business models.

During installation and maintenance, the products can share their usage & maintenance history and “aspirations”.



TECHNOLOGY FOR PEOPLE

Technology is still the answer but to a new question.

Today technology adapts to our needs. We augment and enhance our human skills to see more, hear more and understand more, which helps workers better achieve their goals with transparency and accuracy



ARTIFICIAL INTELLIGENCE

AI is taking on more sophisticated roles within the technology interfaces

85% of executives say they will be investing extensively in AI-related technologies over the next three years.

Average resolution and fix time of infrastructure issues by Virtual Engineers cut up to 93%

VALUE DRIVERS

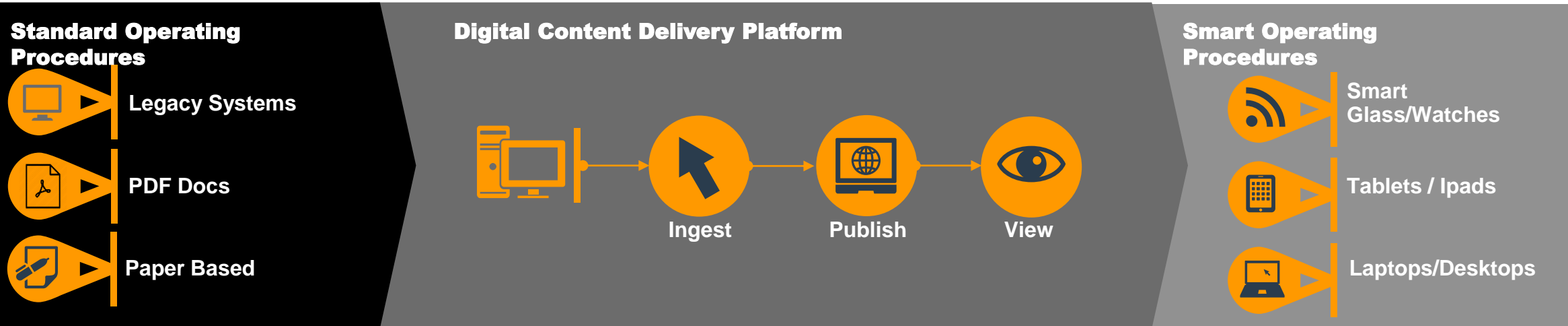
Handling time	17% ↓
Simpler work processes	30% ↓
First time right	100% ↓
Employee & customer satisfaction	5-10% ↓
Reduction in onboarding time	50% ↑
Cost of safety and insurance	5-20% ↑

SMART OPERATING PROCEDURES ENABLE THE DIGITAL FIELD WORKER

STATIC PROCEDURES

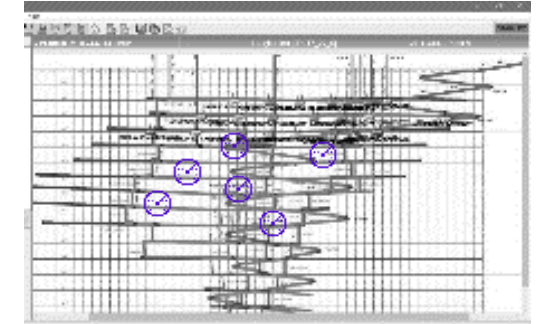
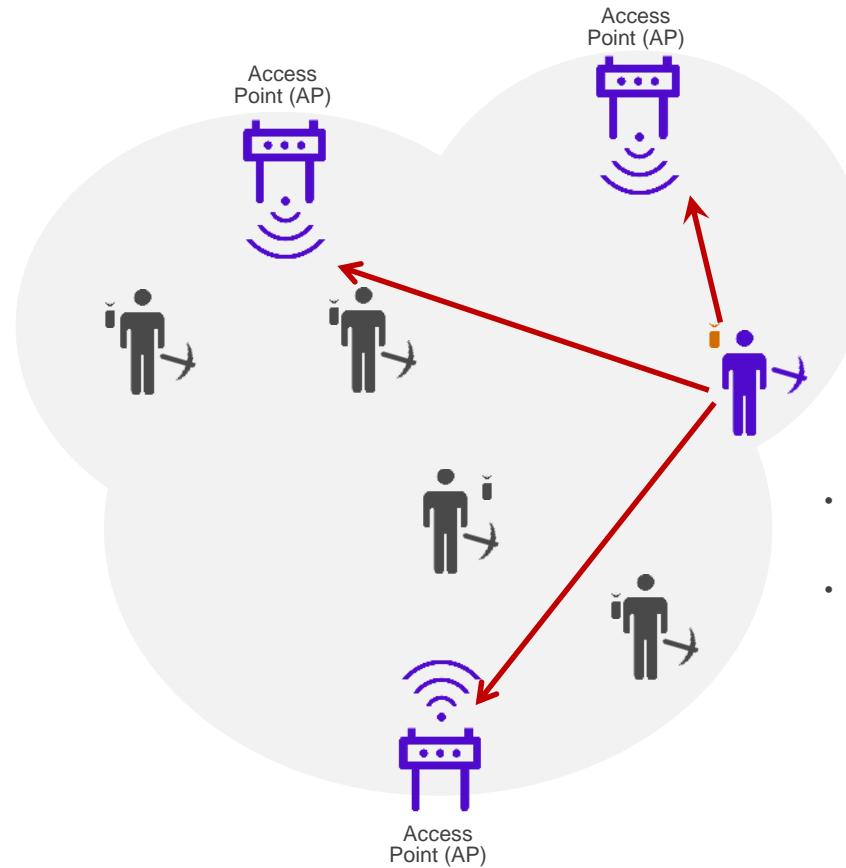
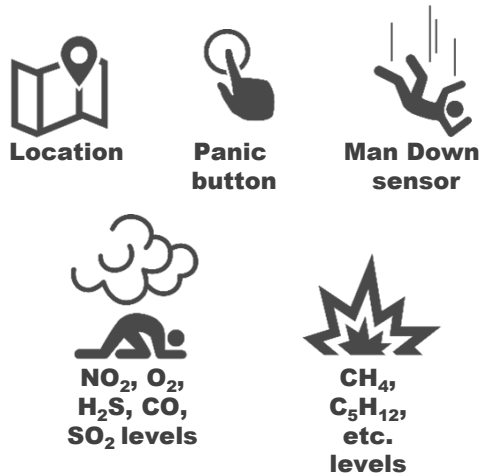
PLATFORM TO CONVERT CURRENT PROCEDURE TO SMART OPERATING PROCEDURES

SMART PROCEDURES



EMPLOYEE TRACKING FOR SAFETY

- Allows to know the **location of personnel operating at the plant** that wear an RFID-fitted device.
- Location is known through **triangulation using the wifi network mesh** already in place.
- An dispatch operator at a **Control Room** then **monitors the location** of the personal detectors and other manually and automatically triggered events:



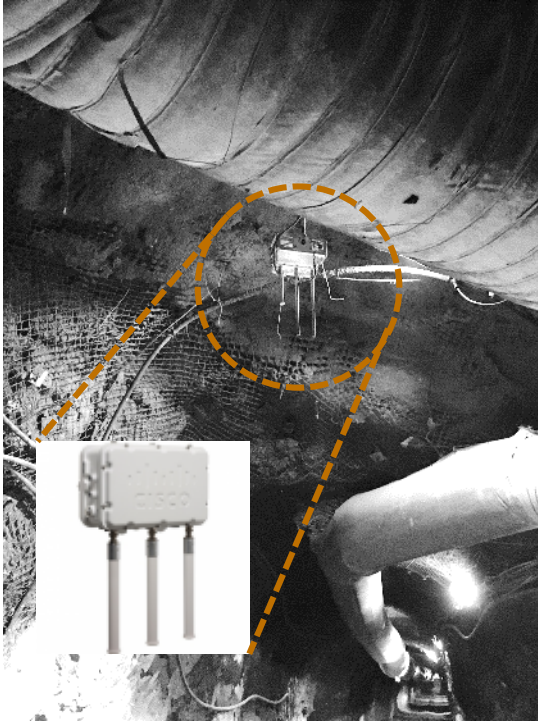
*Dispatch operator at Control Room**

- Location of RFID fitted devices
- Notification of manually and automatically triggered events

EMPLOYEE TRACKING FOR SAFETY

ACCESS POINTS (APS)

Placed at 30-80 meters from each other



RFID-FITTED PERSONAL DEVICES TO BE DISTRIBUTED

Personal Gas Detectors



All functionalities including detection of O_2 , CO , NO_2 and CH_5 gases

Personal and Asset badges



Only location and panic-button functionalities.

DIGITAL OPERATIONS

TRANSFORMING “VIDEO SURVEILLANCE” TO “OPERATION EFFICIENCY AND SAFETY”

From **Video Surveillance...**

Operators monitoring 20+ screens
Showing feeds from 100+ cameras
Trying to stay alert! 98% of CCTV
feeds unseen



Video Management System

CCTV Cameras

To **Operations Safety and Efficiency**
Safety, Security, Operations insights



Video Analytics

Video Management System

CCTV Cameras

INTUITIVE DASHBOARD IS KEY IN MAKING VIDEO ANALYTICS ACTIONABLE

The dashboard interface includes a top navigation bar with the following elements:

- Left: User name "VaspUser" and a notification bell icon with "58".
- Center: Title "Plant Safety Monitoring" and subtitle "Command & Control Application".
- Right: Date and time "Tuesday August 25 6:48 PM".

The main content area features a 3D floor plan of a factory with various equipment labeled, such as "PRECISION TUBE MILL", "ENIG-T ANNEALING PLANCE", and "HYDROFORMING". A red arrow points North (N). A person icon is highlighted in a yellow box on the floor plan. A red circle in an inset video feed highlights a specific area.

On the right side, there is a red banner showing a person icon, the time "12:29 PM", and the date "Monday August 22". Below this is a video feed of the factory floor. A yellow box in the video feed highlights a person, with a text box that says "Detect intrusion in restricted/forbidden zones". Another text box at the bottom of the video feed says "Person too close to machine!".

At the bottom of the dashboard, there are search and close icons labeled "Search Related" and "Close".

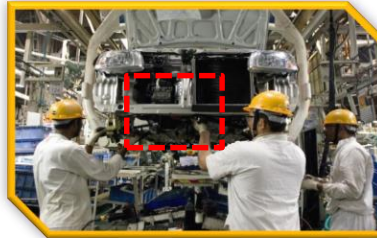
KEY USE CASES ENABLED VIA VIDEO ANALYTICS



Unmanned Critical Zone



Unauthorized Intrusion detection



Dangerous Proximity Detection



Pathway Obstruction Detection



Oil/Water Spillage Detection



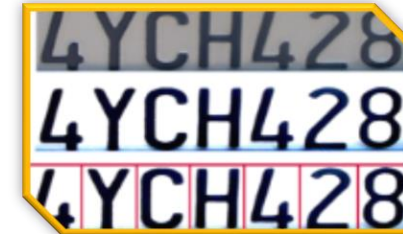
Personal Protective Equipment Compliance



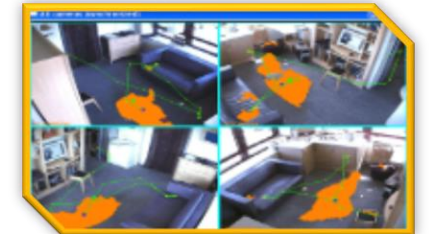
Safety alerts



Anomaly/Incident detection



License plate recognition



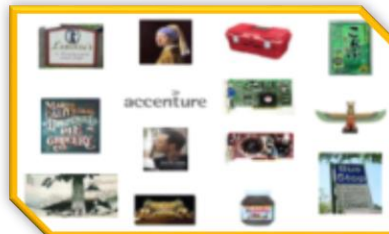
Footfall tracking



People recognition



Post-event analysis



Object recognition



Suspicious behaviour



**Traffic monitoring/
Crowd monitoring**

KEY ADVANCED ANALYTICS

Forecasting



Forecast is extending in the future the behaviour of a time series with the consumption from the past.

- Price forecasting
- Volume forecasting
- Quantity forecasting
- ...

Predicting



Predictive is estimating the probability that something will happen in the future taking into consideration the past.

- Price prediction
- Market prediction
- Clients behaviour
- ...

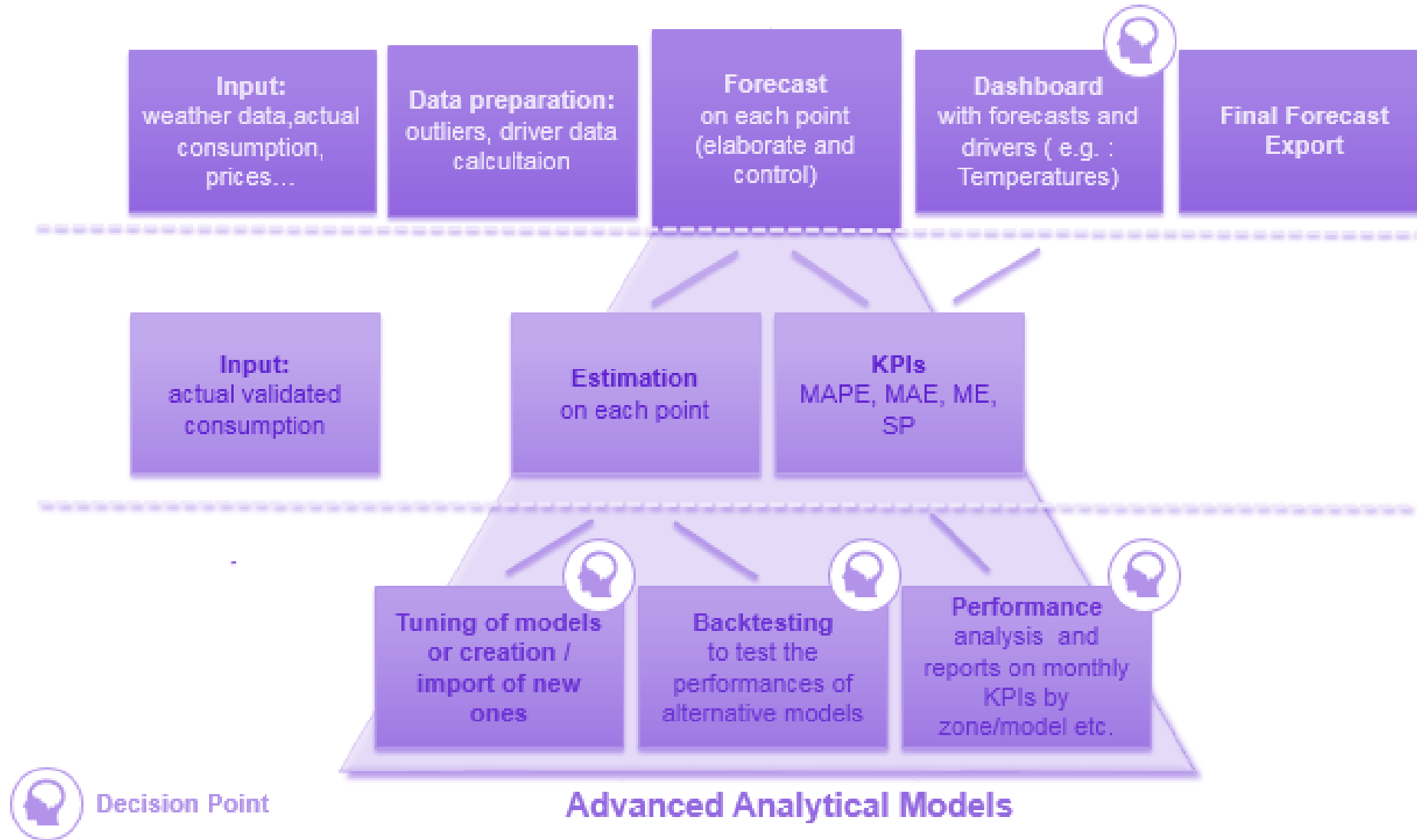
Optimizing



Optimization is the selection of a best element with regard to some criterion from some set of available alternatives.

- Plan optimization
- Flow optimization
- Price optimization
- ...

INDUSTRIALIZED ANALYTICS BUSINESS PROCESS WORKFLOW



A mixed-integer linear algorithm...

...converted into a script...

Maximize the P&L:

$$\max_{S, T, M, Q, y, b} \sum_{i=1}^{31} (C_i^{FR} Q_i^{FR} + C_i^{IT} Q_i^{IT} + C M^{FR,IT}) - \sum_{z=FR,IT} (D^z y_1^z + E^z y_2^z + F^z y_3^z + G^z y_4^z)$$

Constraints

$-H_i^f \leq T_i^f \leq I_i^f$
 $K_i^f \leq S_i^f \leq J_i^f$
 $-P_i^f \leq Q_i^f \leq P_i^f$
 $0 \leq M_i^{FR,IT} \leq I_i^{FR,IT}$
 $\sum_{i=1}^{31} T_i^f = 0^z$
 $T_i^{FR} + S_i^{FR} + Q_i^{FR} - R_i^{FR} - M_i^{FR,IT} = 0$
 $T_i^{IT} + S_i^{IT} + Q_i^{IT} - R_i^{IT} + M_i^{FR,IT} = 0$
 $\sum_{i=1}^{31} S_i^f - N^z = y_1^z + y_2^z + y_3^z + y_4^z$
 $50000 b_1^z \leq y_1^z \leq 50000 b_2^z$
 $0 \leq y_2^z \leq 50000 b_2^z$
 $-50000 b_3^z \leq y_3^z \leq -50000 b_4^z$
 $-50000 b_4^z \leq y_4^z \leq 0$
 $b_1^z + b_3^z \leq 1$
 b_2^z, b_3^z, b_4^z are binary

$z = IT, FR; i = 1, \dots, 31$ **Storage I/W limits**
 $z = IT, FR; i = 1, \dots, 31$ **LTC offtake limits**
 $z = IT, FR; i = 1, \dots, 31$ **Liquidity limits**
 $i = 1, \dots, 31$ **Capacity Limits**
 $z = IT, FR;$ **Storage monthly target**
 $i = 1, \dots, 31$ **French balancing**
 $z = IT, FR;$ **Italian balancing**
 $z = IT, FR;$ **Surplus variables constraint**
 $z = IT, FR;$ **First level LTC increase**
 $z = IT, FR;$ **Second level LTC increase**
 $z = IT, FR;$ **First level LTC decrease**
 $z = IT, FR;$ **Second level LTC decrease**
 $z = IT, FR;$ **Increase/decrease selection**

Notation:

Variables:

S^z = LTC Offtake quantities,
 T^z = Storage quantity (positive if withdrawal, negative if injection),
 Q^z = Trade quantities, (buying, negative selling),
 $M^{FR,IT}$ = Used Capacity from French to Italian Market,
 y^z = surplus variable
 b^z = activation level binary variable

Parameters:

C^z = Market Price
 R^z = Storage max injection
 I^z = Storage max withdrawal
 J^z = LTC max daily max offtake
 K^z = LTC max daily min offtake
 P^z = liquidity limit
 $I^{FR,IT}$ = available capacity from French to Italian Market
 N^z = LTC monthly target
 O^z = Storage monthly target
 D^z = Steering price, LTC increase 0-50000
 E^z = Steering price, LTC increase 50000-100000
 F^z = Steering price, LTC decrease 0-50000
 G^z = Steering price, LTC decrease 50000-100000
 R_i^z = demand quantities
Indices:
 i = index on the gas day (1...31)
 z = index on the country (FR, IT)

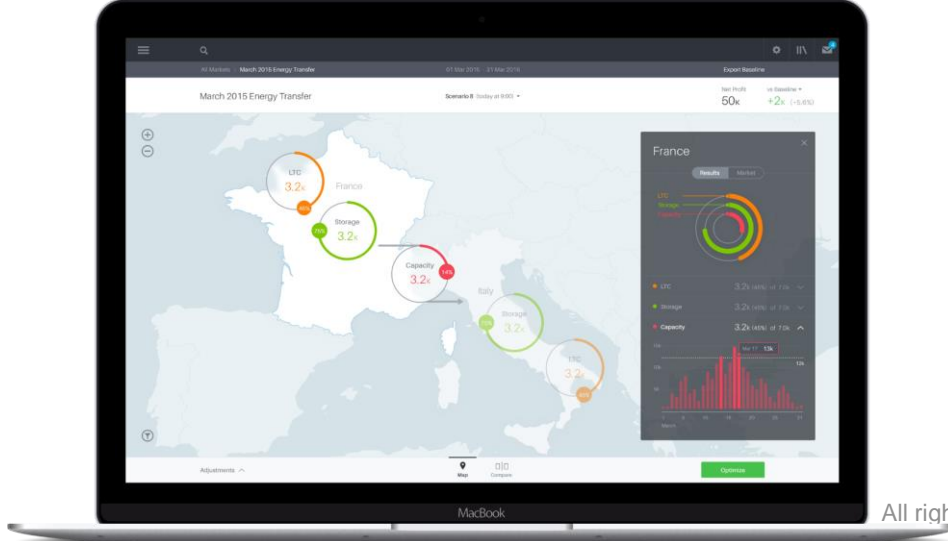
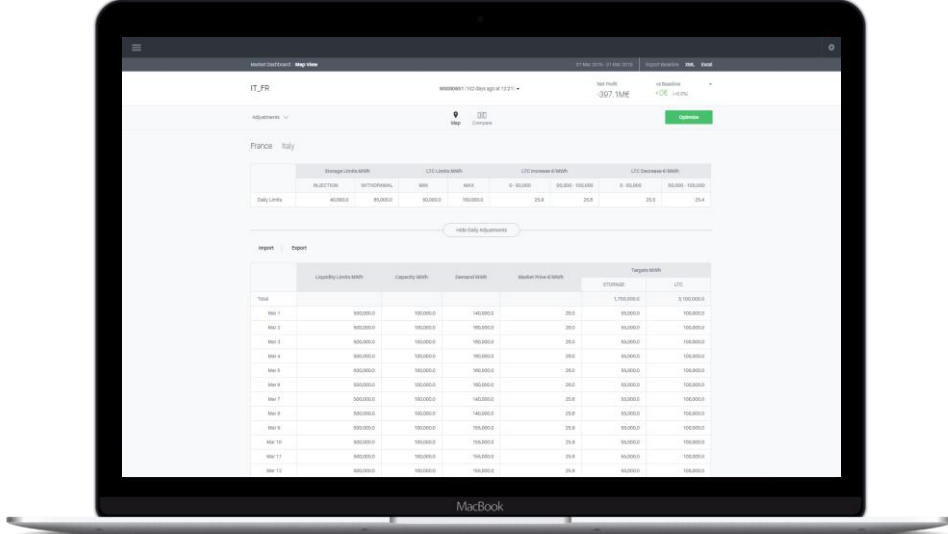
Produced by demand and price forecasting models

```

# ... (code snippet) ...
def solve_mip():
    # ... (code snippet) ...
    solver.solve()
    # ... (code snippet) ...
    status = solver.get_status()
    if status == 'Optimal':
        # ... (code snippet) ...
    else:
        # ... (code snippet) ...

```

...becomes an accessible app!



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CONTACT

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