

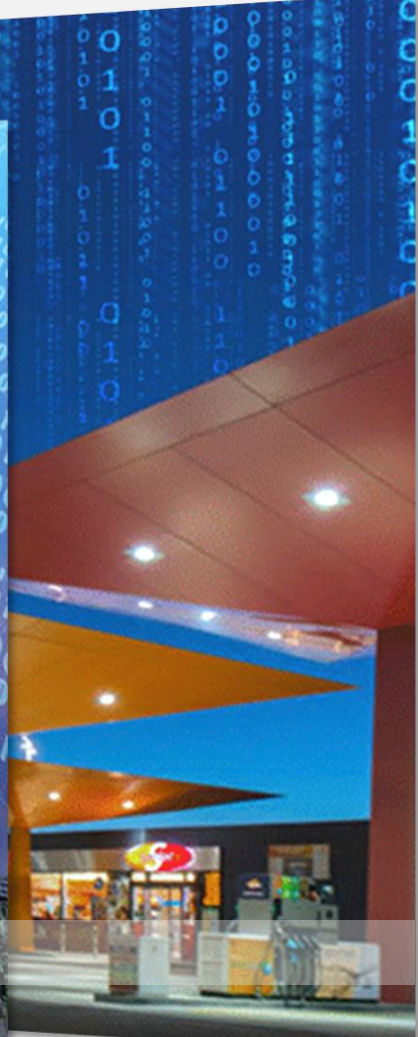
Repsol Digital Program

6th Summer School on INtelligent signal processing for FrotIER Research and Industry


Introduction to AI and IoT with some examples



REPSOL







 A global vision of Repsol

Ver más tarde  Compartir



MÁS VÍDEOS

  0:00 / 1:55

  YouTube 

“ The world’s most valuable resource is not longer oil, but data ”

The Economist, May 6th 2017



CONTEXT



2011

Marc Andreessen, "Software is eating the world"

2013

CEO General Electric Jeffrey R. Immelt wrote, "We believe that every industrial company will become a software company"

2014

He doubled down, moving GE's corporate headquarters from Fairfield, Connecticut, to Boston, in large part to lure world-class software engineers in the area

2019

AI is eating software

Analytics and AI automates core business processes, pharma, telco, transport, even software development

Forbes

Software Ate The World, Now AI Is Eating Software



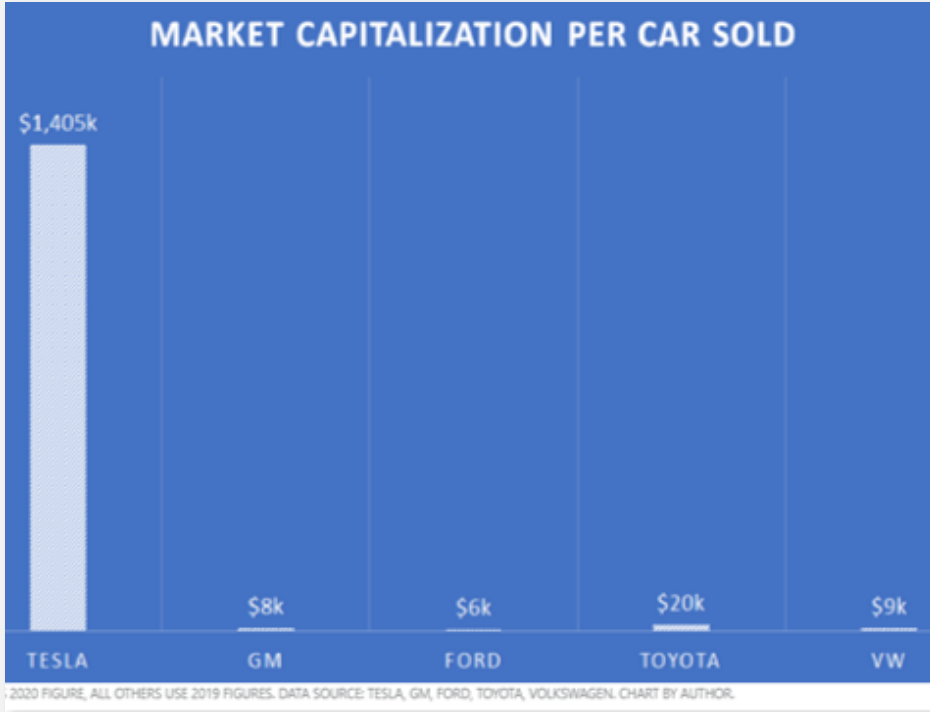
Tarry Singh Former Contributor
COGNITIVE WORLD Contributor Group ©
AI



AI Is Eating Software DEEPKAPHA.AI

By Martijn van Attekum, Jie Mei and Tarry Singh

CONTEXT



Software and AI provides competitive advantages

Electric-car maker Tesla (NASDAQ:TSLA) is worth about \$700 billion

Tesla is worth more than Berkshire Hathaway, Johnson & Johnson, Visa, and Mastercard. It's worth more than Disney and Netflix combined.

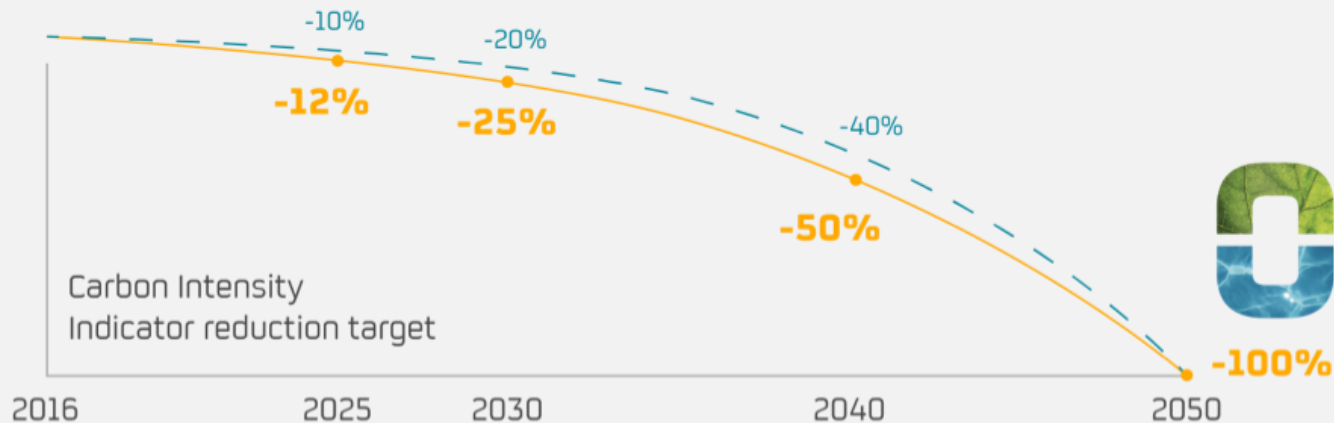
FIRST O&G TO TARGET NET ZERO EMISSIONS



MISSION

Bring the energy of future to our customers

Carbon Intensity Indicator reduction target [gCO₂/MJ]



Repsol 2050
Net Zero Emissions
Commitment

Initial objectives

New and more ambitious targets

Leading the energy transition in line with the objective of the Paris agreement to limit global temperature increase to well below 2°C

AI TO CONTRIBUTE TO EMISSION REDUCTION



MISSION

Bring the energy of future to our customers



Repsol Digital
23.655 seguidores
6 meses • 🌐

What happens when the challenge consists of getting the best out of ourselves? It's obvious to the winners of [Microsoft #EnergyCore's](#) international hackathon: you enjoy delivering solutions that change the world. Our [#datascientists](#) [Adrian B.](#), [Elena Tomas Herruzo](#), [Emilio Martín](#) and [Jorge Zaldivar](#) have achieved it with their winning project, which relies on [#ArtificialIntelligence](#) to contribute to emission reduction.

As Jorge explains, 'it's been an exciting challenge that has allowed us to put our data engineering and automated learning skills to test, while competing with colleagues from other companies and institutions around the world'.

Yet another example of how at [Repsol](#) we rely on the talent of our professionals to find new and better ways of generating energy in a sustainable manner, faithful to our commitment to being a [#ZeroNetEmissions](#) company by 2050.

[#RepsolDigital](#) [#Sustainability](#)

AI TO CONTRIBUTE TO EMISSION REDUCTION



#RepsolDigital

FIRST EDITION OF HACKIA 2021

We live the energy of Data and Artificial Intelligence



METHANE DETECTION

Advanced analysis of satellite images to reduce emissions



ASSET HEALTH 2.0

Anticipating eventual incidences in our facilities

HACKIA IN NUMBERS

5 DAYS	30 EXTERNAL CONTESTANTS	50 GIGABYTES OF DATA
5 CHALLENGES	60 DATA SOURCES	100 PEOPLE INVOLVED
5 COMPANIES COLLABORATING WITH DATA & ANALYTICS AND SUSTAINABILITY		

CONTESTANTS

 STYRENE MARKET SCENE Optimizing decision-making in hydrocarbon markets	 ENERGY TRANSITION SCENARIOS Anticipating and defining with precision commercial actions	 MARKET OBSERVATORY Calculation tool to simulate situations that support energy transition
--	---	---

MISSION

Bring the energy of future to our customers

WHAT?

Spain Digital 2025 is a strategy to boost the country's digital transformation process, in coordination with the European strategy through public-private partnerships and the participation of all economic and social actors in the country

HOW?

In Its development had been involved more than 15 ministries and public agencies and more than 25 economic actors, business and social
Consists of 50 measures grouped in 10 axes

GENERAL OBJECTIVES

1. Relaunching economic growth
2. Reducing inequality and increasing productivity
3. Encouraging the use of new technologies
Respecting constitutional and European values and protecting individual and collective rights

OBJECTIVE 2025



Strengthening the citizens digital competences with special emphasis on the needs of the labour market and on closing the digital divide in Key Education

- 80% of the people have basic digital skills and the 50% of them are women

Objectives of Strengthening the Spanish capacity in cybersecurity 2025

- Have 20,000 specialists in cybersecurity, AI and data

Promoting the digitization of public administrations through technological updates

- 50% of public services are available via app, simplifying the relations between citizens and the administrations

Accelerating the digitalization of enterprises, with a focus on micro-SMEs and start-ups

- At least 25% of SMEs' turnover should come from e-commerce

OBJECTIVE 2025



Accelerate the digitalization of the production model in strategic economic sectors such as Agri-food, Mobility, Health, Tourism, Trade or Energy

Start the change for been a data economy, guaranteeing security and privacy and taking advantage of the opportunities offered by AI

Guarantee the rights at the new digital environment and the labour, customers, citizens and the company rights

Contribute to closing the increased digital gap in recent years, whether for socio-economic, gender, generational or territorial reasons

- A 10% reduction in CO2 emissions as an effect of the digitization of the economy
- At least 25% of companies should use AI and Big Data
- The aim is to draw up a Digital Rights Charter
- Objective aligned with the 2030 Agenda and the UN

WHAT IS ARTIFICIAL INTELLIGENCE?



DATA

AI is a collection of technologies that combine data, algorithms and computing power.

ALGORITHMS

Artificial intelligence (AI) refers to systems that display intelligent behaviour by analysing their environment and taking actions – with some degree of autonomy – to achieve specific goals.

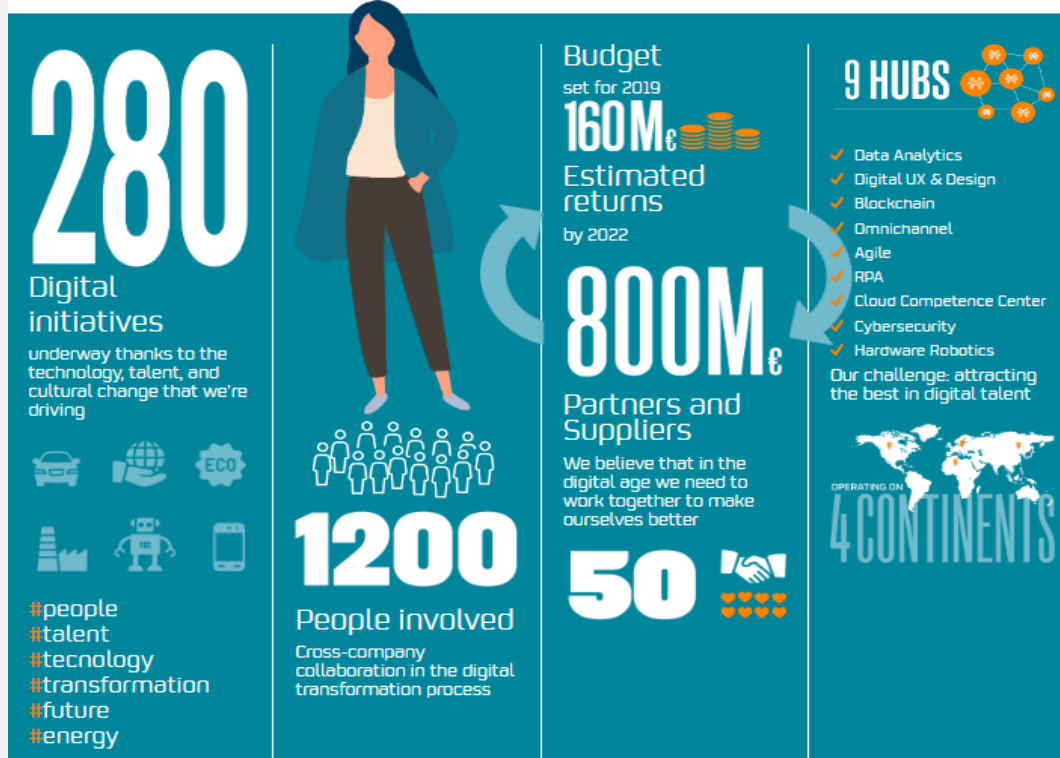
AI-based systems can be purely software-based, acting in the virtual world (e.g. voice assistants, image analysis software, search engines, speech and face recognition systems) or AI can be embedded in hardware devices (e.g. advanced robots, autonomous cars, drones or Internet of Things applications).

COMPUTING CAPABILITIES

Artificial intelligence (AI) systems are software (and possibly also hardware) systems designed by humans that, given a complex goal, act in the physical or digital dimension by perceiving their environment through data acquisition, interpreting the collected structured or unstructured data, reasoning on the knowledge, or processing the information, derived from this data and deciding the best action(s) to take to achieve the given goal.

AI systems can either use symbolic rules or learn a numeric model, and they can also adapt their behavior by analysing how the environment is affected by their previous actions.

OUR DIGITAL TRANSFORMATION IN FIGURES



We've launched more than 280 digital initiatives to help our businesses transform and get closer to our customers through new merged digital experiences.

EXPLORATION



Predictive algorithms and **Smart sensors** to monitor seismic activity and optimize drilling safety.

Cloud-based global information for greater collaboration, improved connections, and improved safety and efficiency.

PRODUCTION



Software for control all the **logistical** elements present on oil rigs.

Artificial Intelligence to manage operations and enhance safety.

Digital twins of physical assets to simulate and contribute to more sustainable operations.

PROCESSING AND DIVERSIFICATION



Advanced predicting models to plan raw material extraction and keep out equipment in working order.

Automation to achieve higher quality products. RPA to transform the employee Automation experience.

TRANSPORTATION



Trucks and boats equipped with **sensors and IoT** to ensure full safety and control over transported materials and to monitor deliveries.

Artificial Intelligence and appification to connect the entire logistics chain.

Blockchain for the certification of hydrocarbon samples.

DISTRIBUTION



Smart sensors and advanced mathematical algorithms to automate operations at service stations.

Artificial Intelligence and machine learning to automate operations at service stations.

Blockchain to boost sovereign identity with providers.

CONSUMPTION



Appification and **omnichannel** strategies.

Big Data and Artificial Intelligence to improve our relationships with our customers.

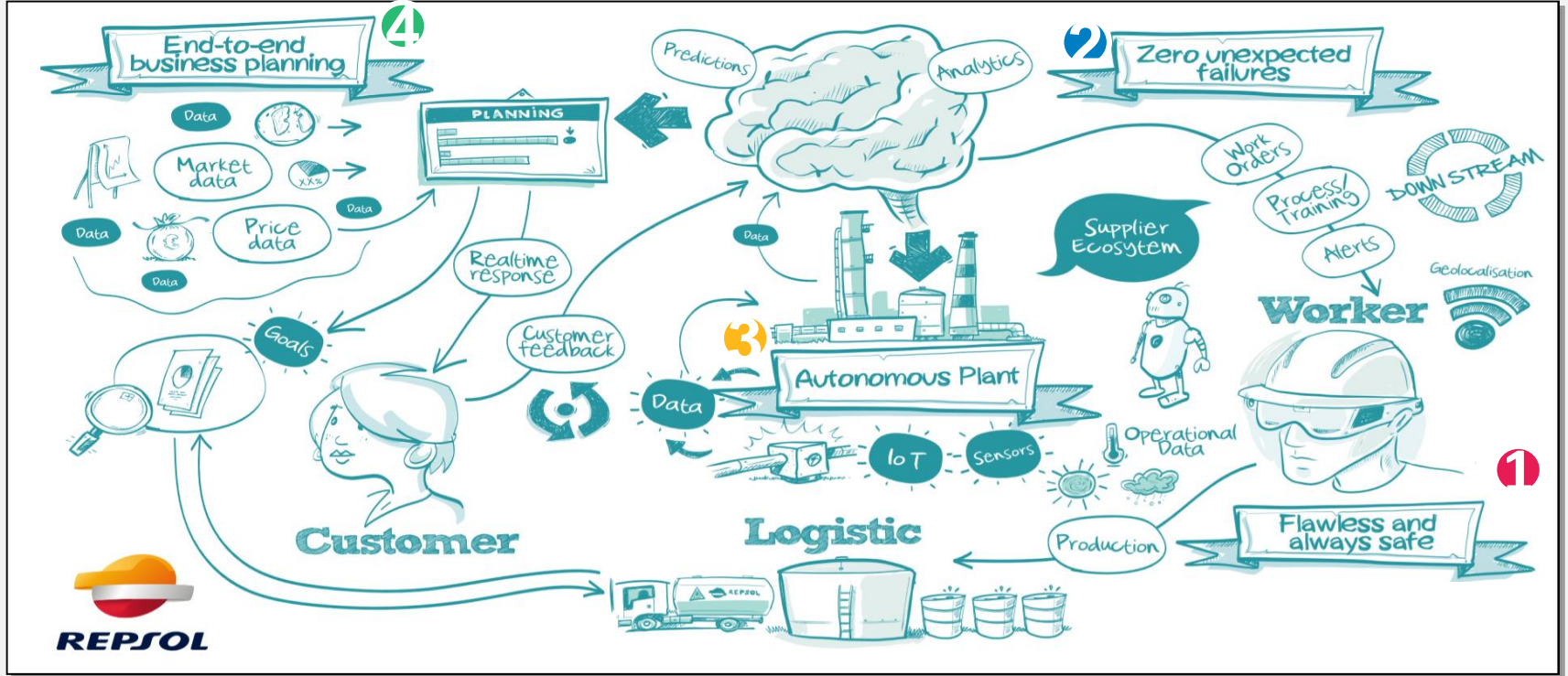
Encouraging new types of **mobility**.

Home automation systems.

Using agile methodologies to develop these projects quickly and repeat them while contrasting their use and consumption with the market.

Appification and the Cloud: Migrating our IT infrastructures to new cloud architecture, and APIs that facilitate the necessary rhythm to implement new solutions.

INDUSTRIAL FOUR DIGITAL INITIATIVES ACROSS INDUSTRIAL



REPSOL

INDUSTRIAL FOUR DIGITAL INITIATIVES ACROSS INDUSTRIAL



Digital initiatives

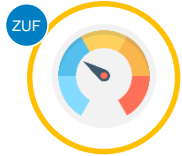
Key objectives



Flawless and always safe



- Improve workforce and plant safety levels with tasks automation and real-time data assessment and connectivity



Zero Unexpected Failures



- Increase reliability to reduce maintenance costs, extend asset life cycle and maximize production based on advanced analytics and mobilization



Autonomous Plant



- Exploit real-time plant data to autonomously optimize parameters to improve process interventions and economic value



End to end business planning



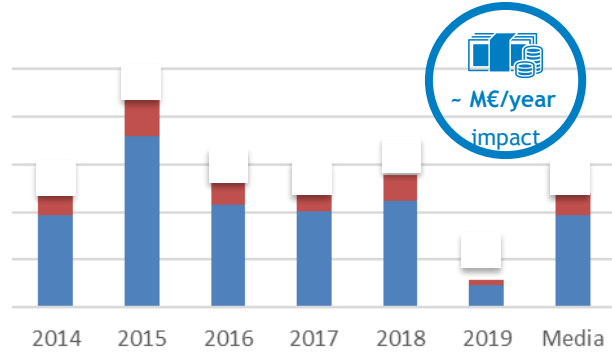
- Leverage advanced analytics to optimize decisions based on integrated along the value chain sources of information

+ 100 projects

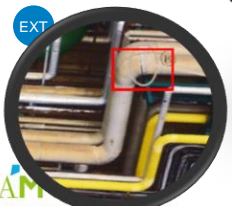
200M€ impact



CORROSION DETECTION



Internal Corrosion



External Corrosion

Tarragona
Actualizado hoy a 04:00h

Mostrar detalles

Todas las áreas | Crudo y vacío | Aguas ácidas

De peor a mejor índice de salud ✓
De mejor a peor índice de salud

Icono	Código	Riesgo	Criticidad
🔴	637LGAS78 LINEA 10" SCH-20	Riesgo moderado	★ Criticidad Operativa 2
🔴	637LGAS78 LINEA 10" SCH-20	Riesgo moderado	★ Criticidad Operativa 2
🔴	637LGAS78 LINEA 10" SCH-20	Riesgo moderado	★ Criticidad Operativa 2
🔴	637LGAS78 LINEA 10" SCH-20	Riesgo moderado	★ Criticidad Operativa 2
🟠	637LGAS78 LINEA 10" SCH-20	Riesgo moderado	★ Criticidad Operativa 2
🟠	637LGAS78 LINEA 10" SCH-20	Riesgo moderado	★ Criticidad Operativa 2
🟠	637LGAS78 LINEA 10" SCH-20	Riesgo moderado	★ Criticidad Operativa 2
🟡	637LGAS78 LINEA 10" SCH-20	Riesgo moderado	★ Criticidad Operativa 2
🟡	637LGAS78 LINEA 10" SCH-20	Riesgo moderado	★ Criticidad Operativa 2
🟡	637LGAS78 LINEA 10" SCH-20	Riesgo moderado	★ Criticidad Operativa 2
🟢	637LGAS78 LINEA 10" SCH-20	Riesgo moderado	★ Criticidad Operativa 2
🟢	637LGAS78 LINEA 10" SCH-20	Riesgo moderado	★ Criticidad Operativa 2

Mapa de la refinería
Todas las áreas

Activar corrosión externa



External corrosion



- Comercial available solutions for internal corrosion.
- We have developed our own external corrosion tool.

THE CHALLENGE



- Look for correlations between thermography images and insulation breakdown in a non invasive way.

OBJECTIVE: AUTOMATICALLY DETECTION OF DEFECTS



RUPTURE



DETACHMENT OF STEEL



STEEL PARTIAL
DETACHMENT



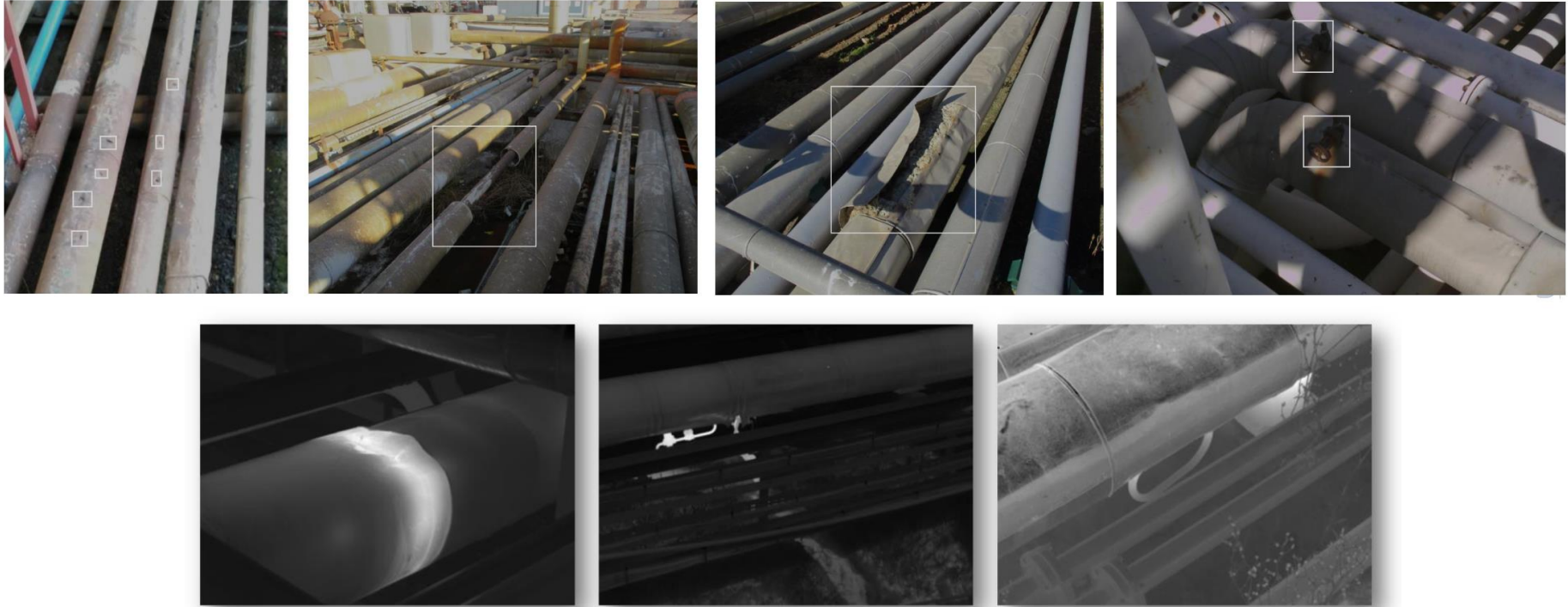
JOINT DEFECTS

EXTERNAL CORROSION: DIFFICULTIES



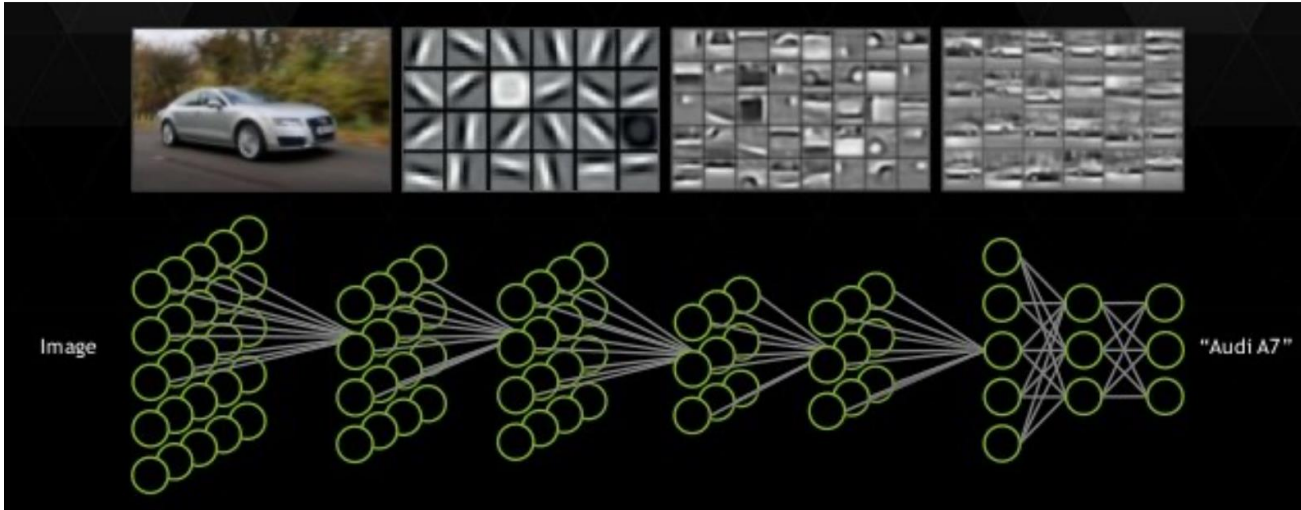
- Only data for one rack in one refinery for MVP
- Ground truth difficult to know even for experts; they have to assess the defect on-site
- Detect the accurate x,y,z coordinates

OBJECTIVE: AUTOMATICALLY DETECTION OF DEFECTS



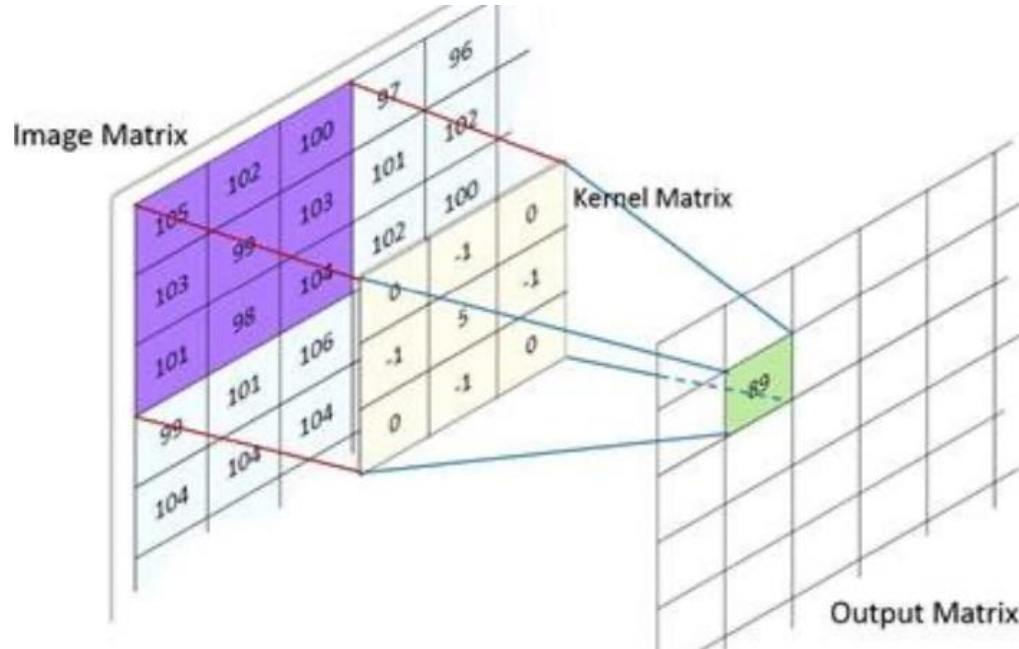
- Thermal model: 295 images (80%train-20 %test) 1 class : defect / no defect
- Visual model: 460 images (70%train-30 %test) 4 classes.

ANALYTICAL MODEL: COMPUTER VISION CHALLENGES



- One of the challenges of traditional machine learning approaches is Feature Extraction
- For complex problems such as object recognition or handwriting recognition, this is a huge challenge.

ANALYTICAL MODEL: COMPUTER VISION CHALLENGES



- One of the challenges of traditional machine learning approaches is Feature Extraction
- For complex problems such as object recognition or handwriting recognition, this is a huge challenge.

ANALYTICAL MODEL: COMPUTER VISION RESEARCH



Semantic Segmentation

1348 papers with code · [Computer Vision](#)



Image Classification

1185 papers with code · [Computer Vision](#)



Object Detection

971 papers with code · [Computer Vision](#)

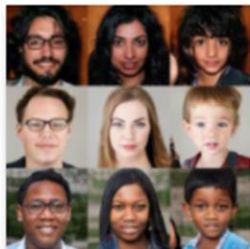


Image Generation

473 papers with code · [Computer Vision](#)



Pose Estimation

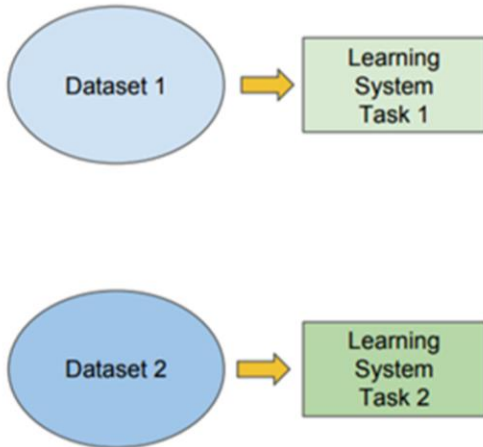
443 papers with code · [Computer Vision](#)

Traditional ML

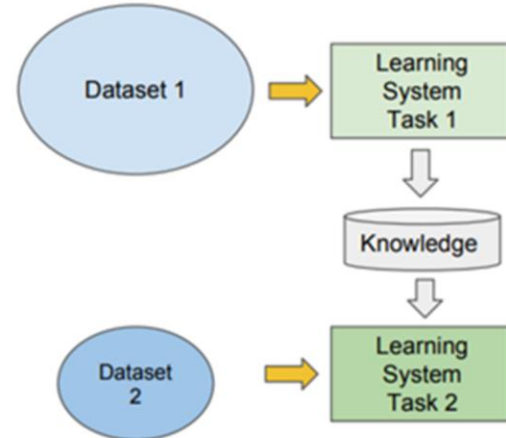
vs

Transfer Learning

- Isolated, single task learning:
 - Knowledge is not retained or accumulated. Learning is performed w.o. considering past learned knowledge in other tasks



- Learning of a new tasks relies on the previous learned tasks:
 - Learning process can be faster, more accurate and/or need less training data

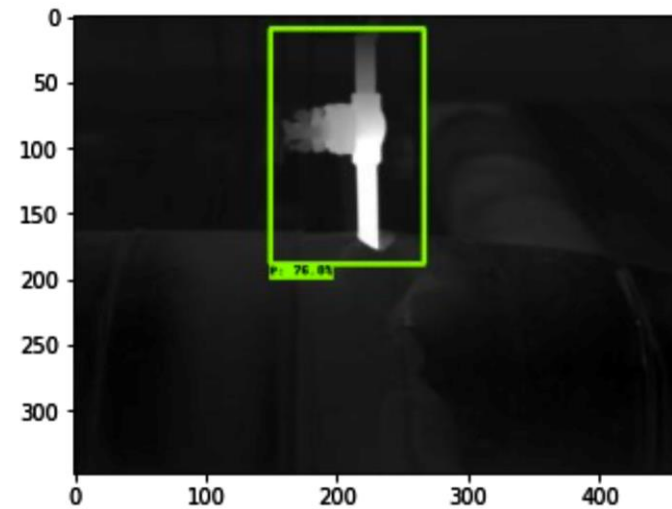


ANALYTICAL MODEL: TRANSFER LEARNING BECAUSE ...



Transfer Learning is the fastest and easiest way to build a Deep learning model without worrying about how much data you have

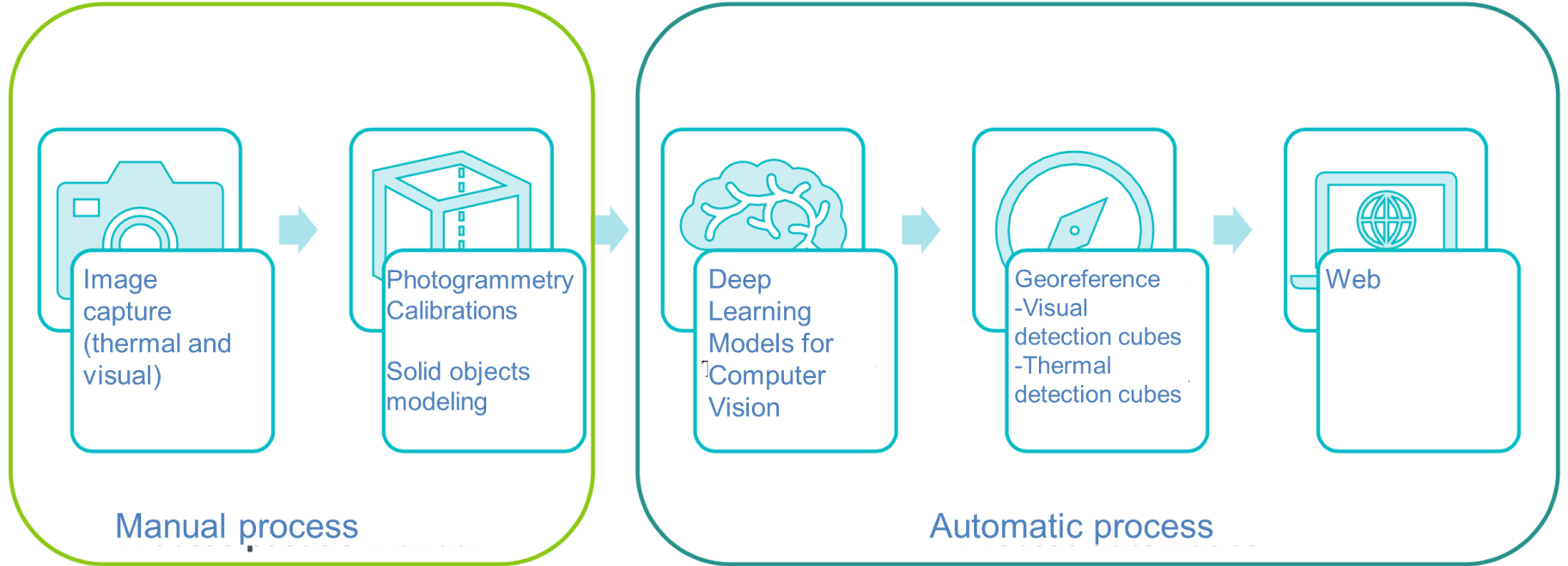
ANALYTICAL MODEL: HOW TO MEASURE



Metrics	Value
Precision	0.5
Recall	0.37

Metric	Value
Precision	0.95
Recall	0.69

ANALYTICAL MODEL: IS A PIECE OF THE PROCESS



REPSOL'S UPSTREAM PROCESS



Exploration

The search for oil and gas reservoirs is of the utmost importance, and we dedicate a large part of our time and technology to geology, geophysics, and environmental impact studies that help us to determine an area's potential.



REPSOL'S UPSTREAM PROCESS



Opportunity identification

Before exploration can begin, we need to obtain permission in the form of mineral rights. Then we can start taking measurements to identify and assess the opportunities.



Exploration

We evaluate the characteristics of the onshore or offshore discovery in order to decide on the most appropriate development model and to get a better understanding of the potential reserves so that we can move on to the next phase.



Development and production

We develop and construct the facilities necessary to achieve optimal production. We extract the reserves from the reservoir, producing oil and gas.

REPSOL'S UPSTREAM PROCESS



REPSOL'S INWELL ROOM



40 windows.

Located in Madrid, this room connects and monitors in real time all the processes of the company. Worldwide.

Inwell is operating 24x7 real time.

Each 10 minutes we train the models that predict all the activities: risks, maintenance, future events, ...

DIGITALIZING OUR CUSTOMER SERVICES



Customer Journey



The Repsol Commitment
Net Zero Emissions
by 2050

DIGITALIZING OUR CUSTOMER SERVICES



Multi-energy

Cross-selling between current customers and channels, while incorporating new services such as electric mobility, energy, and advanced mobility services.



Customer-centric

Rollout of a new cross-company loyalty program to get closer to the end customer and reach eight million digital customers by 2025.



Digitalization

Expansion of digital platforms to strengthen our bond with our customers thanks to AI-driven personalization.

DIGITALIZING OUR CUSTOMER SERVICES



Waylet

Carbon offsetting.



Solar panels

Self-consumption at home.



Energy monitoring

For an efficient home.

DIGITALIZING OUR CUSTOMER SERVICES



Wible

Carsharing service.



Self-consumption energy

Share energy with your neighbors.



Charging station

An extensive EV network.



REPSOL