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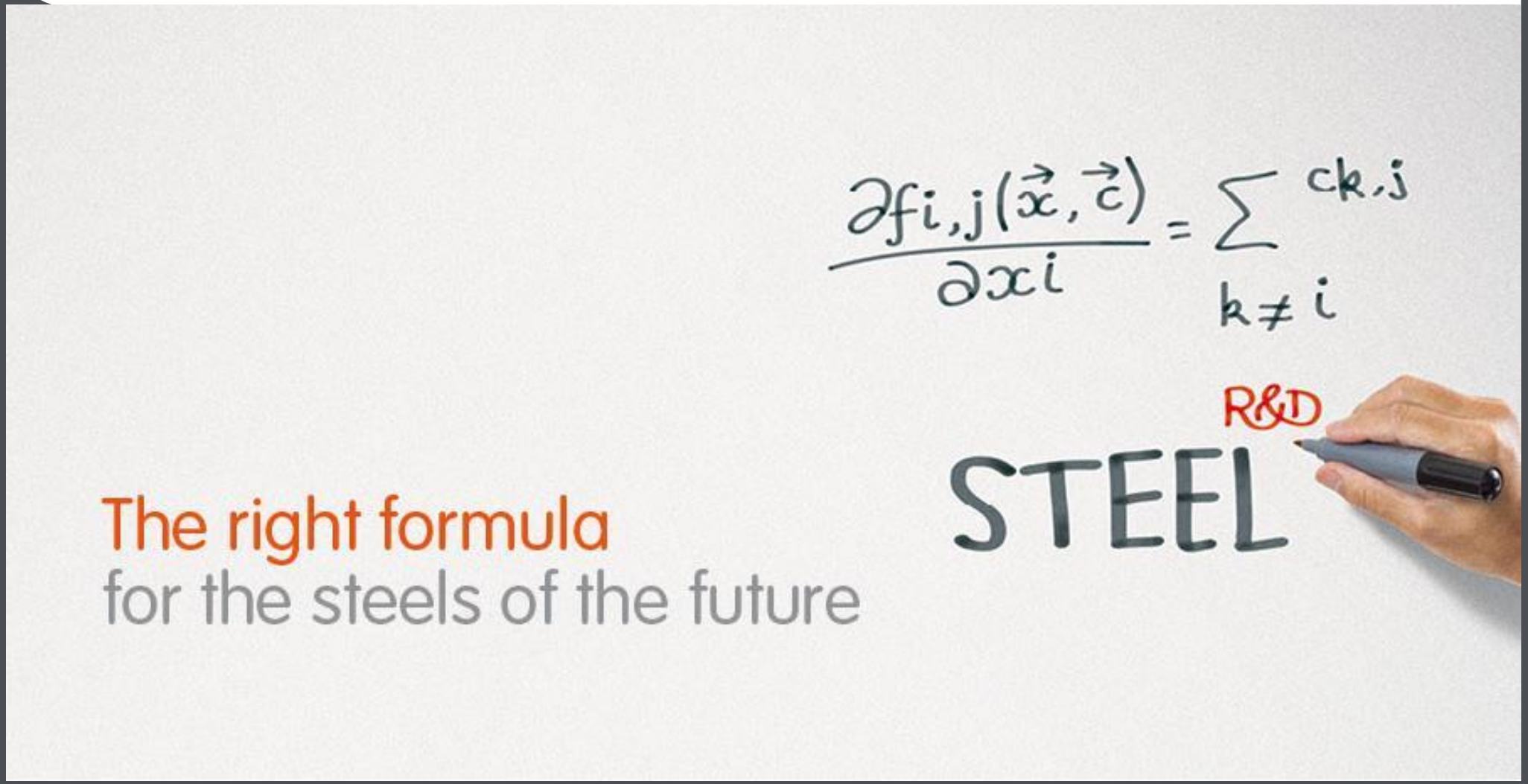
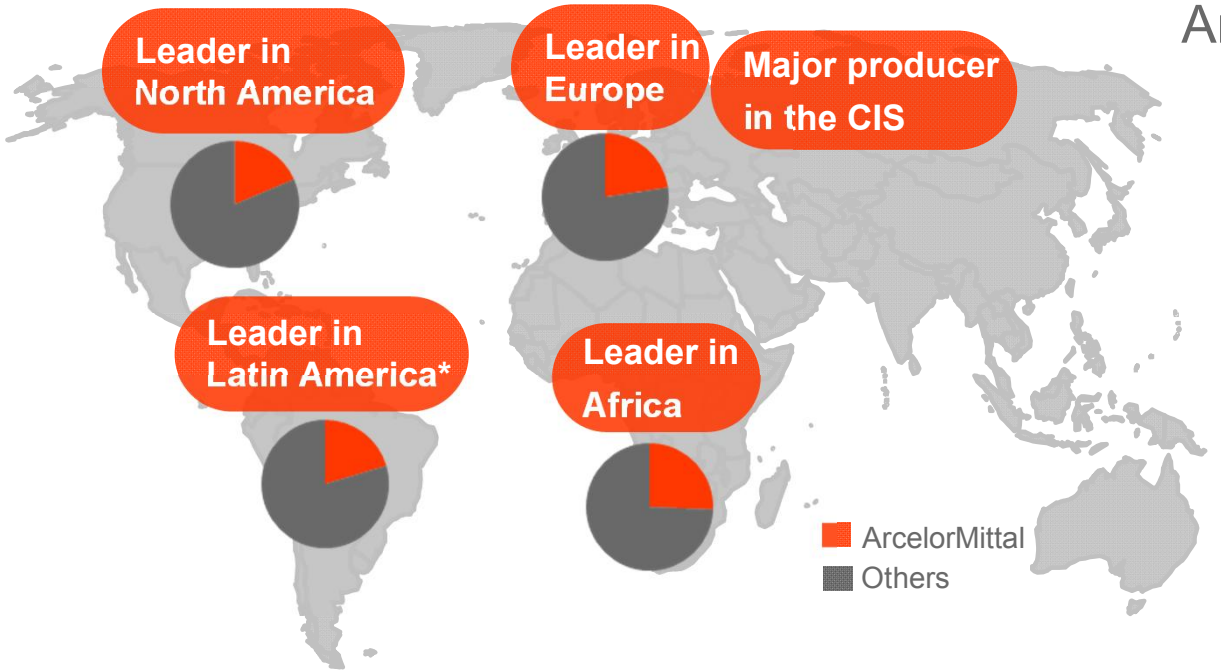
Transformación digital en la cadena logística



Geographical reach

Market position by region

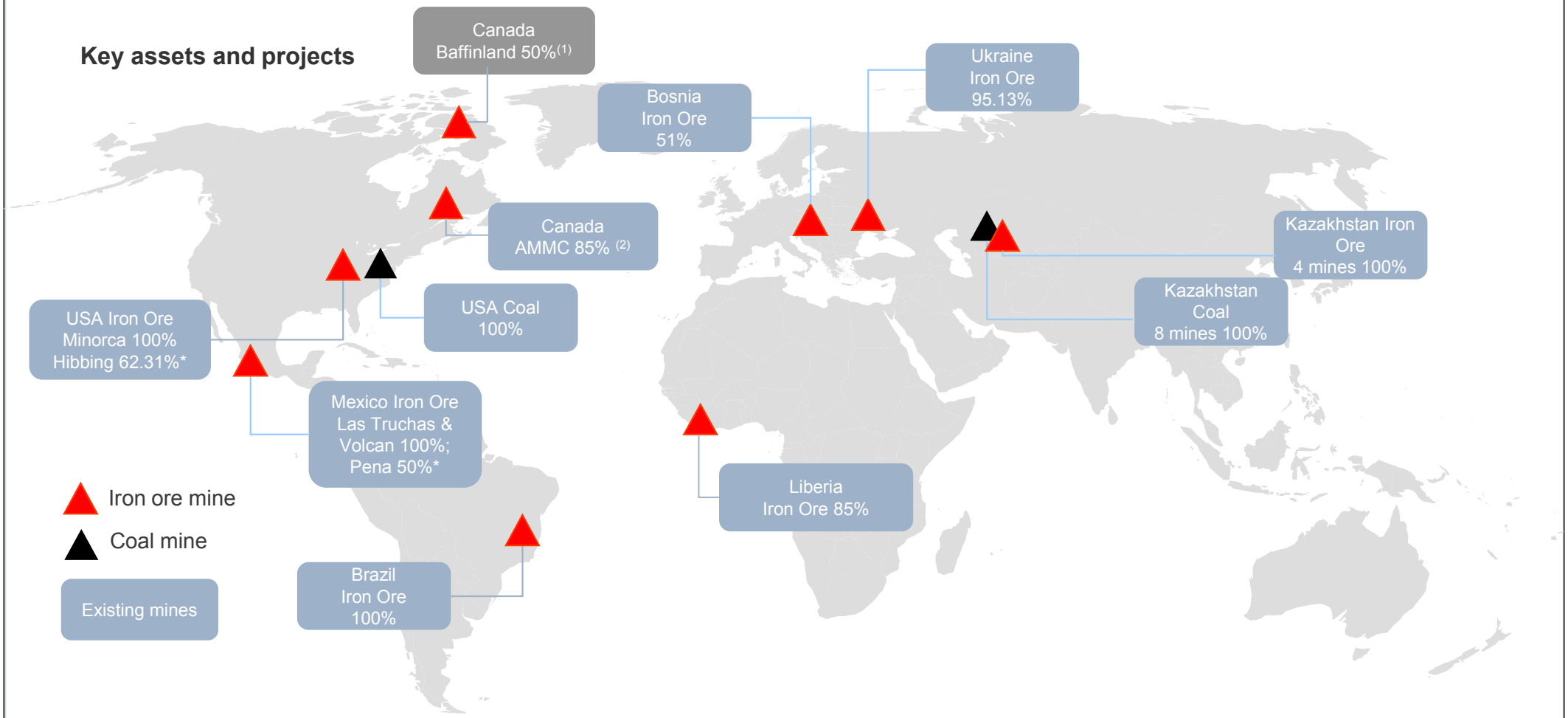


Emerging markets continue to offer the best organic growth potential for ArcelorMittal

- Superior demand growth potential
- We have the platform and experience:
  - Already the steel market leader in the Americas, Europe and Africa and top-four producer in the CIS
  - Brazil is one of our franchise businesses
  - We also have JV projects in the Middle East and China

A global mining portfolio addressing Group steel needs and external market

Key assets and projects



Geographically diversified mining assets

ArcelorMittal Global R&D

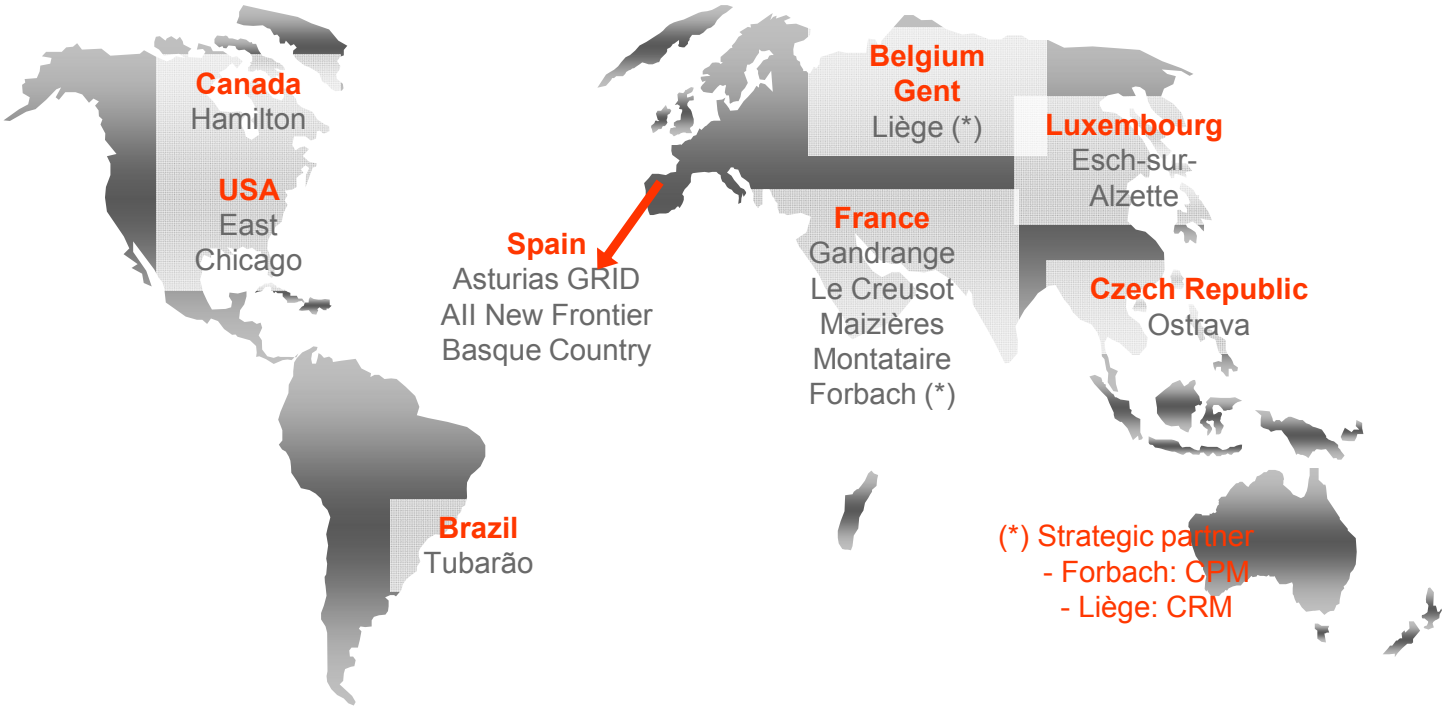
12+1 Research Centres Located Worldwide









Global R&D SPACE: **Key Facilities in Asturias**

R&D Campus of 12.000 m^2 in 11 buildings

ArcelorMittal

GRID: 7000m^2 dedicated to:

- Primary, Refractories, By Products and Energy
- Finishing and Product Technology
- Environmental and Steelmaking Fluids
- Business and TechnoEconomics
- Mechatronics

New Frontier: 4000m^2 dedicated to Frontier Research

- Digital Factory
- Materials Revolution
- Additive Manufacturing
- Sustainable Resources

Industrial Pilot Plants: 1000 m^2 dedicated to

- Gas and Energy Labs
- Hybrid Filtration

Global R&D SPACE: Worldwide Impact

Innovation Service to 94 units in 24 Countries since 2008

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FLAT PRODUCTS AMERICA
- Burns Harbor
- Calvert
- Cleveland
- Coatesville
- Columbus
- Dofasco
- Indiana Harbor
- Lázaro Cárdenas
- Tubarao
- Vega do Sul
- Warren

LONG PRODUCTS AMERICA
- Acindar
- Cariacica
- Contrecoeur
- Costa Rica
- Georgetown *
- Juiz da Fora
- Lázaro Cárdenas
- Laplace *
- Monlevade
- Piracicaba
- Steelton
- Trinidad &Tobago
- Vila Constitución
- Vinton *

FLAT PRODUCTS EUROPE
- Avilés
- Borçelik
- Bremen
- Chateneuf
- Desvres
- Dunkirk
- Eisenhüttenstadt
- Etxebarri
- Florange
- Frýdek-Místek
- Fos
- Galati
- Geel
- Genk
- Ghent
- Katowice
- Krakow
- Lesaka
- Liège
- Mardyck
- Montataire
- Ostrava
- Piombino
- Sagunto
- Sestao
- St. Chély

LONG PRODUCTS EUROPE
- Annaba
- Belval
- Differdange
- Gijón
- Hamburg
- Hunedoara
- Olaberría
- Warsaw
- Zaragoza *
- Zenica
- Zumárraga

CORPORATE TEAMS
- Chicago
- Esch-sur-Alzette
- London
- Luxembourg
- Paris
- Rotterdam

COMMERCIAL AGENCIES
- Birmingham
- Gent
- Istambul
- Madrid
- Milano
- París
- Reims
- Suttgart

ACIS
- Kryviy Rih
- Newcastle
- Temirtau
- Vanderbijlpark
- Saldanha

MINING
- Andrade
- Kazakhstanskaya
- Kentobe
- Kryvyi Rih
- Las Truchas
- Mont Wright
- Peña Colorada
- Port Cartier
- Prijedor
- Saranskaya
- Serra Azul
- Volcán
- Vostochnaya

Introduction – Food for thought

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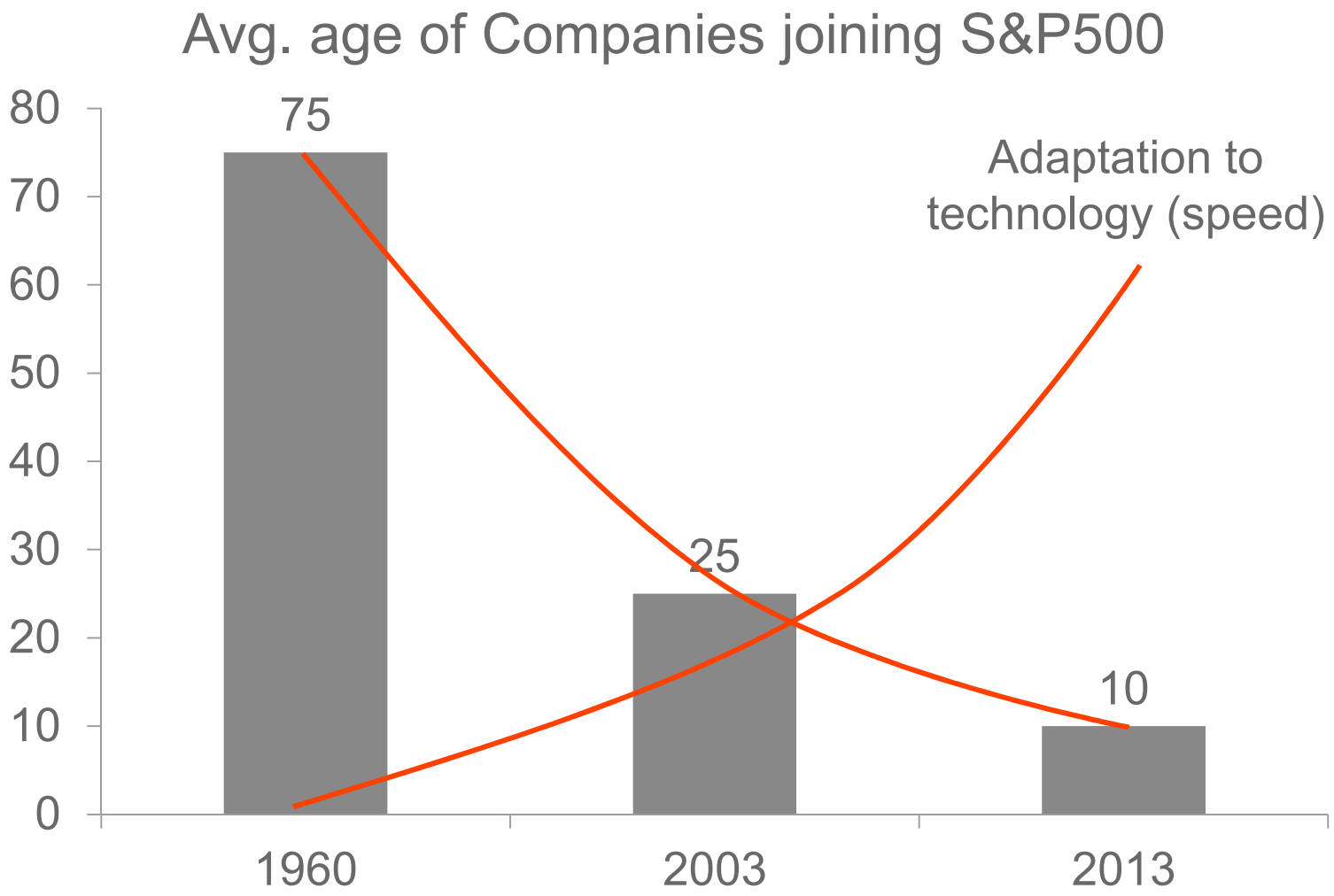

Del dato al conocimiento:
Retos hombre vs máquina en la historia

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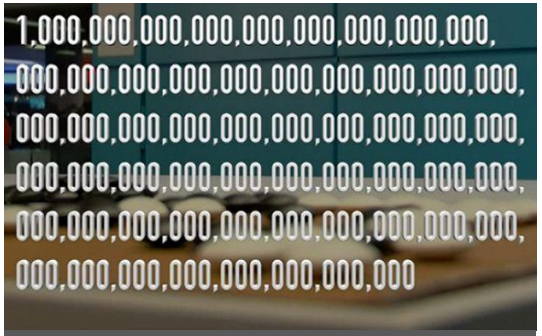
1997
- Ajedrez
- Deep Blue vs Kasparov

2011
- Jeopardy
- IBM Watson vs 2 Humanos

2014
- Rubik
- CubeStormer: 3,25 vs 5,5 seg

2016
- Go
- AlphaGo vs Lee Sedol



Combinaciones Posibles en un tablero 19x19

2017
- Poker
- Libratus vs 4 mejores jugadores

???
- Industria
- ……

"….A Libratus la única información que se le ha proporcionado han sido las reglas para jugar…"
".. Es capaz de predecir los faroles humanos…."
"…La mayor habilidad de la IA para hacer un razonamiento estratégico con información imperfecta ha superado a la de los mejores humanos.."

Introduction – Food for thought

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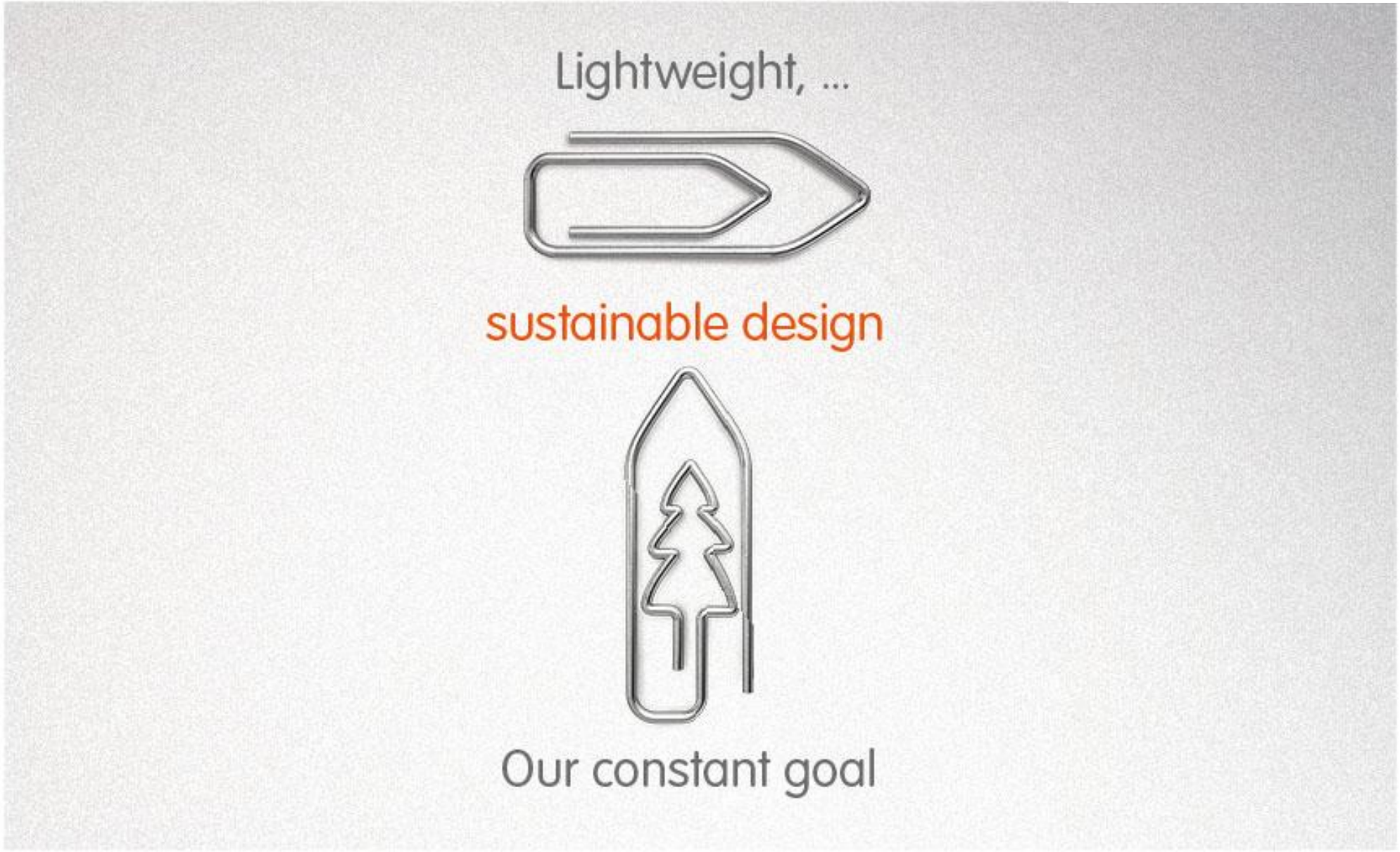
- Humans landed on the Moon using 7.500 lines of software code
  - How many lines you think are there in a Boeing 787?
  - And in a Mercedes S?
  - And in a Chevrolet Volt?
  - And in a Tesla model S?

ArcelorMittal Global R&D Digitalization Program



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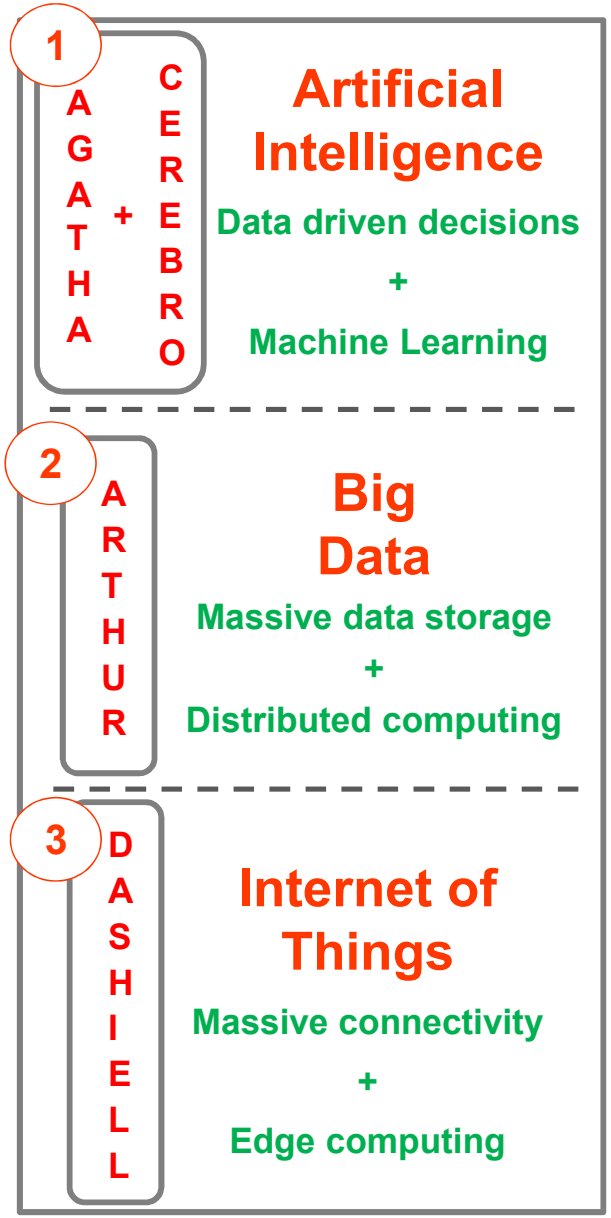
Global R&D Digitalization Program

Key Activities - Main objectives



1 2 3 **Digital benchmark HDG**

1 2 3 **Digital benchmark HSM**

1 2 **Commercial - Pricing**

1 **Procurement**

1 **Supply Chain**

1 **Investments**

1 2 **Product Development**

1 2 3 **Mining**

1 **Strategy**

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AI & Maths & Data-driven business

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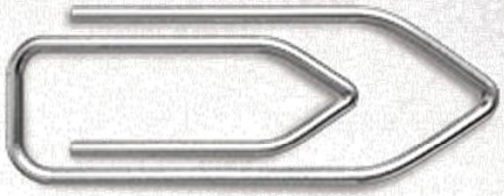
Lightweight, ...



sustainable design

Our constant goal

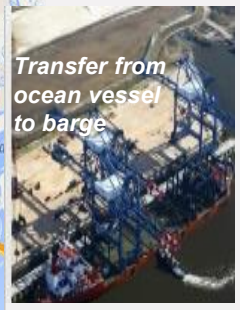
Location

AM/NS Calvert, Alabama

- The **geographical scope** of the project goes from maritime slab arrivals to Pinto Island Port at Mobile to the supply of the slabs to the HSM through the roller table that is located in the Slab Yard
- Slabs received by vessel arrive at **Pinto Island**, Port of Mobile from where they are barged north to **AM/NS Calvert river terminal** to be finally moved by truck platforms to the Slab Yard.
- Carbon slabs from **Indiana Harbor** are shipped by train to Calvert rail terminal, from where they are sent to the outer yards and later moved by truck platforms to the Slab Yard.
- **Stainless** slabs arrive by truck from Outokumpu directly to Bay 1 in the slab yard.

AM/NS Calvert
River Terminal - Calvert

Barges transport cago 40 miles north on Tombigbee River



Pinto Island – Port of Mobil

Maritime slab flows from Lázaro Cárdenas (Mexico), Tubarao (Brazil), and TK Brazil; and Rail flow from Indiana Harbor (USA) to AM/NS Calvert

Barges are unloaded and transshipped to truck platforms, then to AM/NS Calvert Slab Yards.

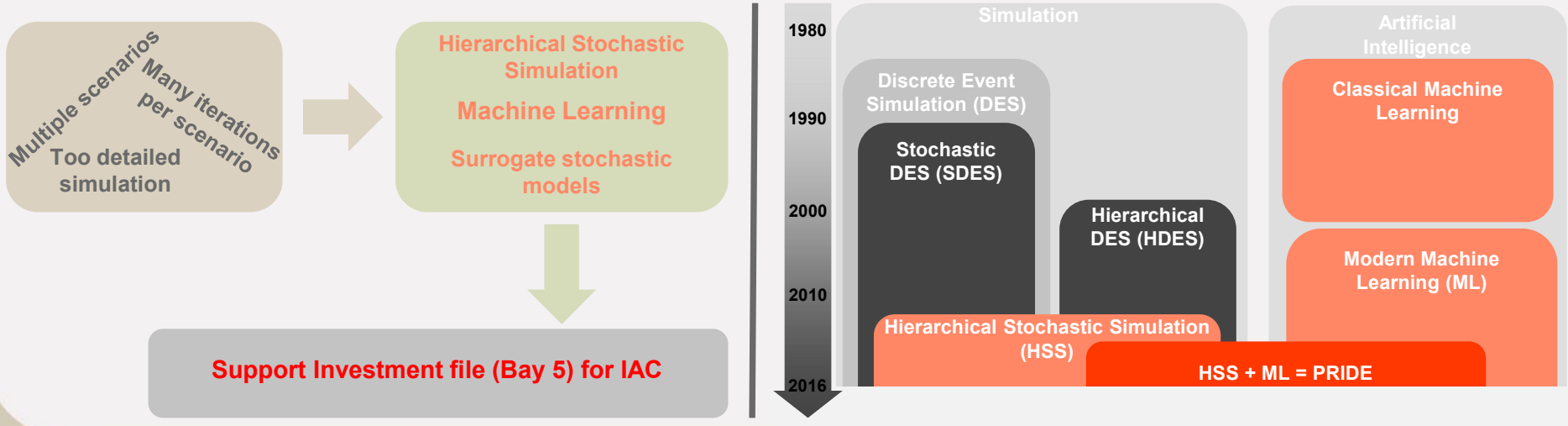
What is Innovative about the Idea

Innovative techniques

- The business analysis needed to achieve the objectives is ***too detailed*** for an analytical derivation, so an empirical approach is needed; considering that ***multiple scenarios*** had to be tested and that ***each scenario*** requires ***many runs*** to attain statistical significance, traditional stochastic simulation methods would require large amounts of memory and not finish in reasonable times.
- The needed speed-up was obtained by replacing subsystems of the simulation with ***surrogate stochastic models.*** We designed the surrogates using ***machine learning*** (a sub-field of ***artificial intelligence***) to build fast models trained offline with synthetic data, generated through detailed simulations of the subsystems. A smart definition of the subsystems allowed reusing the same model throughout the analysis.

Innovative in Business

- This is, to our knowledge, the first ***investment file*** in the Group that is ***supported by*** such a detailed analysis not only of the expected results, but also of the potential risks using a ***data-driven model***.



Technologies Involved

The hardware used was key to perform the study in the limited time frame available; our ***Cerebro*** cluster consists of 38 heterogeneous Intel Xeon-based servers, totaling **1344 processing cores** across 666 processors with **12.7TB RAM**, and 90TB storage. This translates roughly in **25 trillion instructions per second** ($25x10^6$ MIPS).

Even with this raw power, the full year-long simulation would take too long to run millions of times over to account for the tens of thousands of repetitions needed to attain statistical significance for each of the 150 distinct scenarios analyzed.

If a single simulation took 10s to run, the whole analysis would require over 3 months of continuous computing time

Key Trends

- **Uncertainty management**: statistical analysis of outcomes and risk, instead of expected values
- **Machine Learning and Artificial Intelligence:** building of data-driven models to represent complex behavior with reduced complexity (running time, memory footprint)
- Integration of existing (albeit new) technologies into more **powerful methods**
- **High Performance Computing**: extract maximum value from current computational capabilities

Slab Yard – ArcelorMittal Asturias

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Slab Yard – ArcelorMittal Burns Harbor

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Slab Tracking System Overview

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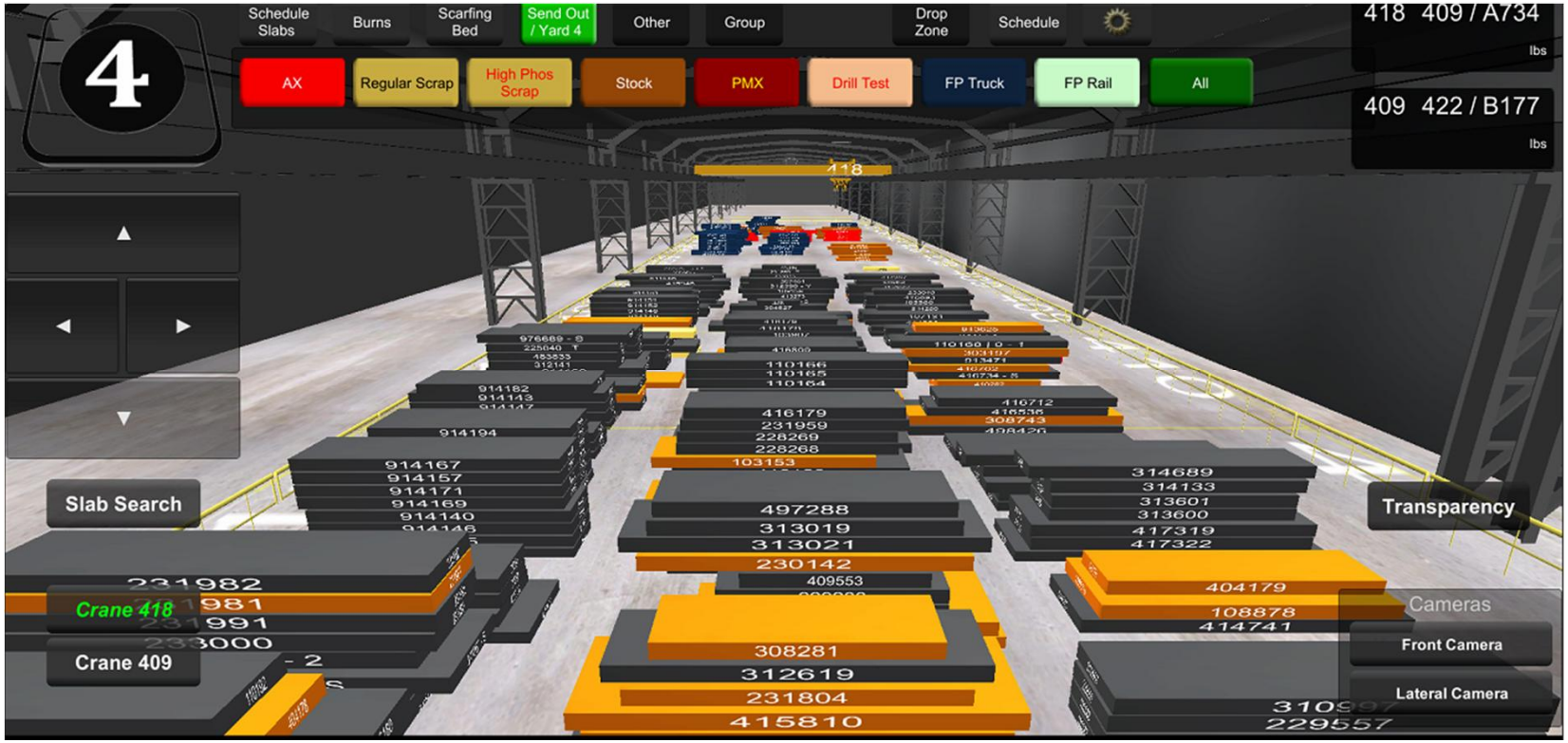
- Computers in the cranes direct crane movement
- Crane operators see a virtual-reality slab yard that they use to color in the slabs they need to move
- As they move slabs, their computers update in real time



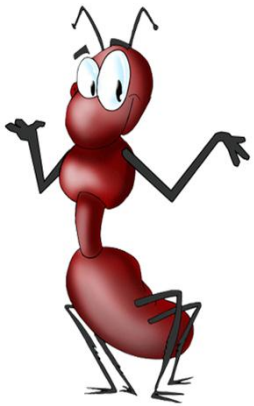
ArcelorMittal KLiP Technology

BIOMIMIC

ArcelorMittal

Producing Steel with Nature Inspiration

Características de las hormigas



- Casi ciegas.
- No pueden hacer tareas complejas solas.
- Depende del fenómeno de inteligencia de enjambre para sobrevivir.
- Capaces de encontrar el camino más corto desde el hormiguero a la comida y retorno.
- Usan estigmergia a través de trazas de feromonas.
- Siguen las trazas de feromona que tienen más probabilidad. Cuantas más hormigas siguen un rastro, más atractivo se convierte para que lo sigan el resto.

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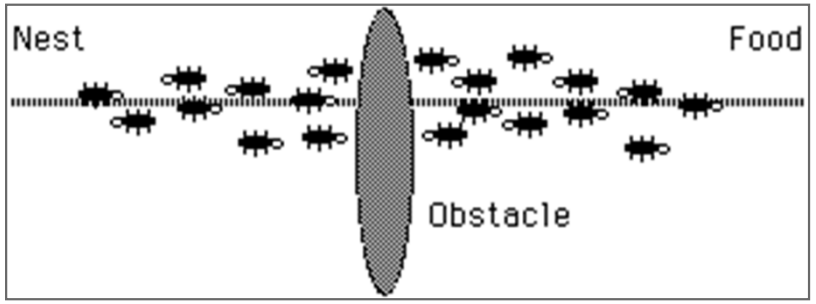
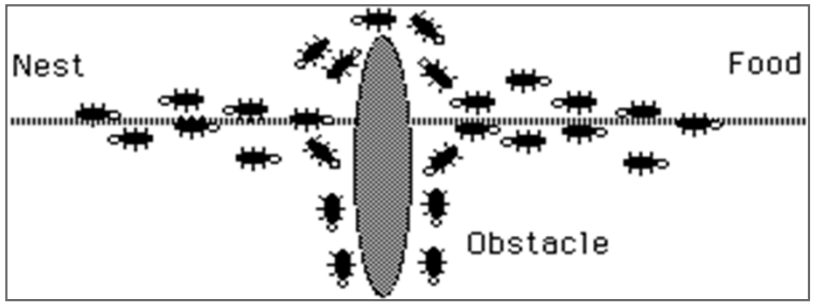
Comportamiento de las hormigas

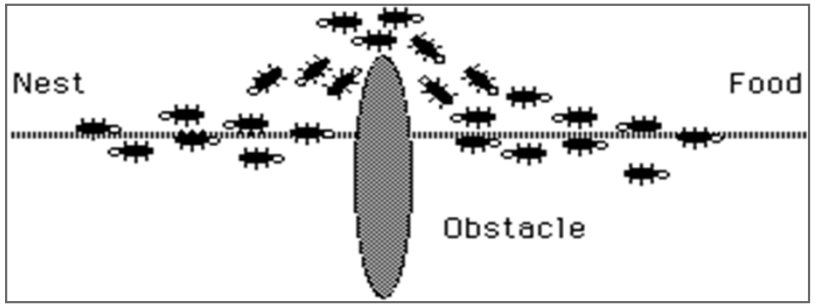
Imaginemos un camino recto a la comida



Aparece un obstáculo en el camino y las hormigas han de elegir: derecha o izquierda



Se comienzan a separar y exploran ambas posibilidades



En breve el camino más corto se convierte en el más probable por una traza más fuerte de feromonas.

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KLiP: More tons, less cost, better quality, 0 CAPEX

Revolutionary Artificial Intelligence algorithms for line scheduling

ArcelorMittal

TECHNOLOGY

- Ant Colony Optimization (ACO)
- Innovative new distributed parallel computation (Ant Hills)

Flexible scheduling of new products


Best Paper Award
ANTS 2014
September 10-12, 2014. Brussels, Belgium

Scheduling a galvanizing line by Ant Colony Optimization

Silvino Fernandez, Segundo Alvarez, Diego Diaz, Miguel Iglesias, and Borja Ena

The best paper was selected by the members of the award committee: Prof. Gerardo Beni, Dr. Maurice Clerc, Prof. Luca Maria Gambardella, Prof. Richard Hartl, and Prof. Alan Winfield

Marco Dorigo
Conference Chair

Luca Maria Gambardella
Chair of the Award Committee

Best paper AWARD ANTS

1st Place Americas Emerging Technology AWARDS

Best paper Global R&D EVER

ArcelorMittal is the industrial leader using and evolving the ACO technology together with the creators

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Saving millions through mathematically optimized decisions

Sourcing + Freight logistics

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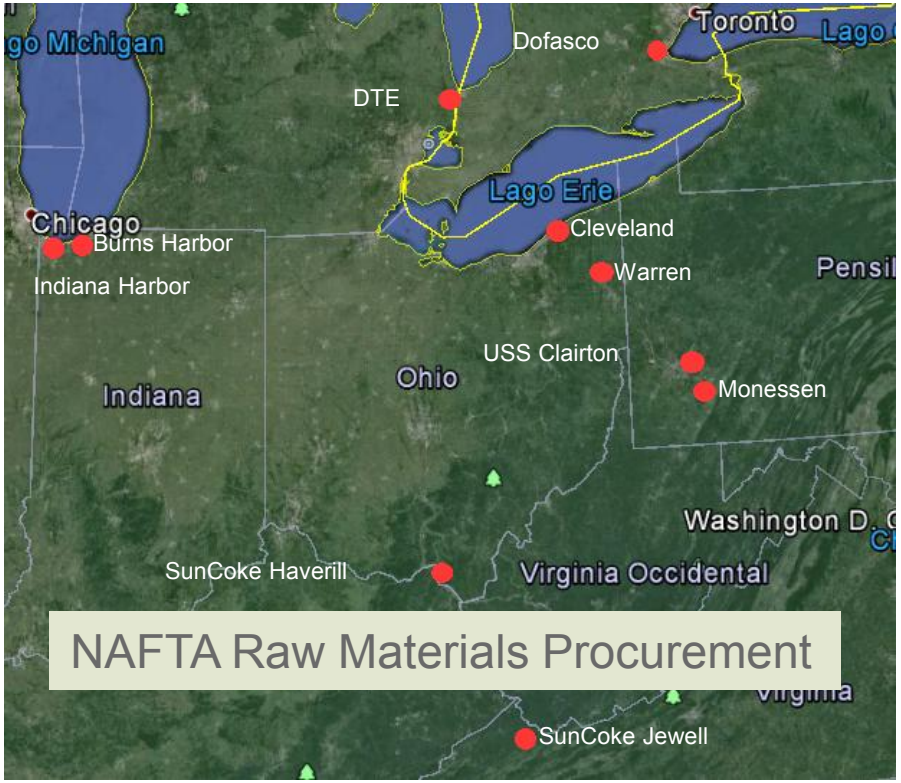
BUSINESS CASES

NAFTA Coke Logistics distribution



Europe Freight Land Logistics

Main takeaways

- Technology around is evolving at unprecedented speed
- Global digitalization is not a debate
- Our ultimate goal is to have a digital enterprise where everything is connected
- New technology both hw & sw open doors traditionally closed due to lack of computing power and/or ability to properly manage huge amounts of data
- Innovation & Differentiation are key to survive (and lead) in our tremendous competitive World

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Transformación digital en la cadena logística