DATA SCIENCE FOR INDUSTRY 4.0

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DATALAB
SAINT-GOBAIN RESEARCH PARIS

PYPARIS 2018

KEY FIGURES

One of the top
100
industrial groups in the world
with around 950 production sites

More than
75%
of sales are made in the habitat markets

More than
4,100
sales outlets

SAINT-GOBAIN

2017 net sales
€40.8 BN

More than
179,000
Employees and 100+
nationalities represented

Created more than
350
years ago

Present in
67
countries

Innovative Materials

Comprising Flat Glass and High-Performance Materials, the Innovative Materials Sector holds a unique portfolio of materials and processes relating to habitat, transport, healthcare and industry markets. It provides the Saint-Gobain Group with its innovation-oriented culture.

25%
Of net sales

+ Flat glass

N°1 in Europe
N°2 worldwide

Present in
34 countries*

Over
34,000 employees

+ High-performance materials

N°2 worldwide

Present in
36 countries*

Over
28,000 employees

* Industrial presence

Construction Products

The Construction Products Sector designs and develops innovative solutions to improve the quality of living places and reduce the environmental impact of buildings, with unique product and service offerings for all construction fields, tailored to local conditions.

29%
Of net sales

N°1 worldwide
- Plaster and plasterboard
- Mortars and floor coatings
- Ductile cast iron pipe

N°2 worldwide
- Insulation (all types of insulation products)
- Tile adhesives

N°1 in Europe
- Wall facings

N°2 in the United States
- Exterior Products

Present in
62 countries*

Over
47,000 employees

*Industrial presence

Building Distribution

The Building Distribution Sector brings the Group a thorough understanding of customers' needs, be they building professionals, private project owners or large companies. It serves over seven million customers each year on the new building, renovation and home improvement markets.

46%

Of net sales

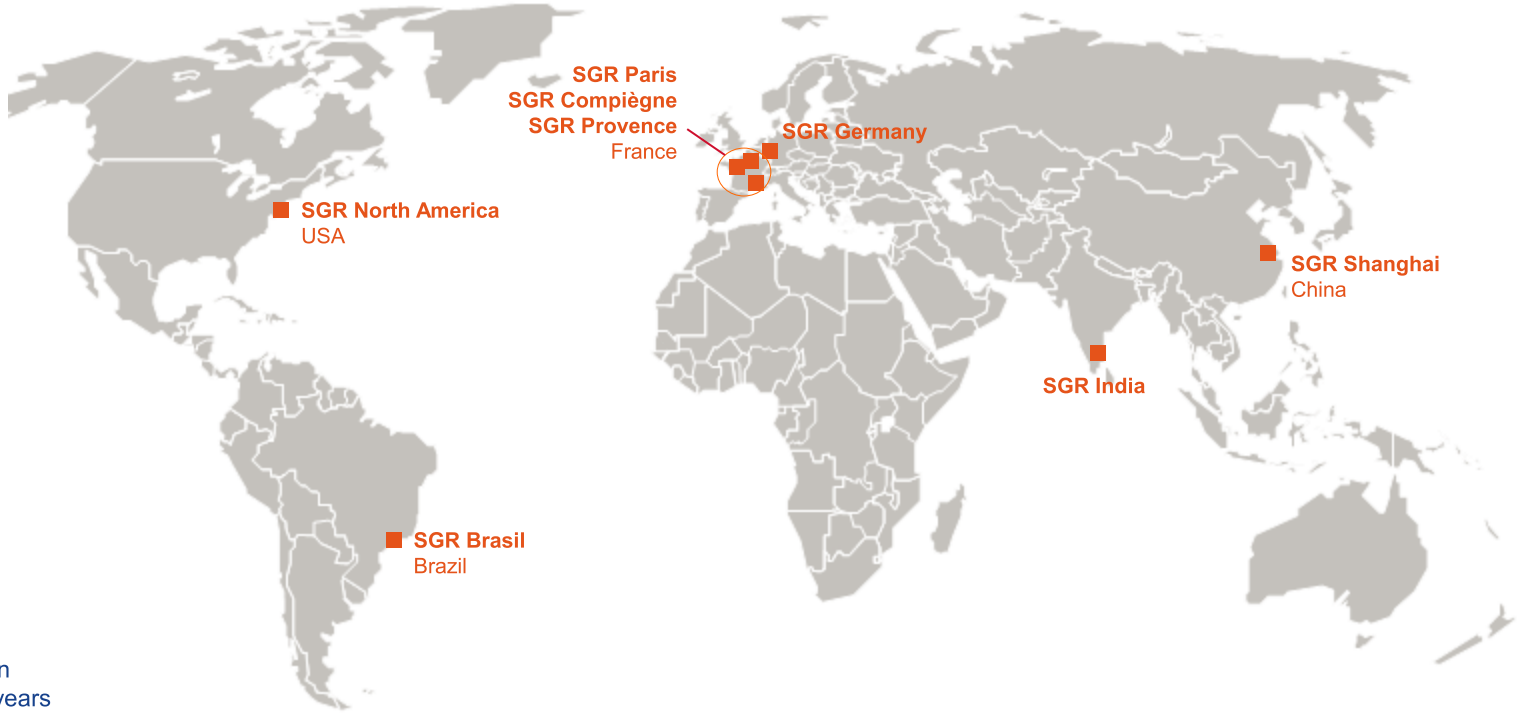
N°1 in Europe
Distribution of building materials

Present in
23 countries

Over
63,000 employees

More than
4,100 sales outlets

R&D centers of Saint-Gobain



TOP100
GLOBAL INNOVATORS

3 700
researchers

8 cross-business R&D centers

1 produit out of 4
sold by Saint-Gobain today didn't exist 5 years ago

R&D centers of Saint-Gobain

Datalab : 3 teams, 25 data scientists
- **Marketing & Sales**
- **Building Science**
- **Industry 4.0**

TOP100 GLOBAL INNOVATORS

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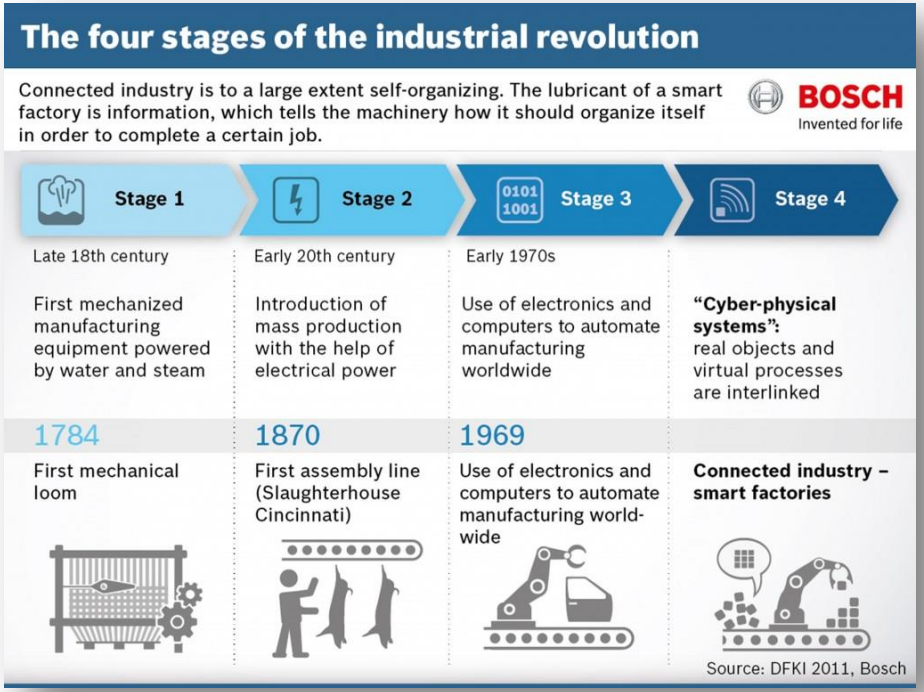
INDUSTRY 4.0

I. A DEFINITION
II. PREREQUISITES
III. TEAM
IV. DATA
V. TOOLS AND METHODS
VI. EXAMPLES

Industry 4.0 : a definition



Industry 4.0 : opportunities

- **Shorter delivery times** – production of a customized product before commissioned by customers
- **More robust production** – production units autonomously learn to deal with exceptional situations
- **Reducing human errors** – increasing use of intelligent robots reduces production errors (especially in case of batch size 1)
- **Better usage of working hours** – advanced work hour planning by combining human and robot resources
- **Predictive Maintenance** – determine the condition of in-service equipment in order to predict when maintenance should be performed
- **Safer working conditions** – working environments with high security risk can increasingly be done by robots
- **Automation of human activities** – modern artificial intelligence allows the automation of complex tasks that were previously done by humans

Data science for industry 4.0

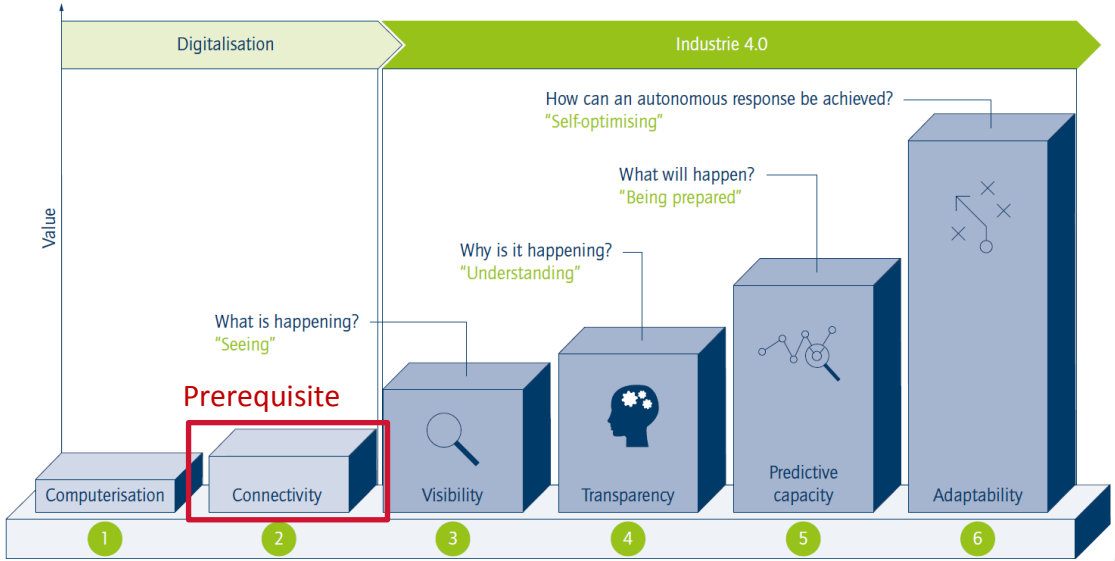
Source: infineon.com

Steam power from agrarian to industrial society

Electric power for assembly lines and mass production

Computerization of production

Smart networks of humans, machines and products



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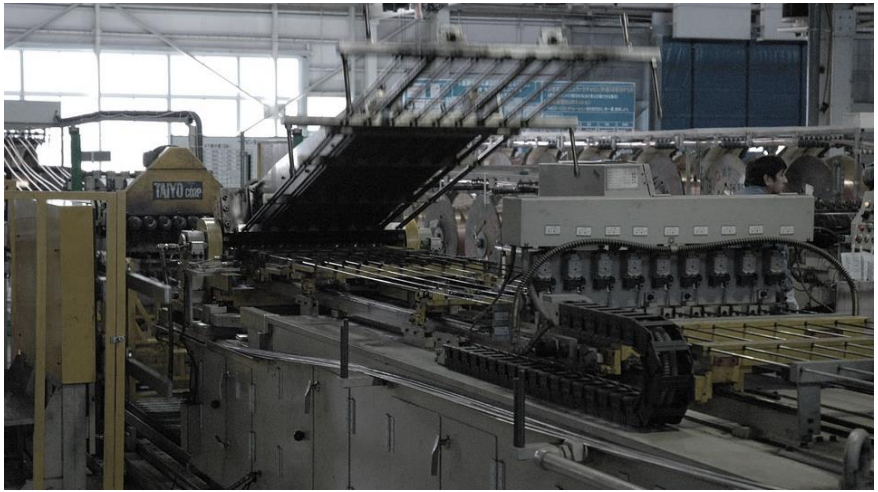
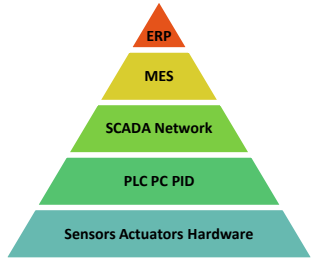
Industry 4.0 prerequisites : connectivity

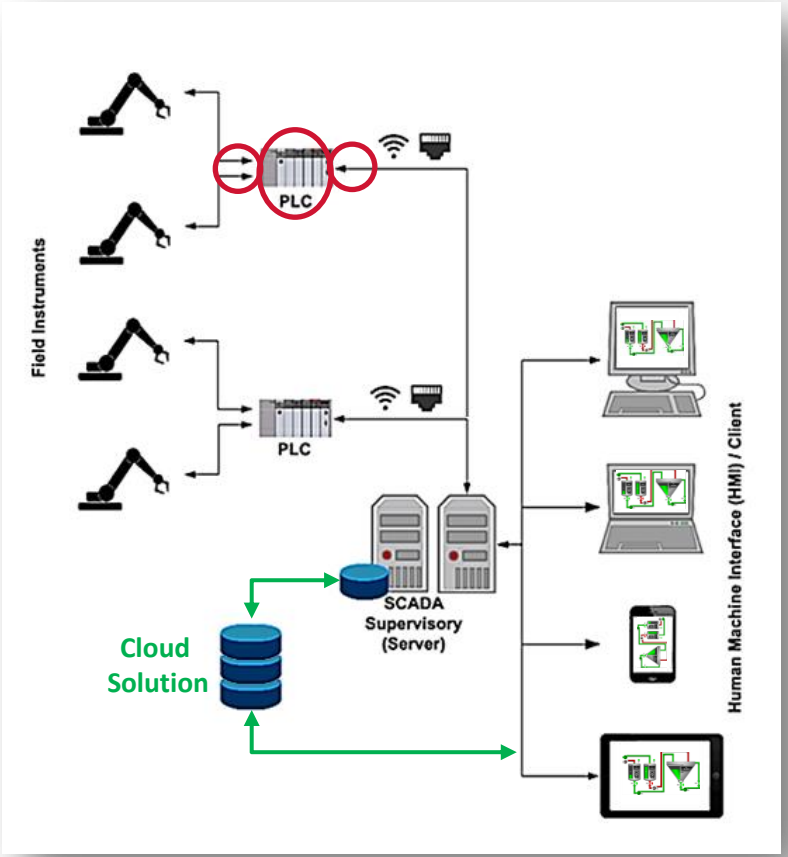


Credit: Max Pixel

P.XU et al. Visual Diagnostics of Assembly Line Performance in Smart Factories, VIS 2016

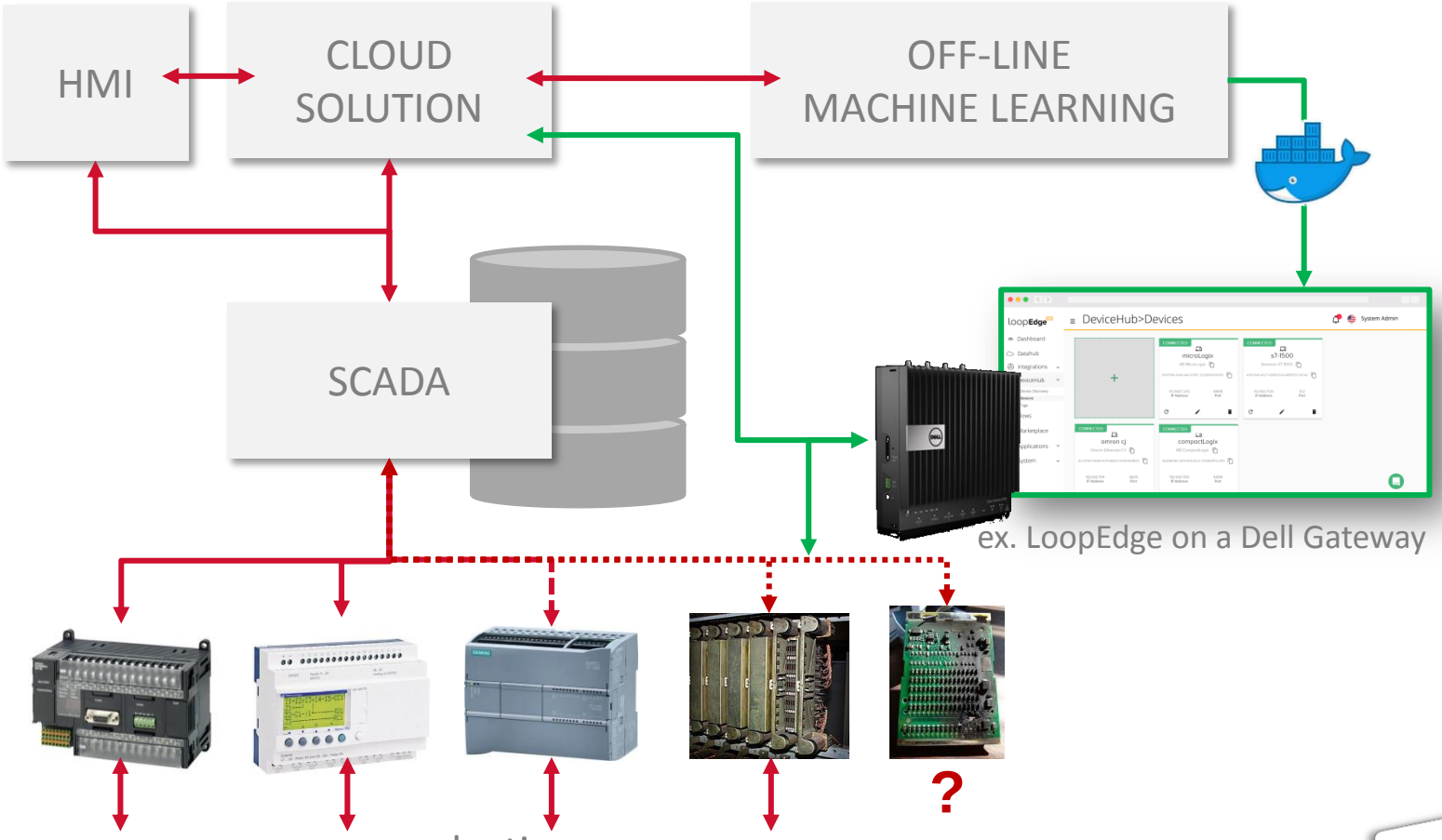
Industry 4.0 prerequisites : connectivity



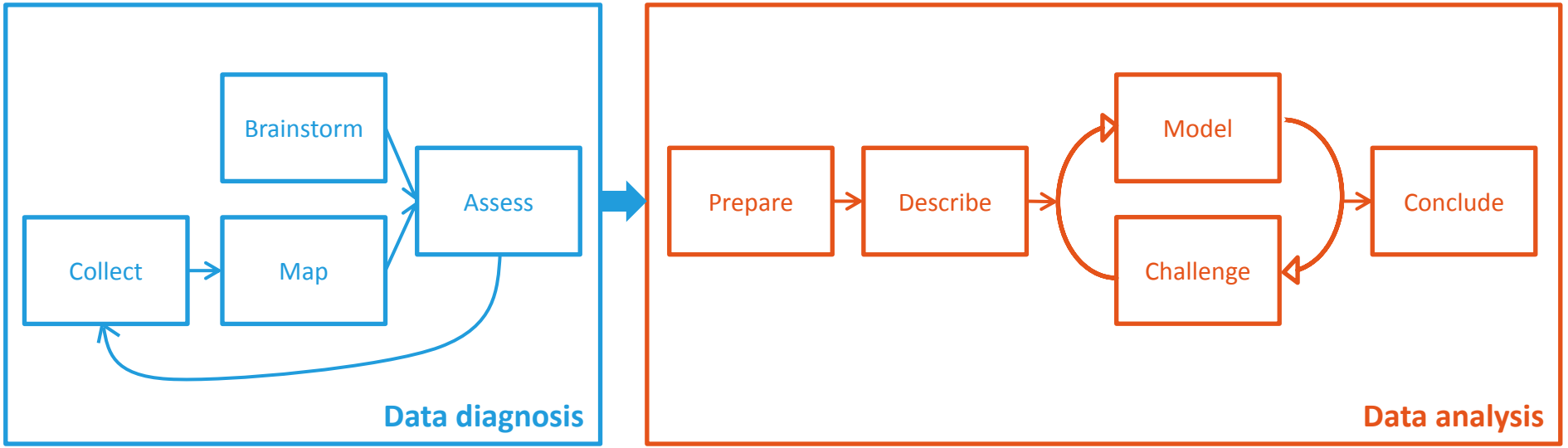


SCADA network

Industry 4.0 prerequisites : connectivity



Data science project workflow for industry



Industry 4.0 team

Sponsor

Defines the goals

Project Leader

General planification and resources management

Data Scientist

Extracts value from data

one project

different roles

Production Expert

Gives operational insights and feedbacks

User/client

Data Owner

Asserts content and quality of the data

Sensors Expert

Defines, selects, develops the right sensors

Industrial IT

Gives access to data, manages architecture

Industry 4.0 team: main risks

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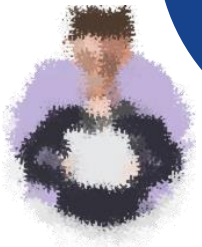

Data Owner

Asserts content and quality of the data

Sensors Expert

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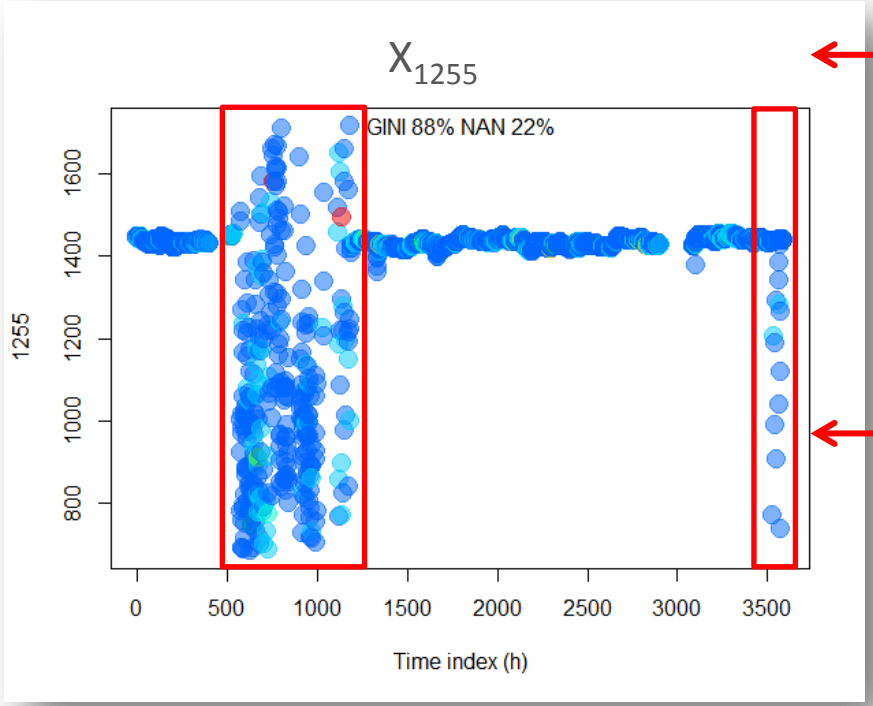
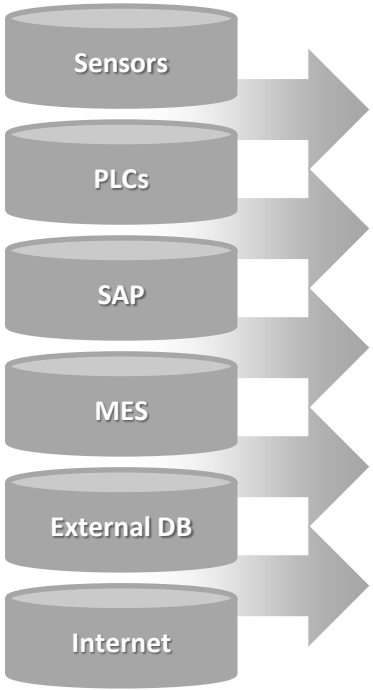
Team: data owner

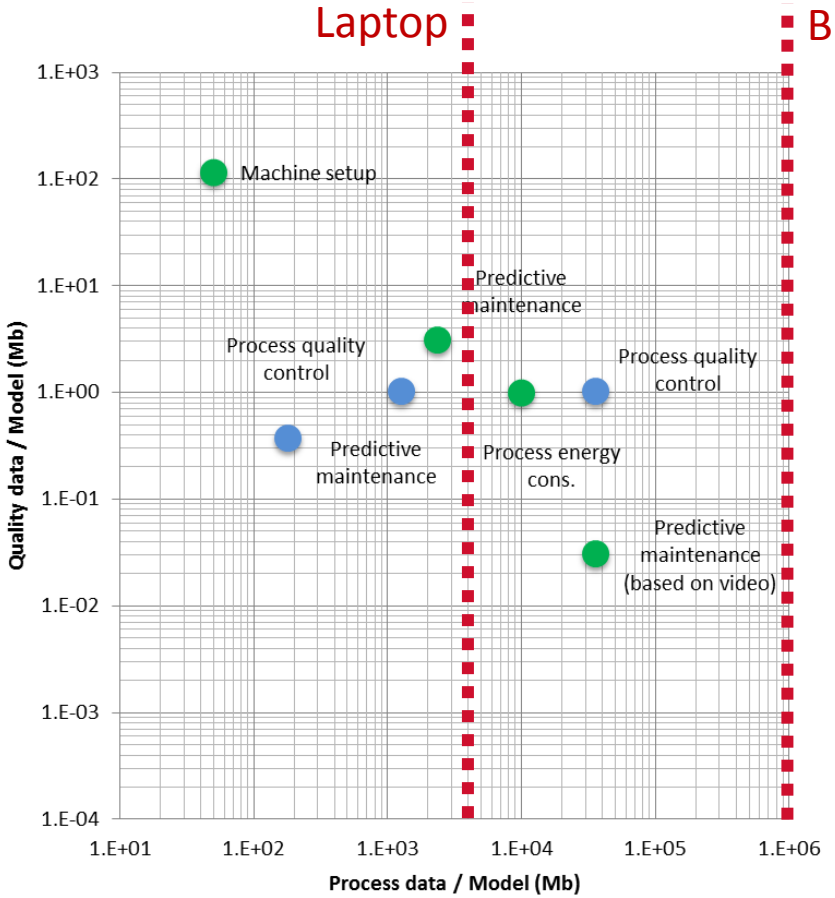


"X_{1255}"
… could be more explicit

sensors failures ?
production stops ?
actual variations ?

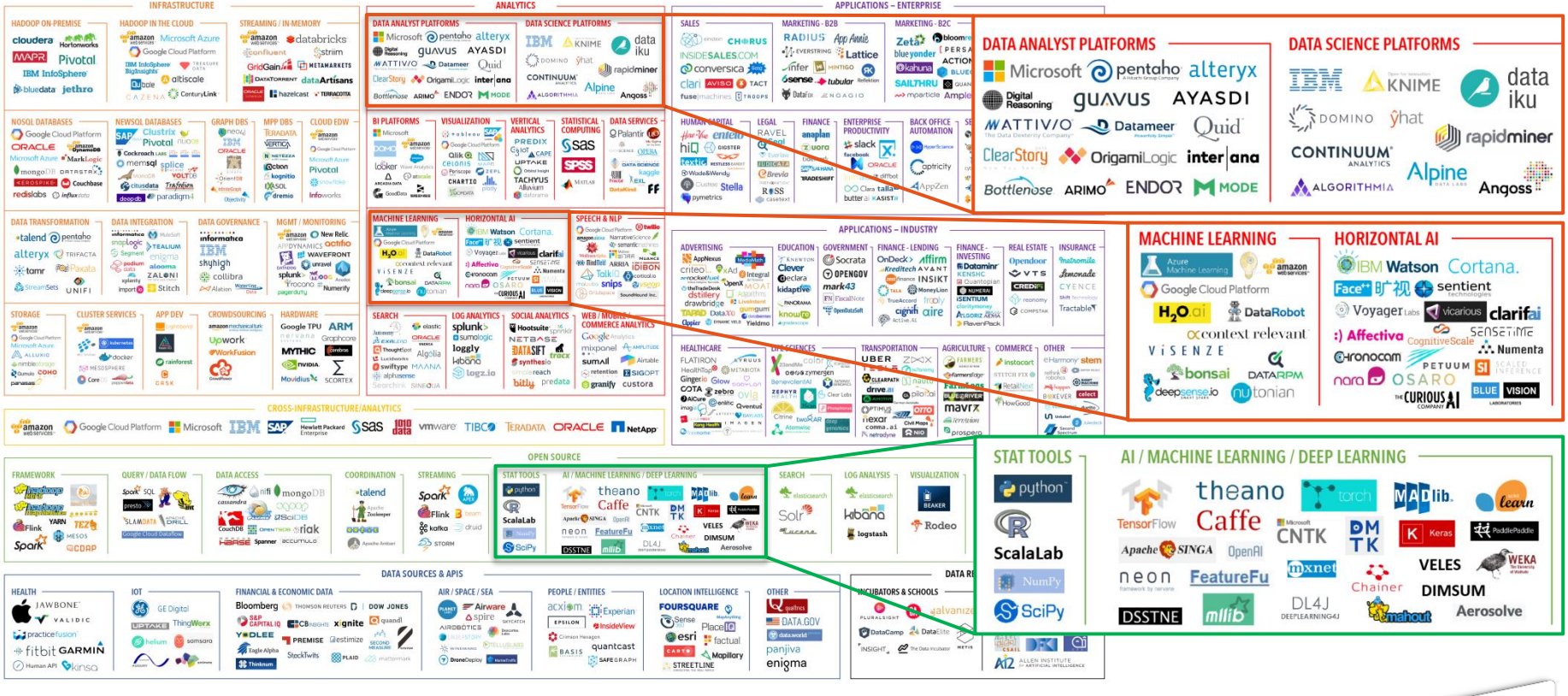
Data: sources & sizes





- All automatic
- Partially Manual
- Manual

Tools : welcome to the jungle!



http://mattturck.com/bigdata2017/

Examples of tools

from data toward information

Data Connection	Big Data Platform	Data Preparation	Machine Learning	Data Visualization
Ignition	Cloudera	Python	Python	JavaScript
BrainCube	Spark	R	R	Python
FieldBox			RapidMiner	MicroStrategy
...				QlickView
				Tableau

Open source
Commercial

Machine Learning cannot be bought

The model is a living object:

- generated by a maieutic process
- data preparation is the key (tailored, line specific, has to be coded)
- need to be fed and trained by experts

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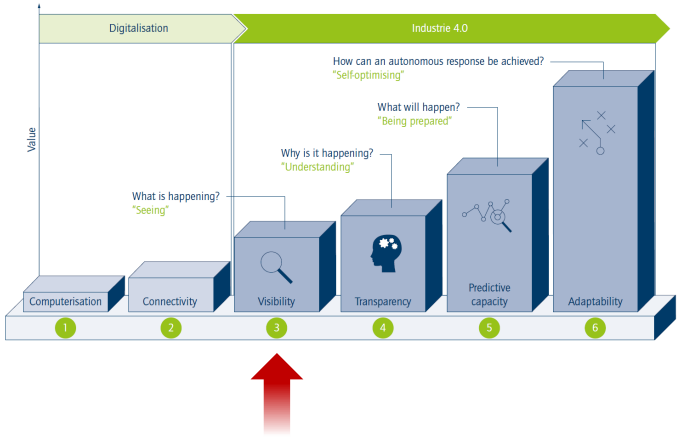
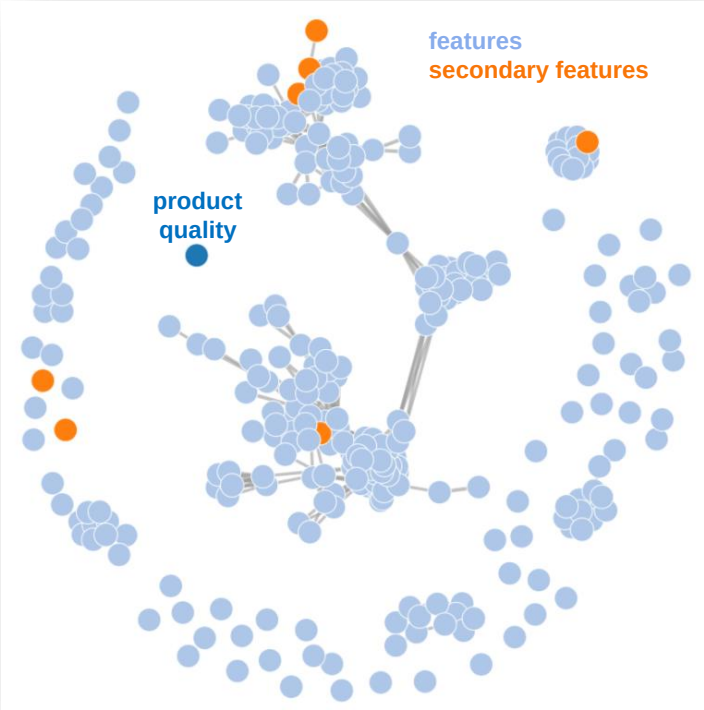
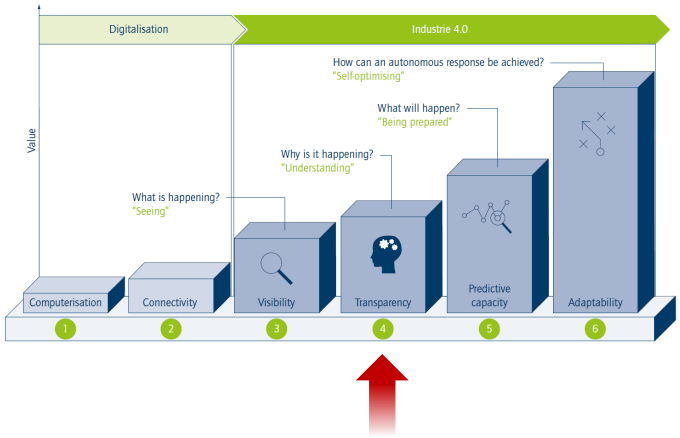
Visibility

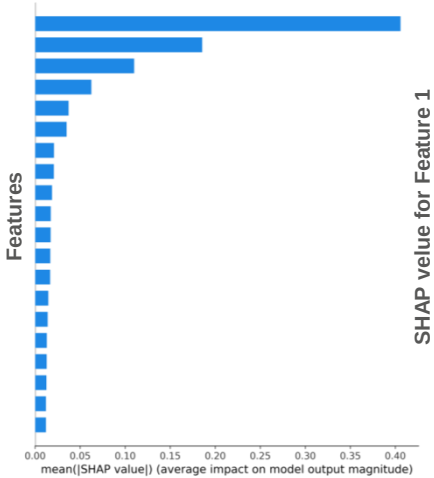


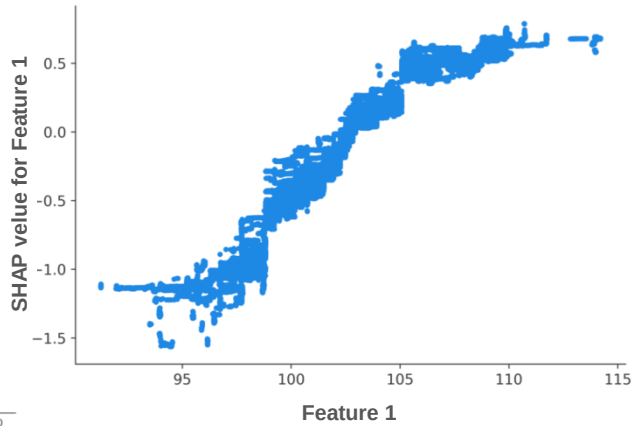


Hive→Pandas + in house MIC python code
+ D3.JS (Mike Bostock) | tSNE + Bokeh

Transparency

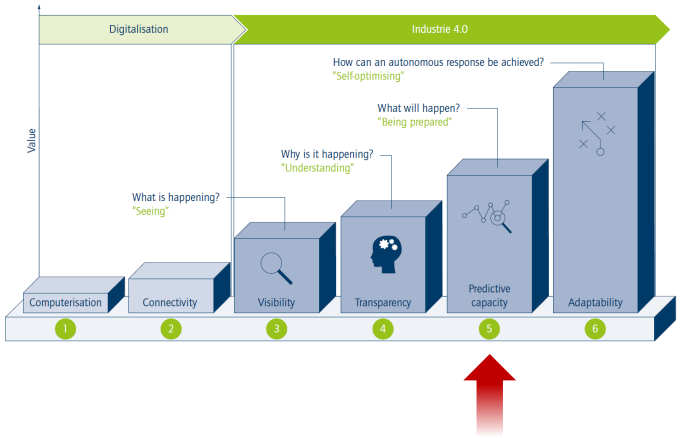


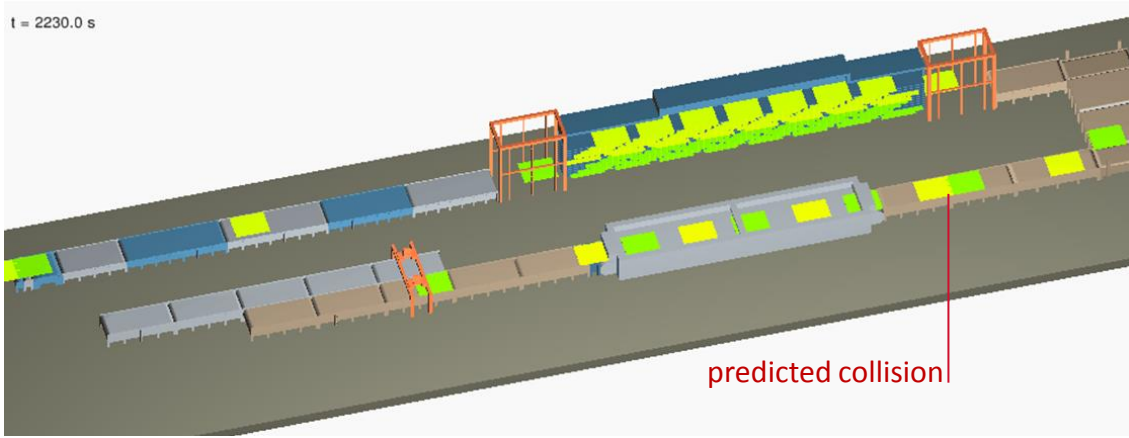




Pandas + Scikit-Learn + SHAP

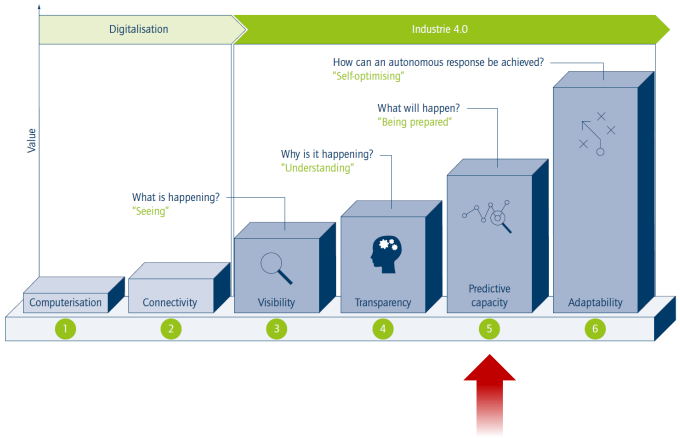
Predictive capacity

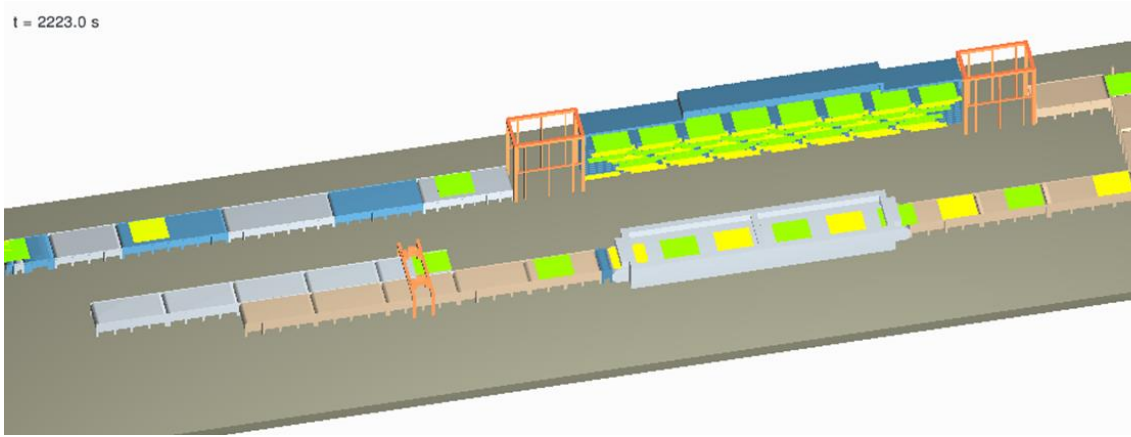




Pandas + simpy + visvis

Predictive capacity





Pandas + simpy + visvis + pulp

Takeaways

- Connectivity is the prerequisite
- Start with a diagnosis, identify opportunities and start small
- Build a project team : IT, data scientists and process experts
- Keep control of your data
- Avoid black boxes: the deliverable has to be the code

Thank you!

- Data scientist
- Dataviz / Virtual-Augmented Reality Eng.

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