






What we are expecting from this presentation:

A We want to inform you on the most important highlights from this topic 

B We need you to take the time to explore the presentation carefully and with a critical mind 

C We would like you to write down every comment or idea that emerges while reading this presentation 

D We exhort you to share with us a constructive feedback for further improvements 

E We invite you to dialog with us if you have any doubt or want to dive into some specific aspects 

Artificial Intelligence



Content

- Definition of Artificial Intelligence & today's scope
- Artificial Intelligence main triggers
- Artificial Intelligence as enabling technology
- Market Overview and expected grow
- Workforce required for Artificial Intelligence
- Artificial Intelligence on Automotive, Industrial Automation and Manufacturing sectors
- The Big Data Opportunity
- Takeaways & Main Conclusions

Artificial Intelligence is the branch of computer science dealing with the simulation of human-like behavior in computers

A useful definition of **Artificial Intelligence (AI)** is the theory and development of computer systems able to perform tasks that normally require human intelligence



- Exceeds human efficiency, but just in one specific function
- Requires of a training process
- Inspired by a brain architecture

AI Technologies

Current Applications

Machine Learning

- Improve by being exposed to data without an explicit algorithm
- Discover patterns in big amount of unstructured data

- Google's Deepmind learned from historic data and reduced energy consumption by 40% on cooling centers



Natural Language Processing

- The ability of computers to work with text the way humans do
- Extracting insights and generating grammatically correct text

- IBM Watson processed 200 M pages in 3 seconds for more precise medicine diagnosis



Speech Recognition

- Automatically and accurately transcribing human speech at a natural speed

- Personal Smart Assistant like Siri and Cortana could manage complete agenda through voice commands



Computer Vision

- Ability to identify objects, scenes, and activities in images
- Seeks to operate in unconstrained environments

- Facebook's facial recognition technology can recognize human faces within 98% accuracy



The digital disruption is being triggered by the unprecedented exponential growth on data availability around the world. A.I. is not a new concept, but nowadays opportunities seems well worth the effort

Why Now?

We need to think big, with a Digital Mind

- The world is changing faster every decade, coming generations are strongly dependent on Internet & electronics devices
- They are shaping the world to this dependency and have brought many trends with them. To be competitive, we should aim to this new digital world

Megatrends

Individualization

- Desire for customized products



Globalization

- International competitive production



New Work Schemes

- Transition from industrial to a knowledge society, new roles emerge



Connectivity

- Human and Machines are all organized within worldwide networks



Artificial Intelligence Triggers

Computing Power

- *4 million times* more processing power than the first single-chip microprocessor introduced in 1971



Big Data

- Major volume of data in the world as effect of the internet, social media, mobile devices and low cost sensors



The Cloud

- Made available the vast amounts of data and information to any Internet-connected device



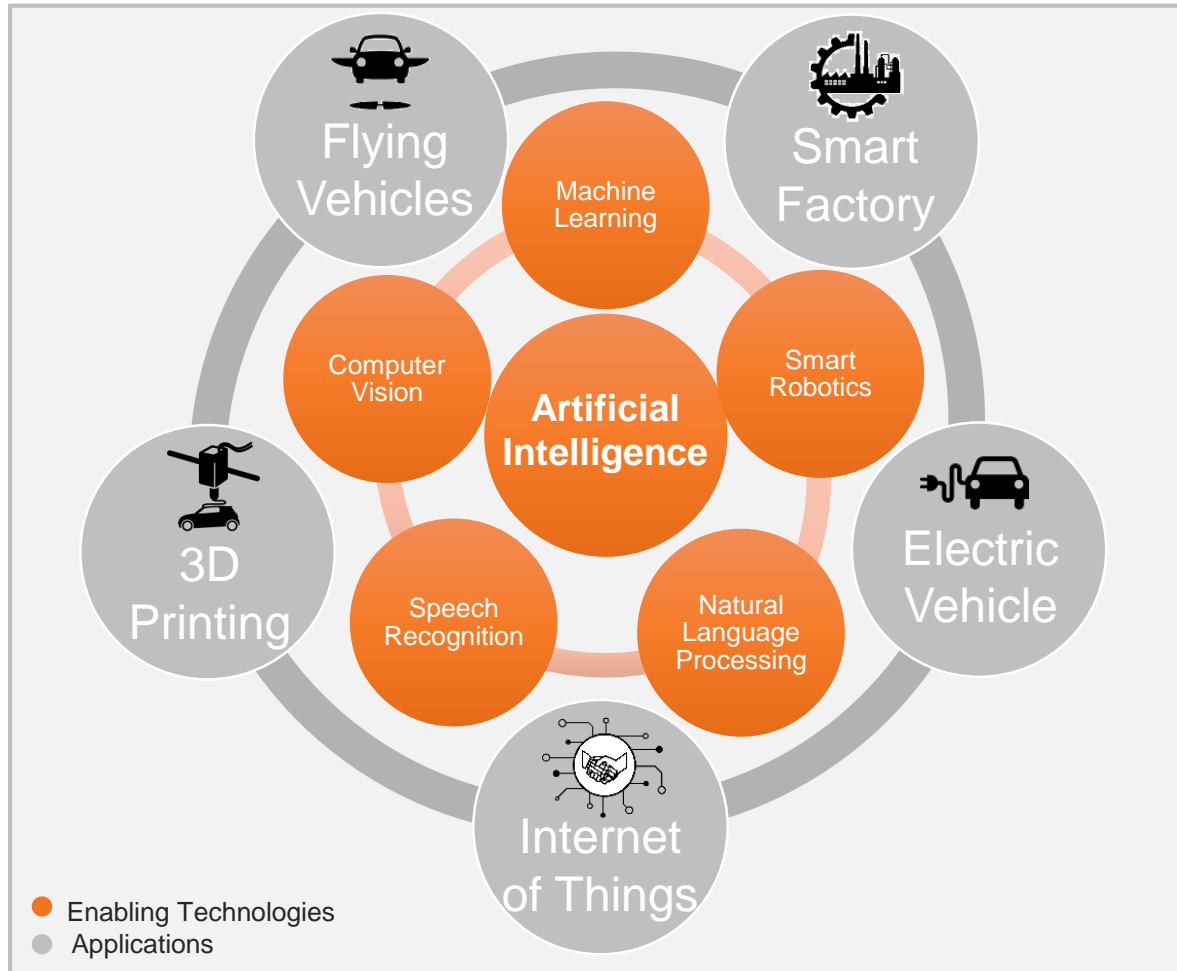
Open Source Model

- Algorithms available on an open-source basis which foster worldwide collaboration
- Provided the tools for a rapid grow of the Start-up ecosystem



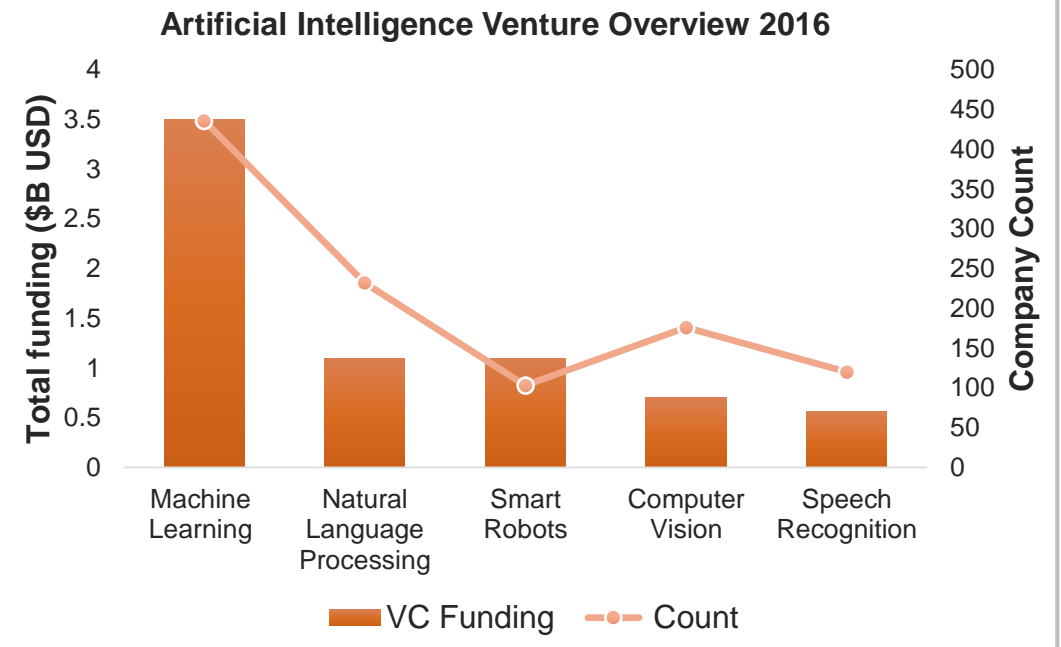
Artificial Intelligence may serve as an enabling instrument to many other disruptive technologies. Machine Learning and Smart Robotics development were the most supported technologies in 2016

Artificial Intelligence as Disruption Enabler



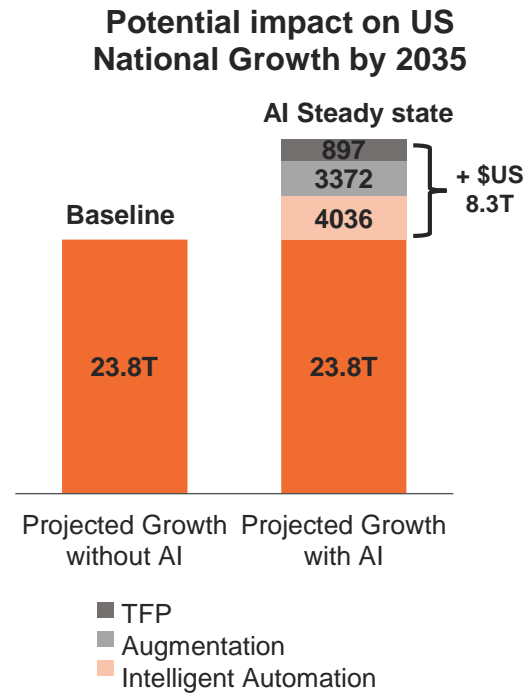
Most Supported Technologies

- From 2011 to 2015, annual US focused VC investments in AI startups has grown around 6x, from 70 to 400 startups
- Machine Learning-related categories accounts for 44% of all AI venture funding and 35% of total startup count in 2016
- Smart robotics overpass all categories in investment per company



Artificial Intelligence is expected to strongly impact USA growth by adding \$8.3T USD to its' 2035 expected baseline. Which effects will include: Automotive, Industrial Automation & Manufacturing

Artificial Intelligence diffusion into the economy will potentiate a remarkable difference on countries' national growth



- Steady state is considered once A.I. has reached at least 50% of its maximum potential
- On countries with high technology adoption rate, A.I.-related technologies may boost labor productivity up to 40%

How does AI benefit the economy?

Total Factor Productivity (TFP):

- Technologies enabling people to make more efficient use of their time



Augmentation:

- Not replacing, but reinforcing human abilities



Intelligent Automation:

- Automate beyond traditional constrained solutions



- Big players support their key segment by reinforcing adjacent sectors which correlate to their main expertise
- Only a few dozen companies in each industry is actively investing on AI-related technology; besides this small percentage, they are the biggest and the brightest players

| Companies | Automotive | Financial Services | Healthcare | Industrial Automation | Internet | Manufacturing | Software & IT |
|----------------------|------------|--------------------|------------|-----------------------|----------|---------------|---------------|
| ABB | ✓ | | | ✓ | | ✓ | ✓ |
| BOSCH | ✓ | | ✓ | ✓ | | ✓ | |
| SIEMENS | ✓ | ✓ | ✓ | ✓ | | | ✓ |
| Ford | ✓ | | | | | ✓ | |
| Google | ✓ | ✓ | ✓ | | ✓ | | ✓ |
| IBM | | ✓ | ✓ | | ✓ | ✓ | ✓ |
| Goldman Sachs | | ✓ | | | ✓ | | ✓ |

*GVA = GDP + subsidies on products – taxes on products

Important companies such as Bosch and Ford have deployed an investing strategy to outsource the back-end development. Talent is scarce and Startups represent an optimal approach to probe new concepts

Automotive

Artificial intelligence may be a key player on the development of autonomous vehicles and in the migration to electric cars

Ford Smart Mobility LLC



- Created in 2016 to focus on design, build and invest in emerging mobility services
- Aims to develop truly Autonomous Vehicles by 2021

Invested on:



- LiDAR 3D mapping visualization for autonomous vehicles
- Unlike Google and Apple, whose approach is through fleets of sensors, Civil Maps will provide Ford with the software and algorithms ready to embed on their vehicles

Industrial Automation

The companies providing services for industrial automation may benefit with the technologies powered by Artificial Intelligence

ABB Technology Ventures



- Invested over \$150 M USD into leading industrial technology
- Could employ vicarious to add value to their robotics and automation systems

Invested on:



- Focused on visual perception problems such as recognition, segmentation, and scene parsing
- Requires less training data than traditional machine learning techniques

Manufacturing

Flexible manufacturing requires of collecting big data banks and robotized production lines, which could rapidly adapt to any unexpected change

Bosch Centre for Artificial Intelligence (BCAI)



- Ranked top 13 smartest AI companies by MIT Technology Review
- Investing €300 M in BCAI, prognoses Artificial Intelligence as key role in manufacturing within 10 years

Invested on:



- Development of navigation systems for autonomous robotics
- Reliable localization of the robot position
- Flexible response to changes in the surroundings

Software is driving the core development of Artificial Intelligence platforms, which is being powered by companies like Google, Microsoft & Facebook. A shortage of talent is expected in the coming years

Artificial Intelligence Developers

The developers in charge of Artificial Intelligence improvement at major companies such as Google and IBM have a certain profile:

Research Scientist

- PhD in machine learning, physics, neuroscience, computer science or similar

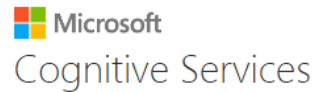
Research Engineers

- Strong math, statistics and programming experience, ideally Lua or Python

Software Engineers

- Experience in C/C++ and ideally experience with Lua or Python

Top Developers



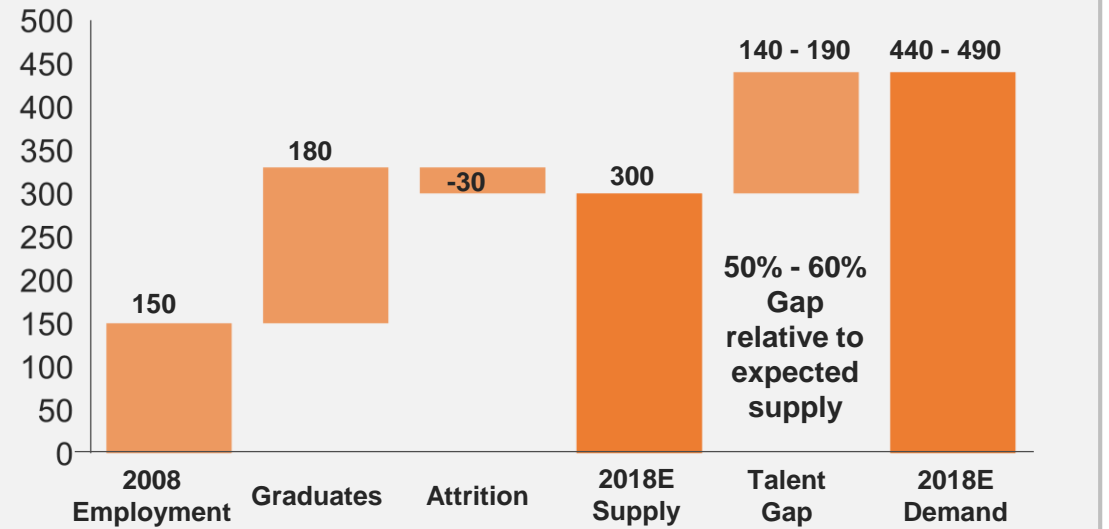
These are hard to find talent, making it complex to build AI core competencies from the ground up. We believe big tech companies with the budget and expertise to invest on state-of-the-art research are and will continue to drive these core AI technologies also called general AI tech

Talent Acquisition Forecast

Trying to acquire new specialized talent may not be a smart strategy:

- Demand may surpass supply by more than half in a short term
- Talent costs may double and the top developer companies may attract most of them
- Remaining talent may be low-quality and high-costly

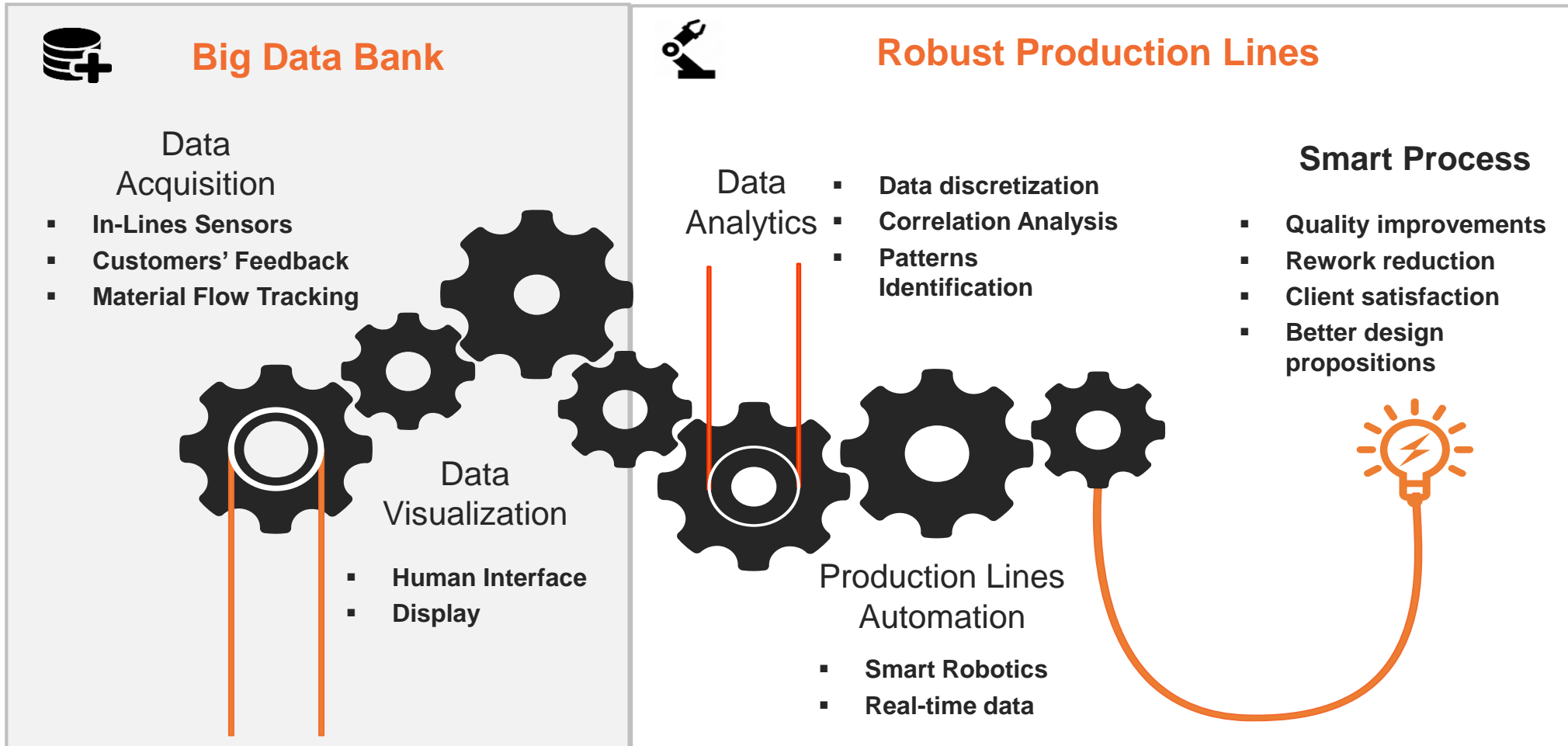
Supply and demand of Artificial Intelligence analytical talent by 2018 in the USA*



*Thousand People

Need to migrate from traditional production lines into smart processes

This transformation process demands serial steps, starting by acquiring data and building a Data Bank, transforming that Big Data into Smart Data through Analytics and automating the production lines based on the insights produced





Big Data is the first step to achieve more robust production lines. Not every data set is valuable, if we want to discretize, filling the reserves with measurable information is essential

Big Data

- Popularized in 2008 as a key point on the transformation of activities on companies and government
- Nowadays it refers to either volume and variety of data sets transmitted at a real time velocity

Why is it important?

- World generates around 2.5 M terabytes of data per day
- 90% of the world's data was created in the last two years
- This is unstructured data, which would take a person decades to analyze and discretize

The Industrial Big Data

- Same concept, but focused on finding the physical root causes behind the processes
- It favors completeness over volume, synchronizing data coming from different working conditions
- Data integrity is vital, low-quality data may alter outcomes



First step into Artificial Intelligence

We have realized that in the manufacturing industry, thousand of variables are related. We need to acquire and store their information in order to aim truly achievable goals for the company

We suggest to start with the following approach:

Tracking the whole value chain

- | | |
|-------------------------|--|
| 1. Raw Material | <ul style="list-style-type: none"> ▪ Material Quality ▪ Delayed Material ▪ Delivery process |
| 2. Process Flow | <ul style="list-style-type: none"> ▪ Common Failures & Possible causes ▪ Maintenance Issues ▪ Product Quality Control |
| 3. Final Product | <ul style="list-style-type: none"> ▪ Customer Metrics Satisfaction ▪ Delayed & damaged product deliveries |

It is important to connect the dots along the manufacturing value chain and understand how everything is related, from raw material through production into the final delivery





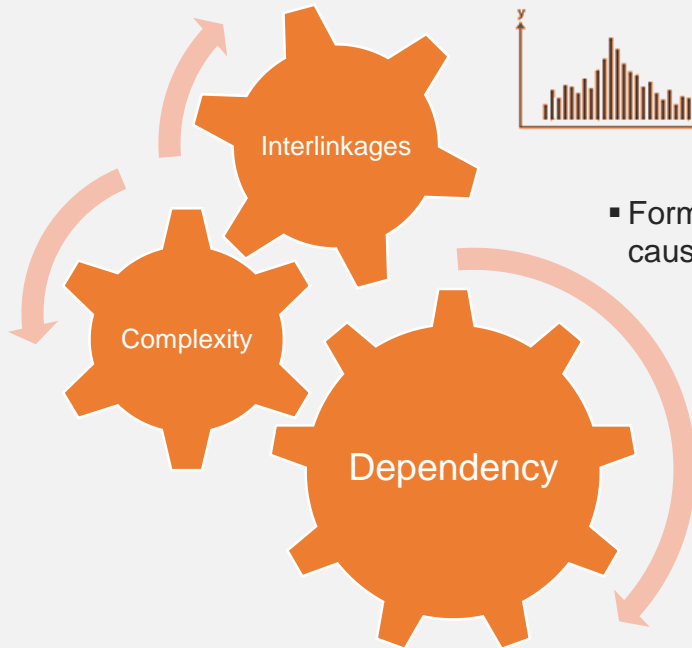
Once big data has been achieved, it has to be processed. The next step for a more robust production line should be Advanced Analytics, which would discretize the data obtained to apply it into manufacturing


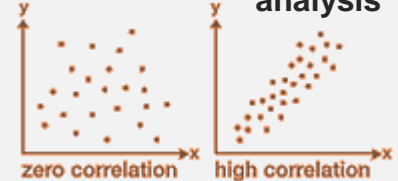
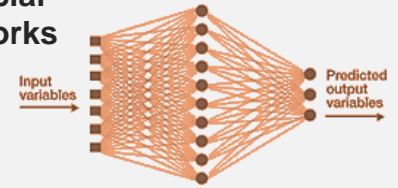
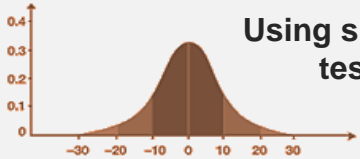
What is Advanced Analytics?

- The application of visualization, statistics and predictive tools to industrial data in order to assess and improve practices

How is it employed?

- More granular approach to diagnosing and correcting process flaws
- Deep dive into historical process data, identify patterns and relationships among discrete process, and then optimize the factors that prove to have the greatest effect on yield
- The critical first step for manufacturers that want to use advanced analytics is to consider how much data the company has at its disposal

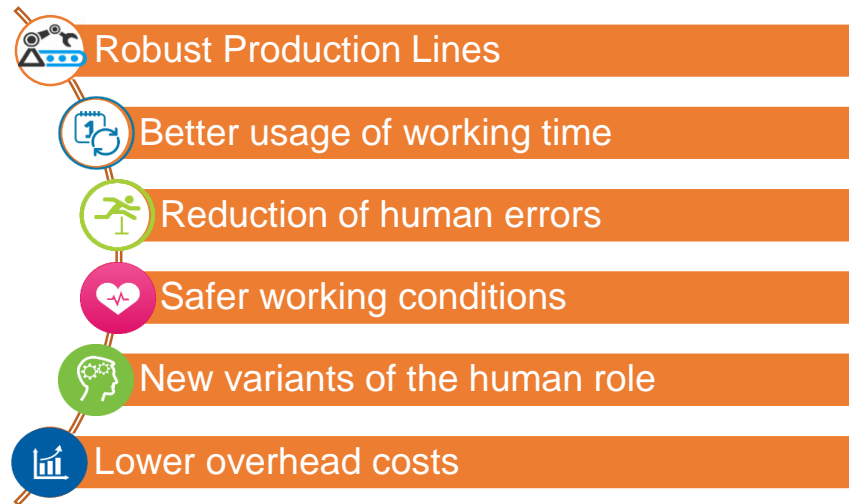






- Identify initial patterns to prioritize data collection & analysis
 - Using data visualizations**
 - 
- Form an initial hypothesis about root causes of yield drop and variability
 - Using correlation analysis**
 - 
- Model complex processes to quantify the impact
 - Using artificial neural networks**
 - 
- Test initial hypothesis, focus on the most statically significant factors
 - Using significant testing**
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There are many front-end applications offered by Artificial Intelligence, one possibility is to migrate into more Robust Production Lines which depends on the Automation of processes through many technologies

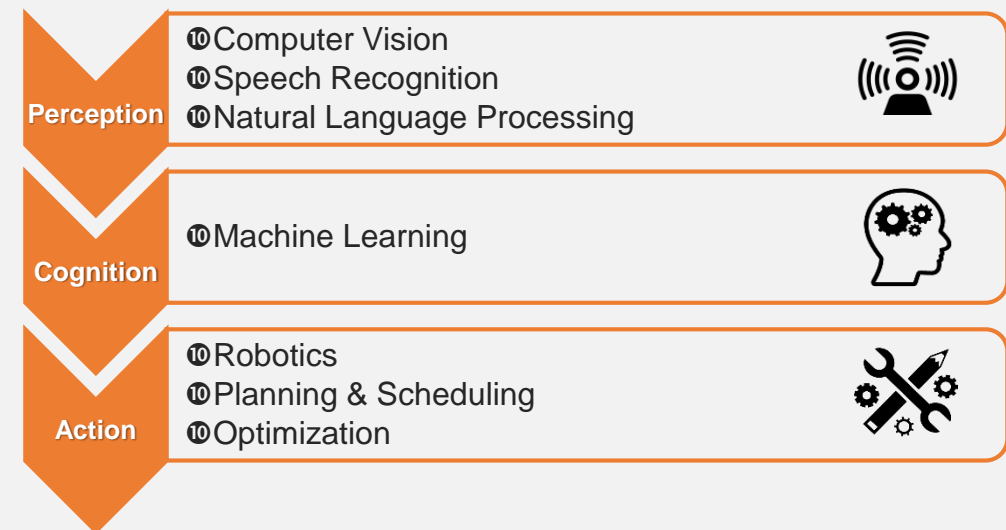
Front-End Applications

- Artificial Intelligence offers a wide range of front-end applications, we suggest to start by migrating into more robust production lines
- A robust production line should be able to modify in-line specifications according to the advanced analytics applied to big data sets
- It consists of a smart assembly process, able to identify quality issues and implement strategies to reduce the rework needed



In a smart process more than just one technology may be needed

- There are different approaches to collect information and to implement the actions, each process would have a specific configuration
- There is only one way to process such data: machine learning through neural networks



High-level technology integration is required to migrate from actual production lines into robust lines, which would lead to less rework

Artificial Intelligence already has a remarkable position as an enabler for major disruptive technologies

Takeaways

| | |
|---|--|
| ▪ Nowadays merging point between: processing power, big data and the cloud have opened the gate to start taking AI in consideration | |
| ▪ Artificial Intelligence may be seen as a technology enabler due its strong influence on many other disruptive trends | |
| ▪ Current Artificial Intelligence applications are narrowed to one specific function and may not be as flexible as human in a near term | |
| ▪ Artificial Intelligence potential may not reside on replacing labor force, but on augmenting human's productivity | |
| ▪ Specialized talent is scarce, strategic partnerships may be needed to fully integrate AI in a manufacturing company | |

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