O Futuro da Indústria no Brasil: reflexões frente às grandes transformações globais.

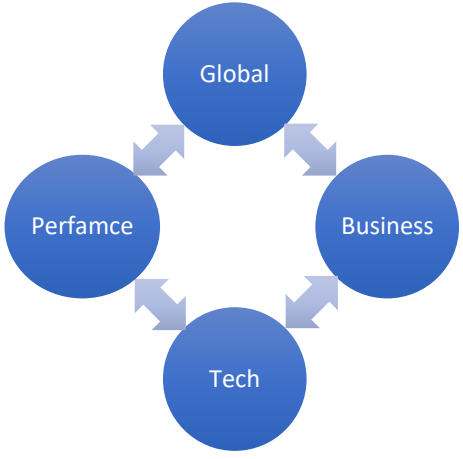
João Fernando Gomes de Oliveira

FFHC, Maio 2018

Agenda:

Main Drivers for a new Industrial world

work in the future: more expertise and less skills



- Materials and sustainability drivers
  - Basic materials issues
  - Push for sustainability
- Technological drivers
  - Car electrification
  - Advanced Manufacturing Processes
  - New materials and light structures
  - Sustainable Energy Systems
  - IOT
- Business drivers
  - Monitoring customer needs and product performance via sensors and smartphone
  - New business models and Product Service Systems
- Performance drivers and industry 4.0
  - Productivity, Automation, big data

Industry 4.0 in Brazil?

Summary

The Commodities Market is now Schizophrenic!

McKinsey's global head bullish on commodities

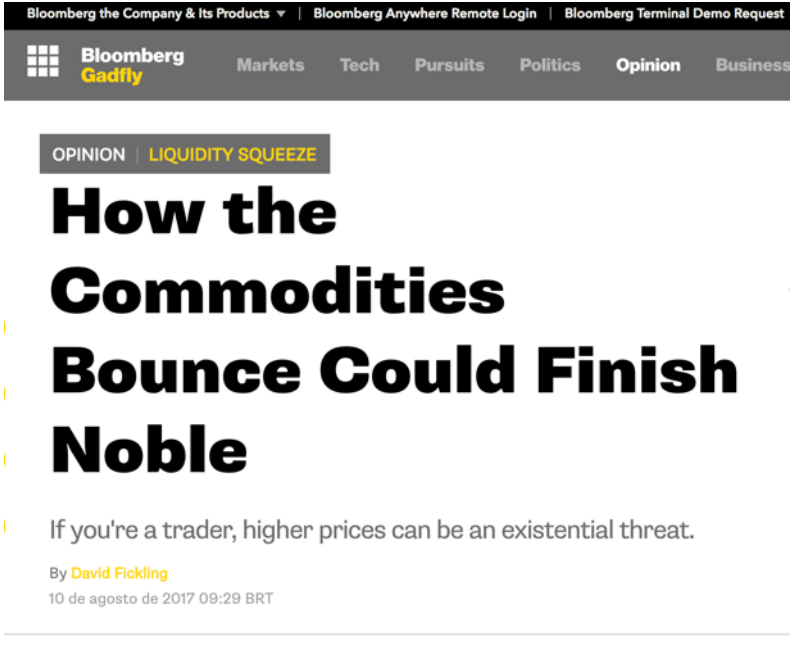
Dominic Barton says Copper and oil demand to be fuelled by 2.4b new consumers

Published: 17:44 May 14, 2017
Ed Clowes, Staff Reporter

GULF NEWS

+MGN

Dubai: The world will see 2.4 billion new middle class consumers come online in the next 15 years, according to McKinsey & Co's most senior executive.



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OPINION | LIQUIDITY SQUEEZE

How the Commodities Bounce Could Finish Noble

If you're a trader, higher prices can be an existential threat.

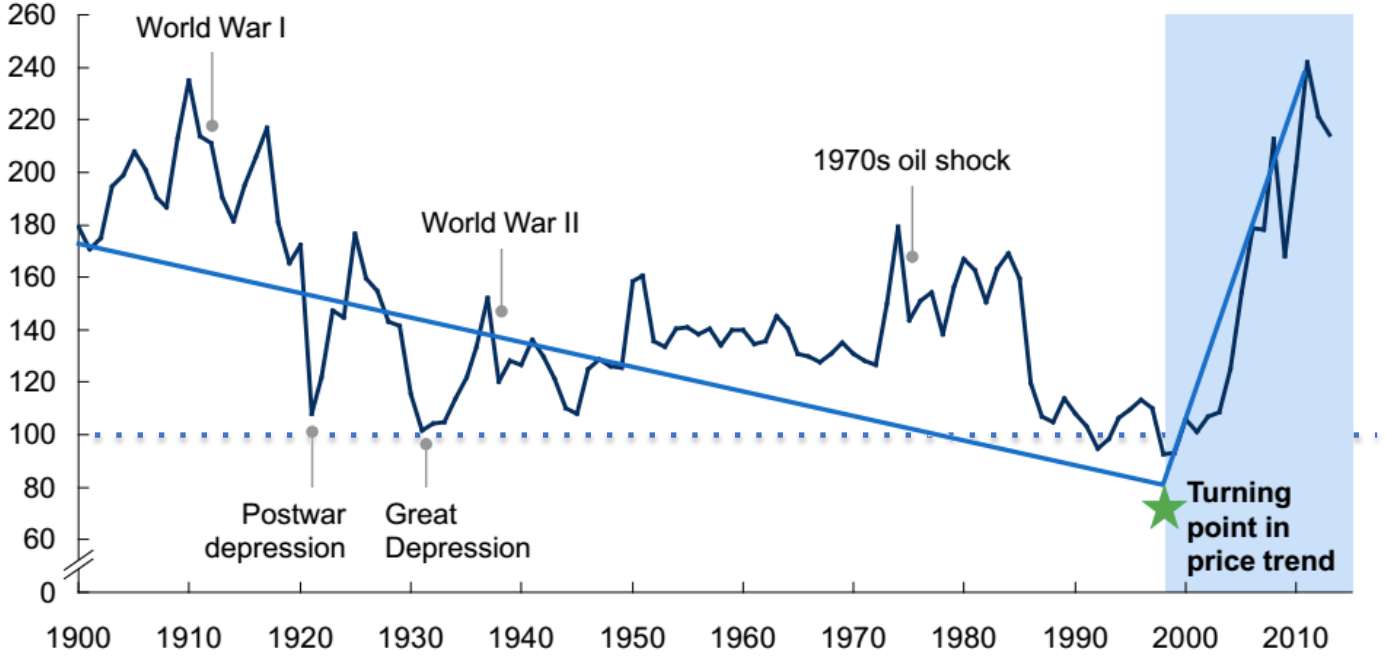
By David Fickling
10 de agosto de 2017 09:29 BRT

Why? Due to four main aspects:

- Increasing demand expectation
- Price turning point
- Bouncing effect
- Unstable regional differences

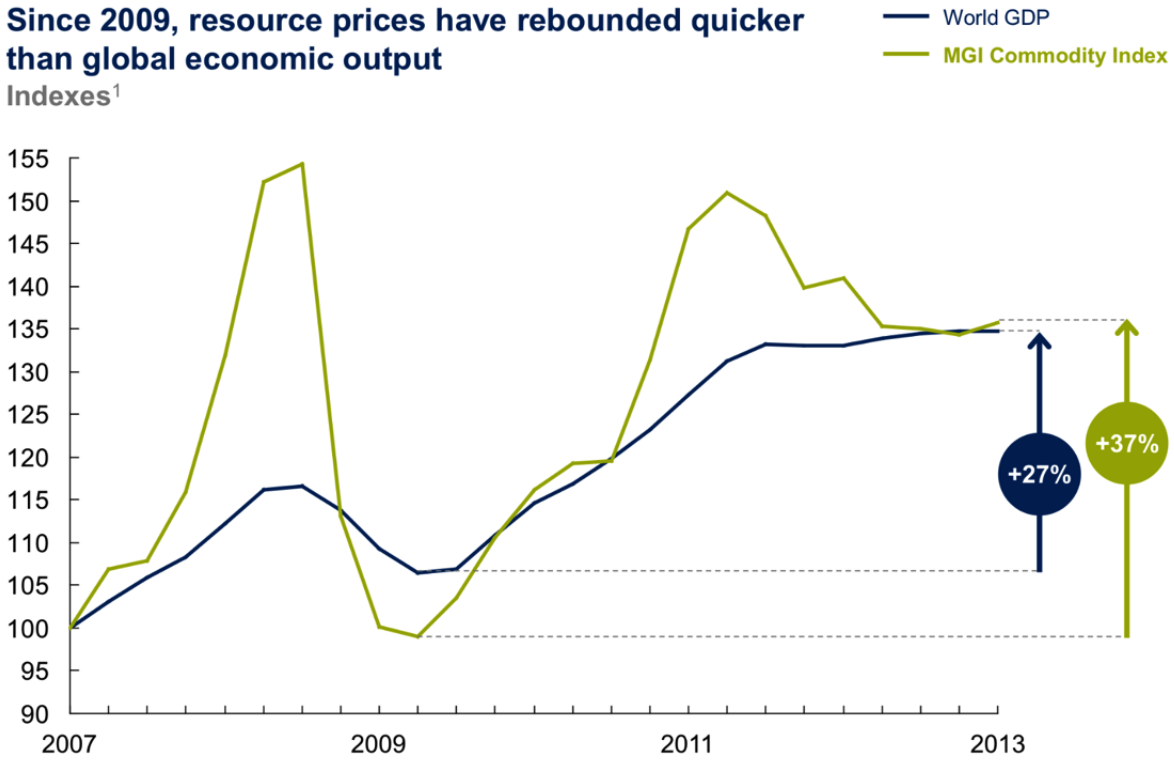
Raw materials are going through an average price rise

McKinsey Commodity Price Index[1]
Real price index: 100 = years 1999–2001[2]



1 Based on arithmetic average of four commodity sub-indexes: food, non-food agricultural raw materials, metals, and energy.
2 Data for 2013 are calculated based on average of the first three months of 2013.
SOURCE: Grilli and Yang; Pfaffenzeller; World Bank; International Monetary Fund; Organisation for Economic Co-operation and Development statistics; Food and Agriculture Organization of the United Nations; UN Comtrade; McKinsey Global Institute analysis

The bouncing effect is here to stay

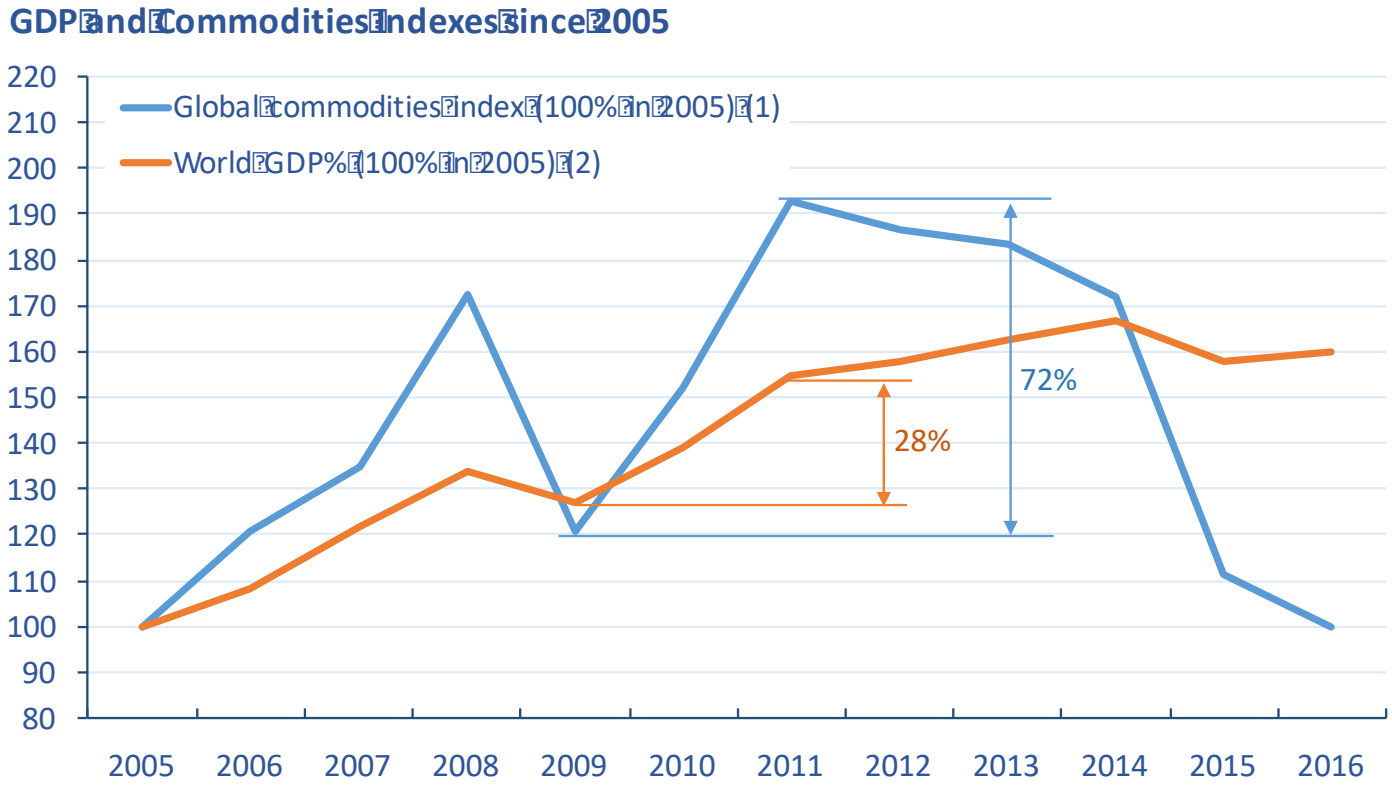


1 Nominal data indexed to 1Q2007.

SOURCE: Oxford Economics; World Bank; International Monetary Fund; Organisation for Economic Co-operation and Development; Food and Agriculture Organization of the United Nations; UN Comtrade; McKinsey Global Institute analysis

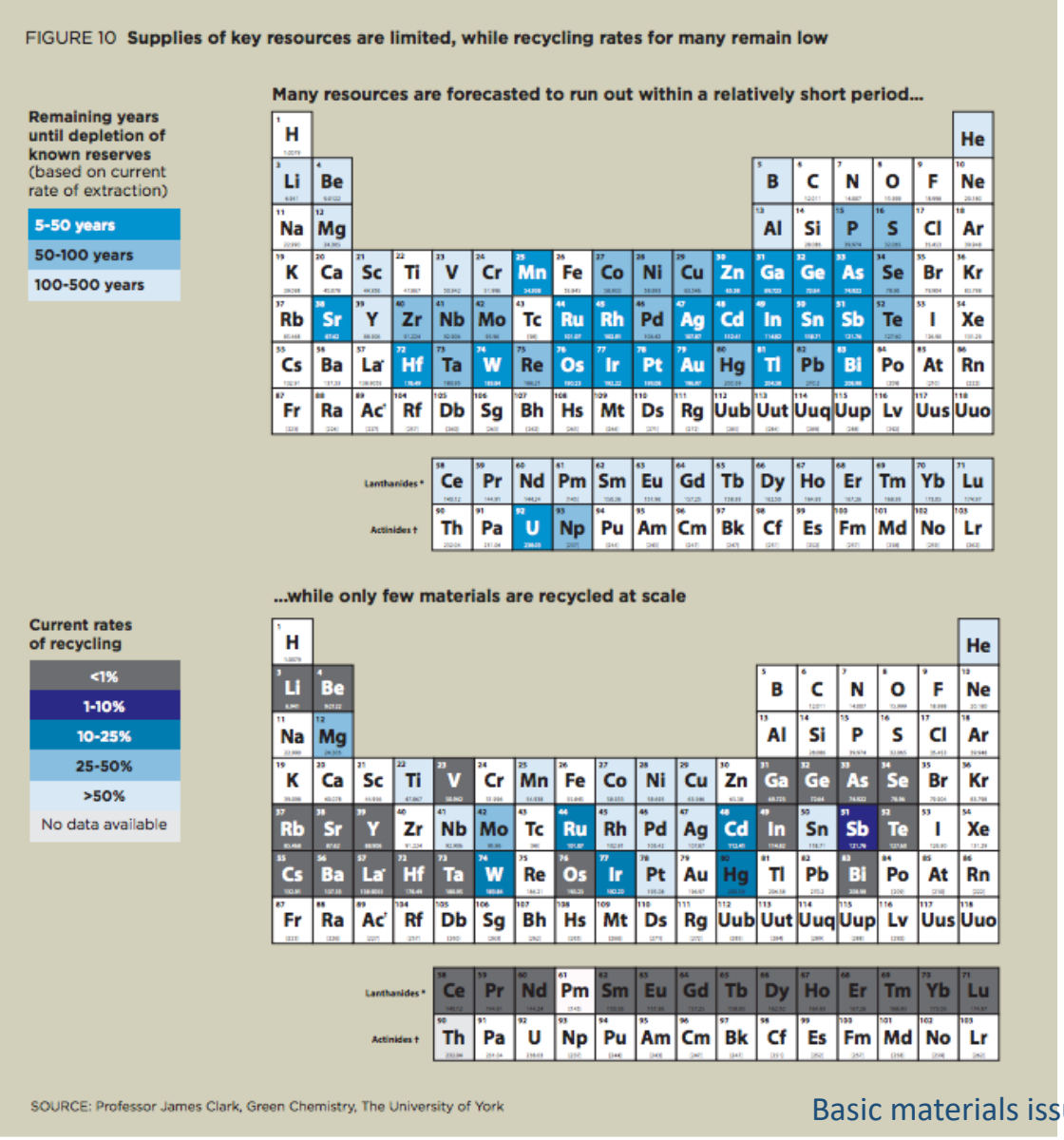
The Bouncing effect

global prices rebound are quicker than global output

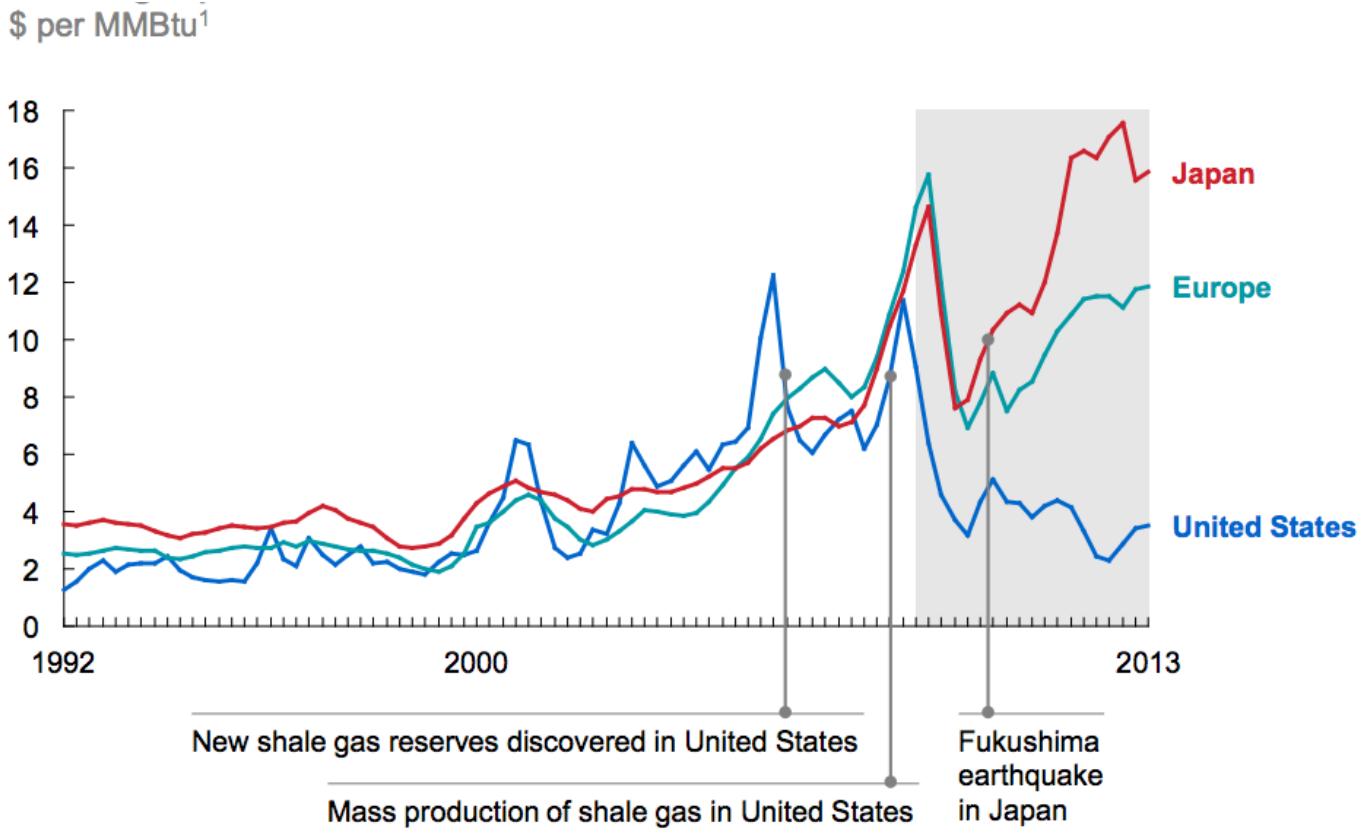


Sources: (1) IMF Primary Commodity Prices @: http://www.imf.org/external/np/res/commod/index.aspx
(2) The World Bank national accounts data @: https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?end=2016&start=2007

Key resources are limited and recycling rates are still low for many elements – this could **partially explain the bouncing effect** and the need of new business models.



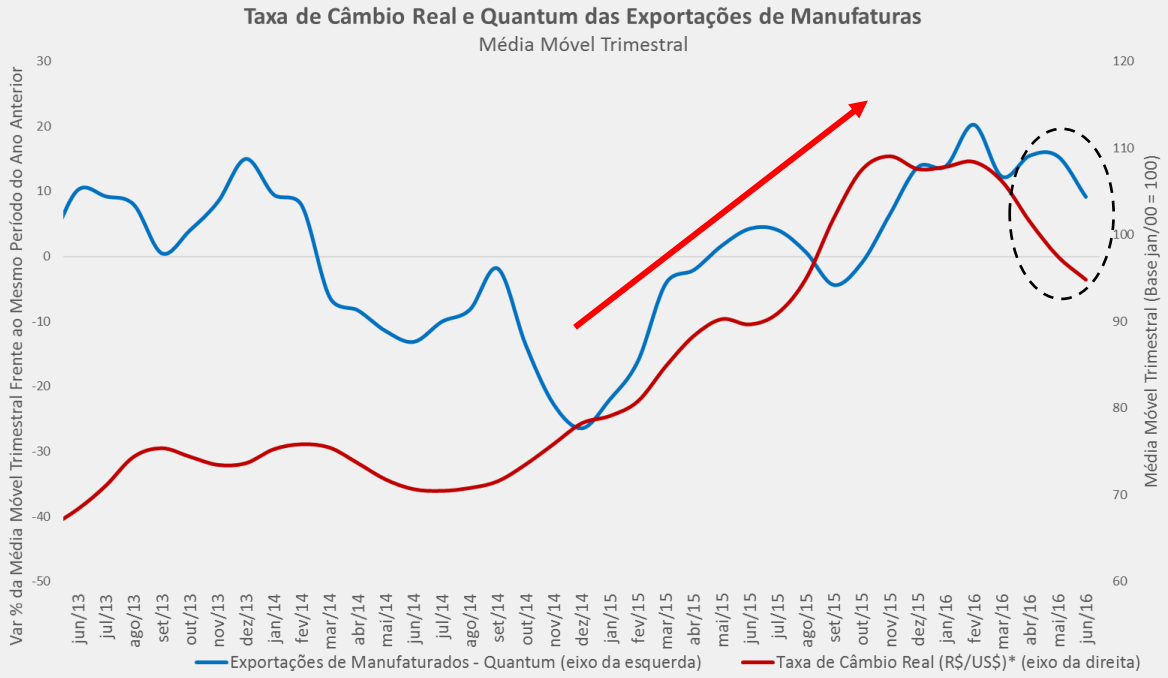
Regional dispersion is faster and more unpredictable



1 Measure for natural gas volume: MMBtu = million British thermal units. Price shown in nominal terms.

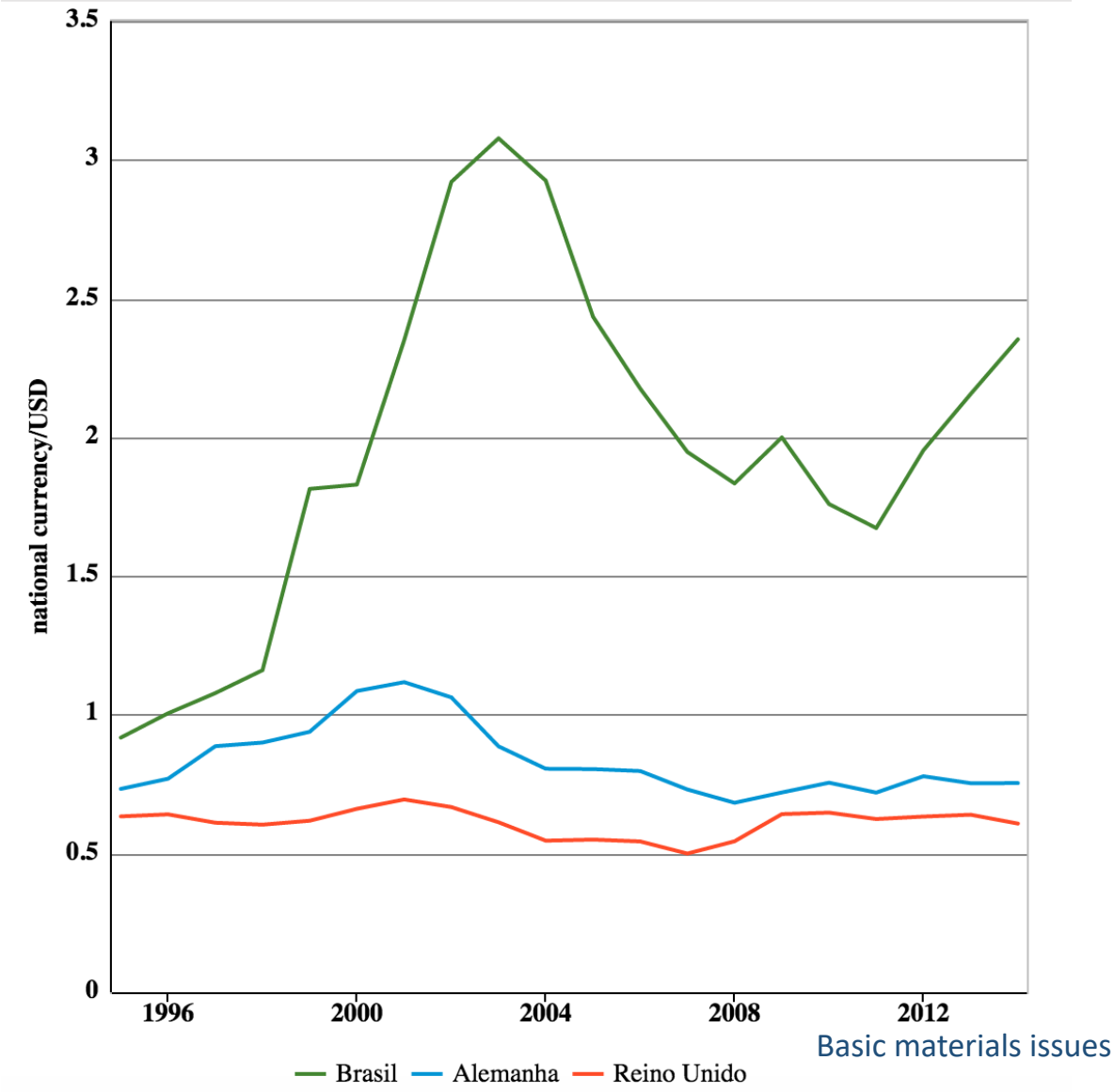
SOURCE: World Bank; International Monetary Fund; United Nations Conference on Trade and Development; UN Comtrade; McKinsey Global Institute analysis

O Desempenho da Industria Brasileira depende do Câmbio

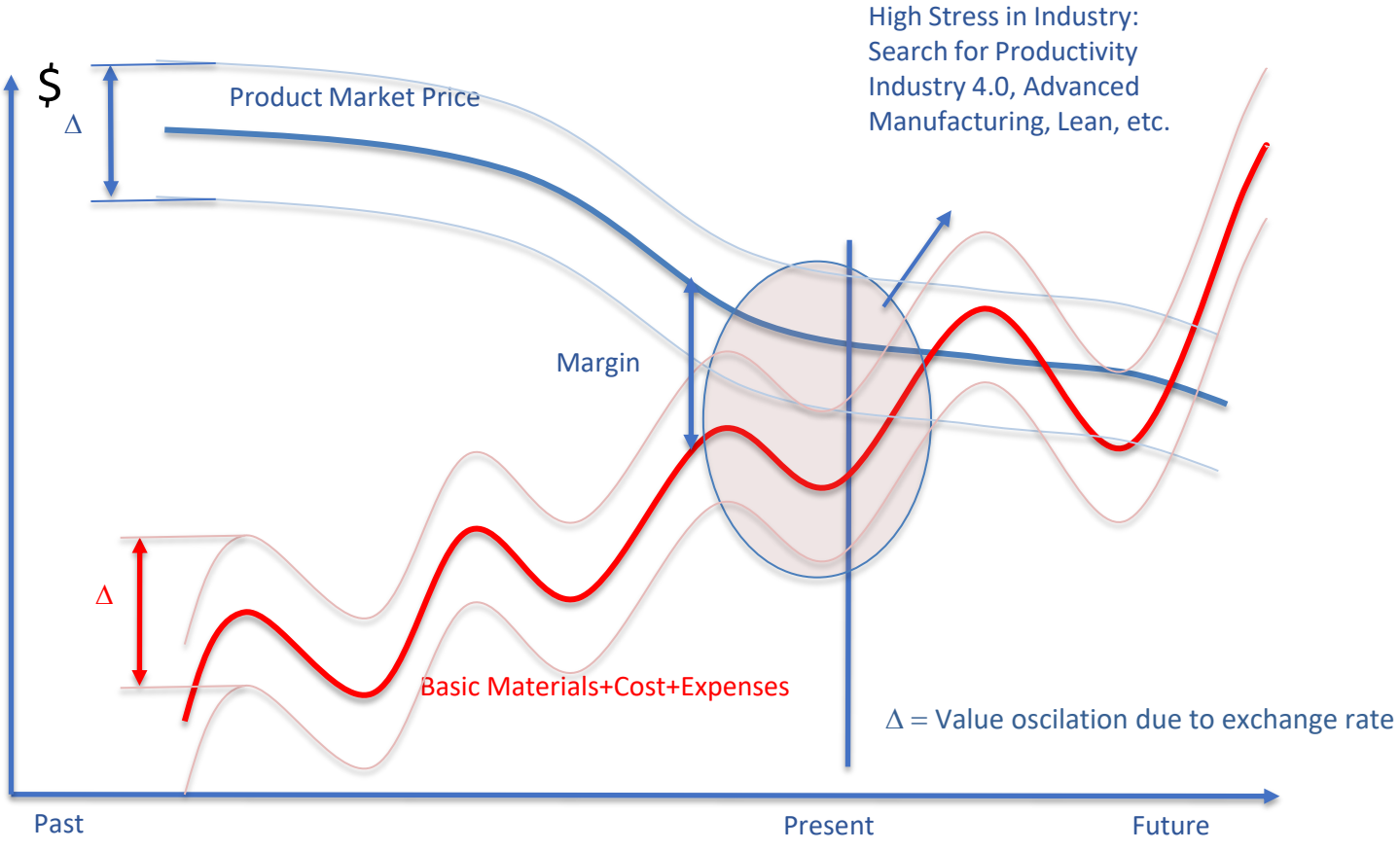


Fonte: Banco Central do Brasil e FUNCEX. * Taxa de Câmbio deflacionada pelo IPCA.

Mas nosso câmbio varia MUITO!



Manufacturing Industry is getting into a quite critical moment



Basic materials issues

The problem with renewables

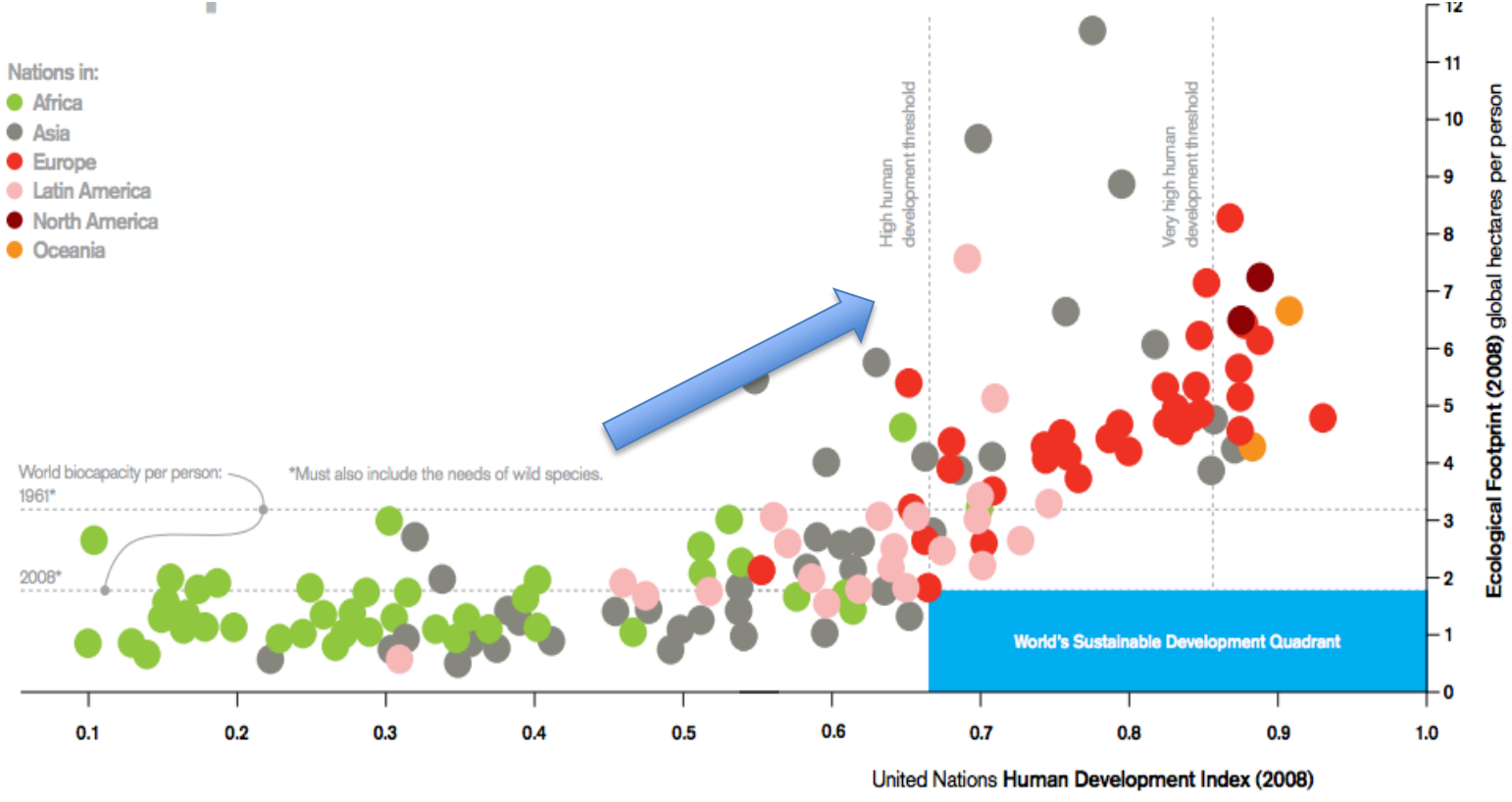
- There were ~ 12 billion hectares of biologically productive land and water on Earth in 2011
- Population of Planet: 7 billion people

Eco Footprint: 12/7 =1.71 hec/person

But today the world uses 2.2 hec/person!!

Source: http://www.footprintnetwork.org/

Correlation between HDI and Eco Footprint



Source: http://www.footprintnetwork.org/

Commodities bouncing effect (CBE) and environmental pressures (EP) influencing the future of Industry.

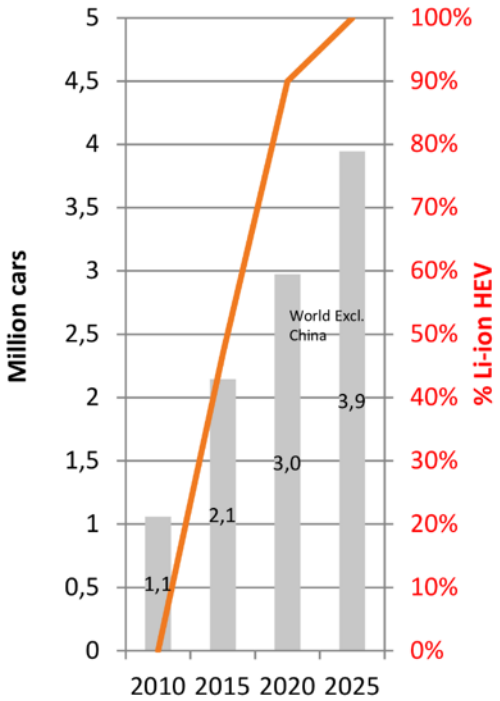
- CBE - **Higher risk in manufacturing investments** that are highly dependent on unstable basic materials, less capital intensive business investments in this kind of manufacturing plants.
- EP - **Regulations for the improvement of environmental performance should keep increasing** globally and require adequate response from industry.
- CBE + EB – **increasing product performance and lifetime**, circular economy, recycling, reuse, remanufacturing. More disassembly businesses.
- CBE + EB – **New business models** will naturally show more acceptance and financial results bringing value to both customer and supplier
- CBE + EB – Product Service Systems will **require more intelligent products with sensors and connectivity** (more IOT systems)

Impacts in the Future of Industry – Part 1

- **General Impacts**
  - Increasing customer concerns with residues disposal.
  - New business models should come with product as a service and longer life products.
  - More disassembly, remanufacturing and recycling business.
- **Impacts on Industrial employment:**
  - Solutions for **supporting clients activities on disassembly, remanufacturing and recycling should bring new job opportunities.**
  - New **business models** (more later) should increase jobs on services until robots may do it.

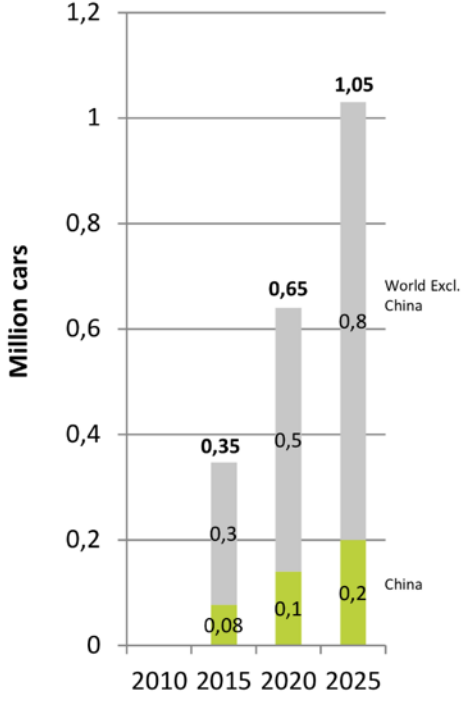
HEV, P-HEV, EV 2025 FORECASTS

HEV manufactured



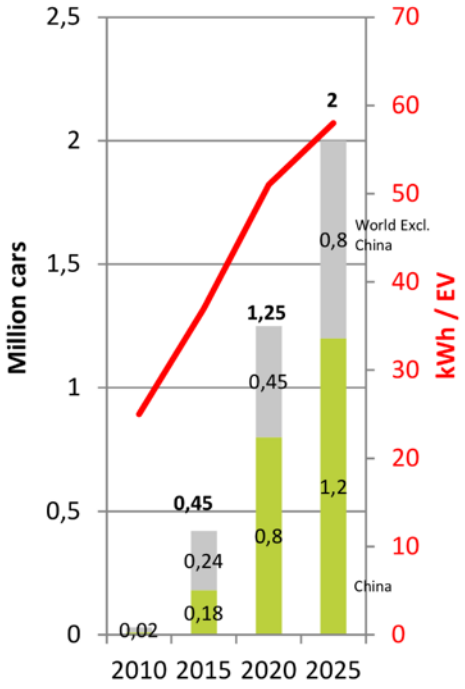
HEV: 1kWh battery / car

PHEV manufactured



PHEV: 12 kWh battery / car

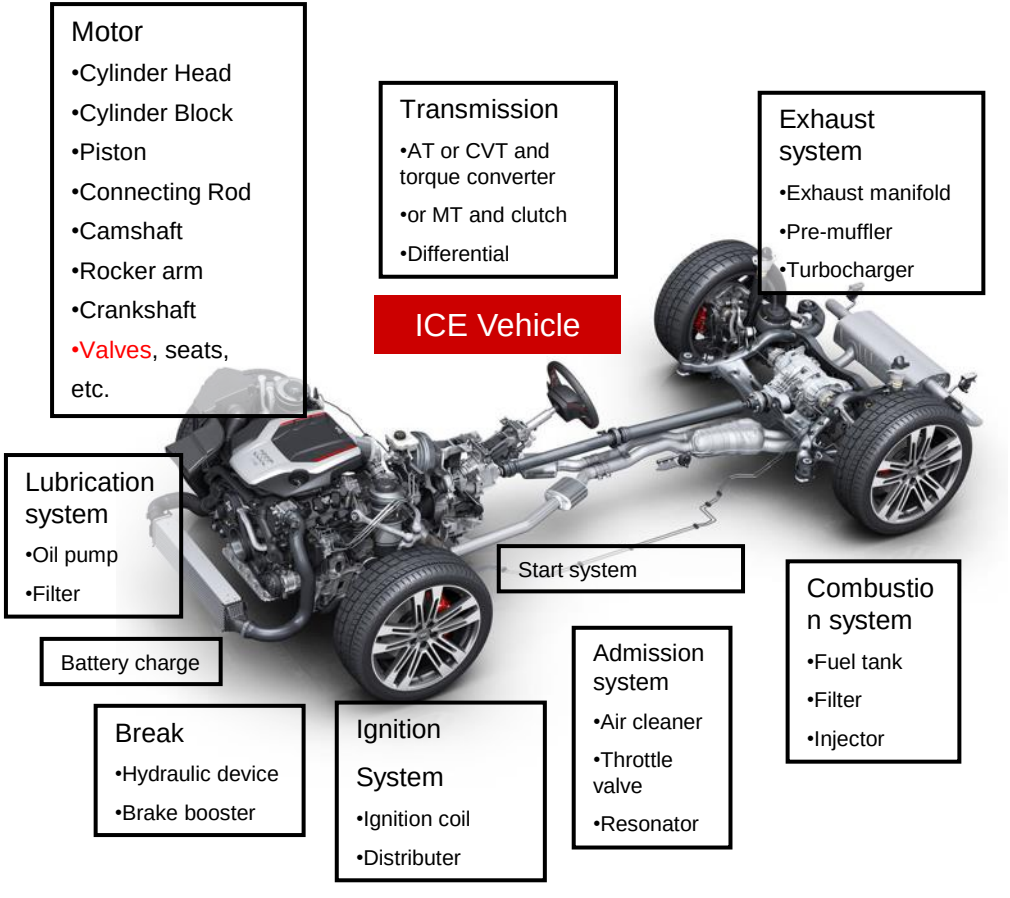
EV manufactured

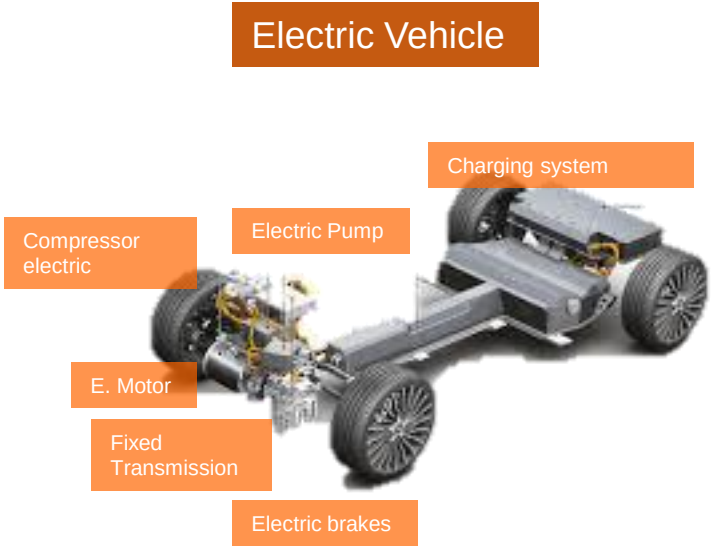


The simplicity of Electric Propulsion

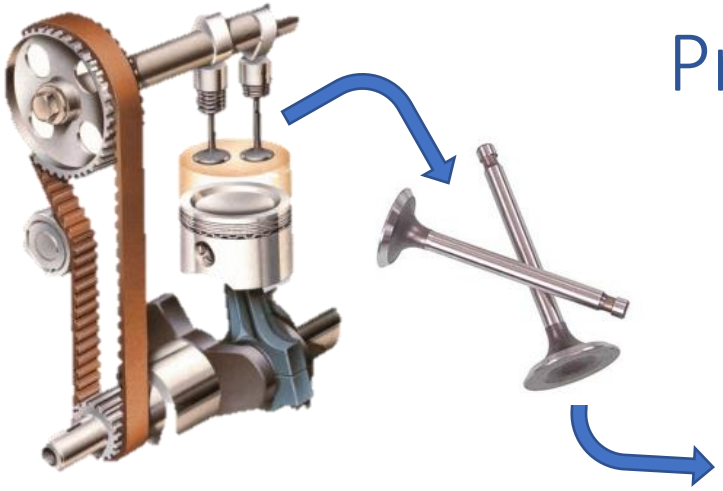
Number de Parts (power train):

Combustion power train･･･10,000 to 30,000 → **Electric･･･around 200**





Car electrification



Production of ICE valves and the use of abrasives

Typical Engine Valve Production Line:

- 1 forging press
- 1 friction welding+turning
- 1 cutoff (abrasive)
- 1 plasma deposition equipment
- 1 double disk grinder (abrasive)
- 2 profile grinders (abrasive)
- 1 form grinder (abrasive)
- 3 center-less grinders (abrasive)
- 1 seat grinder (abrasive)
- 1 abrasive belt finishing (abrasive)

High-mix low volume line (Fujisawa plant)

New coming drivers

- **Chinese new economy:**
  - no longer infrastructure-driven,
  - based on new tech,
  - low environmental impact.
- E-buses are priority from now (all buses in China should be electric): Shenzhen have already 16k e-buses.
- 5% of EV production share in 2020 and 30% in 2030.
- China wants to be ”The Driver” in the EV business
- New EV production predictions are always bullish

Evs Impacting in the Future of Industry – Part 2

- **General Impacts:**
  - **Less investments on traditional** manufacturing infrastructure.
  - **More new players** producing EVs
  - Market should still (up to 2030) need **high performance on hybrid cars**, so development of optimized components still have space in the next 10 years.
  - **Newer components related to EV's**, such as: magnets, e-motor shafts, stators, e-brake systems, tooling for battery manufacturing, foils, electrodes, machines, etc.
- **Impacts on Industrial Profile and Employment:**
  - Progressively **less jobs in traditional auto manufacturing** after 2020. Expansion should be focused on EVs and more easily automated.
  - Growing need for engineering R&D work on product and process **solutions towards new increased final product performance** on HEV AND EV'S, such as: battery components, E-motors, E-brakes and some systems (battery cooling, air conditioning, etc).
  - **New business models for the newer EV business should win (pay per service). EV's are 5-10 times cheaper in $/mile**
  - **Autonomous cars should take much longer than EVs to spread since the challenges are way bigger.**

Additive Manufacturing should enable the production of components for optimized performance

Processes	Materials	Application
SLM (Selective Laser Melting)	Stainless steel316L e 17-4PH; H13 tool steel; Aluminium Al-Si-12 e Al-Si-10; Titanium CP, Ti-6Al-4V e Ti-4Al-7Nb; Cobalt-chrome ASTM75; Inconel 718 e 625	implants; aerospace parts; engine parts; heat exchangers; molds.
DMLS (Direct Metal Laser Sintering)	Aluminium Al-Si-10Mg; Cobalt-chrome MP1 e SP2; Maraging Steel; Inconel 718 e 625; Stainless steel 17-4PH e 15-5PH; Titanium Ti-6Al-4V	implants; aerospace parts; engine parts; heat exchangers; molds.
EBM (Electrical Beam Melting)	Cobalt-chrome ASTM F75; Titanium Ti-6Al-4V, Grade 2;	implants; aerospace parts; engine parts; heat exchangers; molds.
PLS (Plastic Laser Sintering)	Alumide; Carbon Fibre; PA 1101; PA2200/2201; PA 2221; PA2202; PA 2210; PA3200; PAEK; Polyestyrene	implants; aerospace parts; engine parts; heat exchangers; molds.

source: Renishaw; Advanced manufacturing services; EOS; ARCAM

Some of the technologies available for AM

Process	Manufacturer	Principle	Price(US$)
SLM (Selective Laser Melting)	RENISHAW REALIZER SLM Selective Laser Melting 	Fusion of powder layer using laser	~US$ 1 Mi
DMLS (Direct Metal Laser Sintering)	CONCEPTLASER hofmann innovation group eos e-Manufacturing Solutions 	Sintering of powder using laser	~US$ 300k to US$ 1Mi
EBM (Electrical Beam Melting)	CAD TO METAL arcam Arcam AB 	Fusion of powder layer using electric arc	~ US$ 800k
PLS (Plastic Laser Sintering)	RENISHAW eos e-Manufacturing Solutions 	Plastic powder sintering using laser	~ US$ 250k a US$ 800k

However AM will not provide finished parts

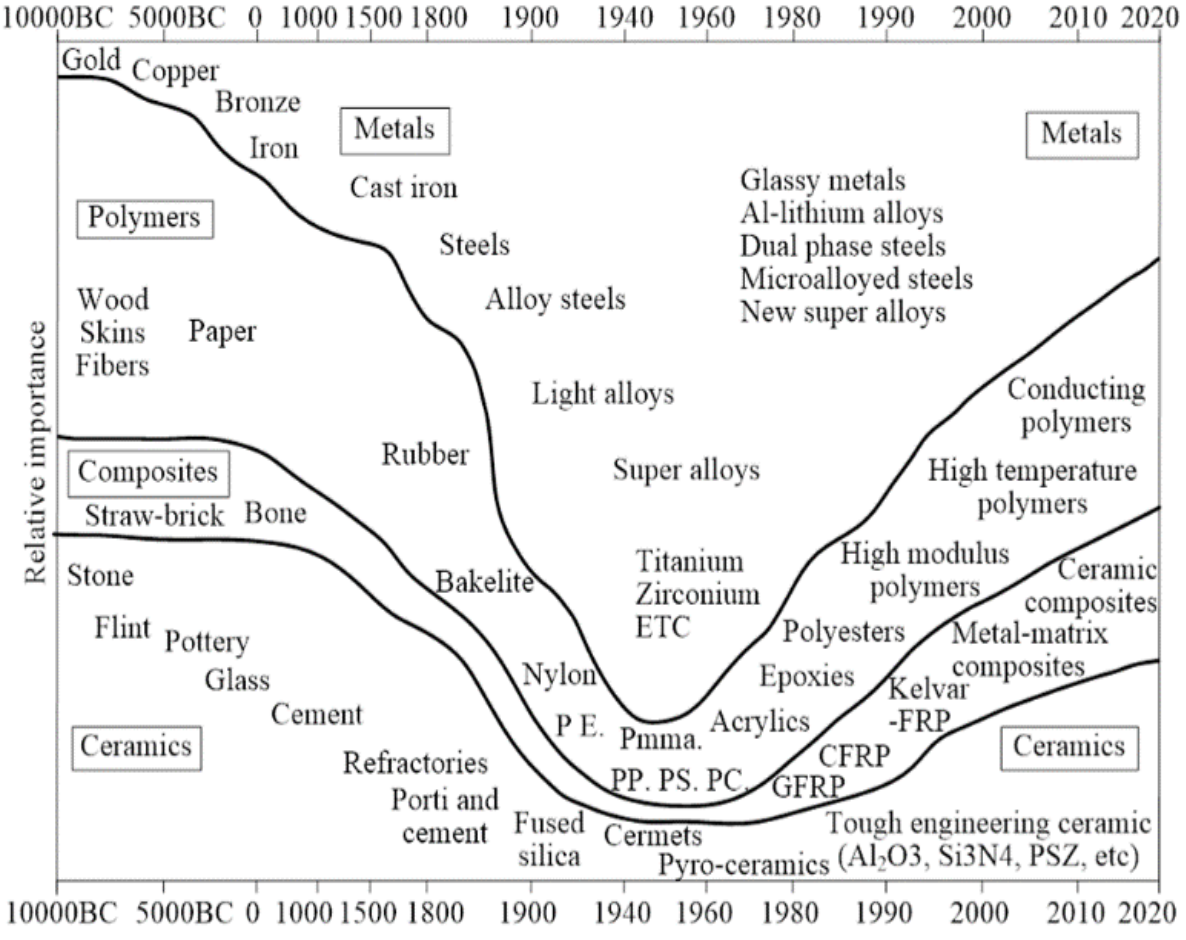
so, we will need Hybrid processes (Additive + Finishing)

- https://youtu.be/24VmCzT12mk

Light Structures – examples

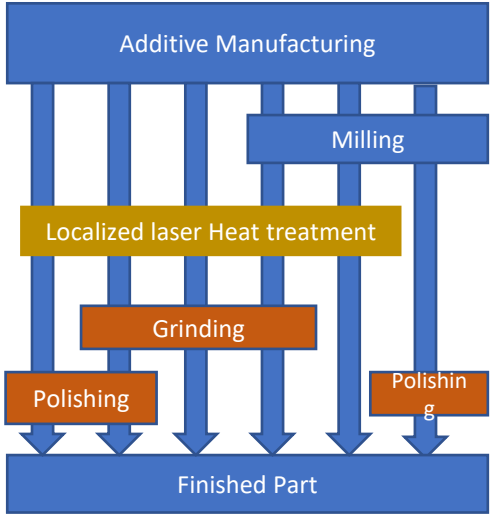

TORRESLAVIJP
AIRBUS

Relevance of materials along human existence



Impacts in the Future of Industry – Part 3

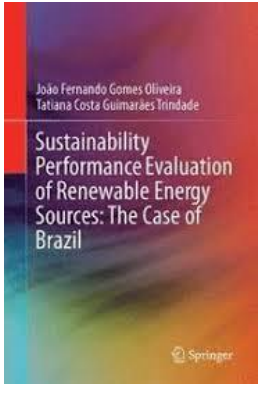
- **The use of hybrid processes will dramatically reduce the amount of sequences for manufacturing operations** (all operations made in one machine) making automation much easier. So, just work for programmers setters, R&D, Engineering, etc.
- **Factory configuration should change to less machines in the lines, less handling and more integrated process stations.** So part manipulations and more experts in the lines.



New materials and light structures

Eolic and Solar should be the two big winners and industrial changers

- Eolic energy:
  - Light structures.
  - Carbon fiber on blades.
  - Huge size and high precision components, such as gears, shafts, hubs.
- Solar energy:
  - Mirror finishing surfaces for the concentration plants
  - PV should solve the high environmental impact in its manufacturing



Sustainable Energy Systems

Key grinding technology for ultra large components

- Electricity from wind:
  - Business growth encouraged by tax breaks for renewable energy and green pricing programs
  - Technical challenges for grinding those ultra large components

Figure 36: Ultra large components for windmill.

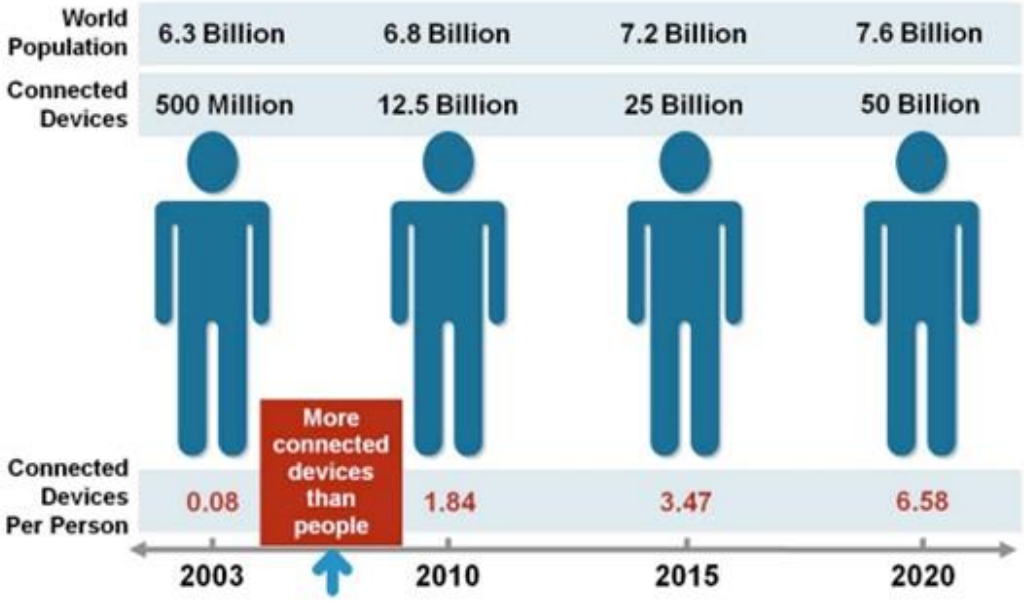
Figure 37: Internal grinding for ultra large components.

Impacts in the Future of Industry – Part 4

- **General impacts:**
  - Manufacturing of large components should increase.
  - New materials should drive the performance and cost reduction in this sector.
- **Impacts on Industrial Employment:**
  - Some phases in the manufacturing of large components are too expensive to automate. Eolic energy should employ lots of people for a long period
  - There should be lots of engineering work in the development of new materials for energy production such as: carbon and glass fiber, light/strengh alloys, etc
  - Finishing of mirror surfaces is not a fully automated process, so, more technical support will be needed.

The Internet of Things

Automation in Future



This machine is really changing the world!

- Display
- Microphone
- Speaker
- Multi-toutch
- GPS
- Compass
- Acelerometer
- Digital ID
- Cameras
- Flash
- Wifi
- Bluetooth
- 4G
- phone
- Etc.

Navegation system

Phone

Agenda

Internet browser

Delivery manager

Restaurant menu

Remote control

Entertainment system

Media center

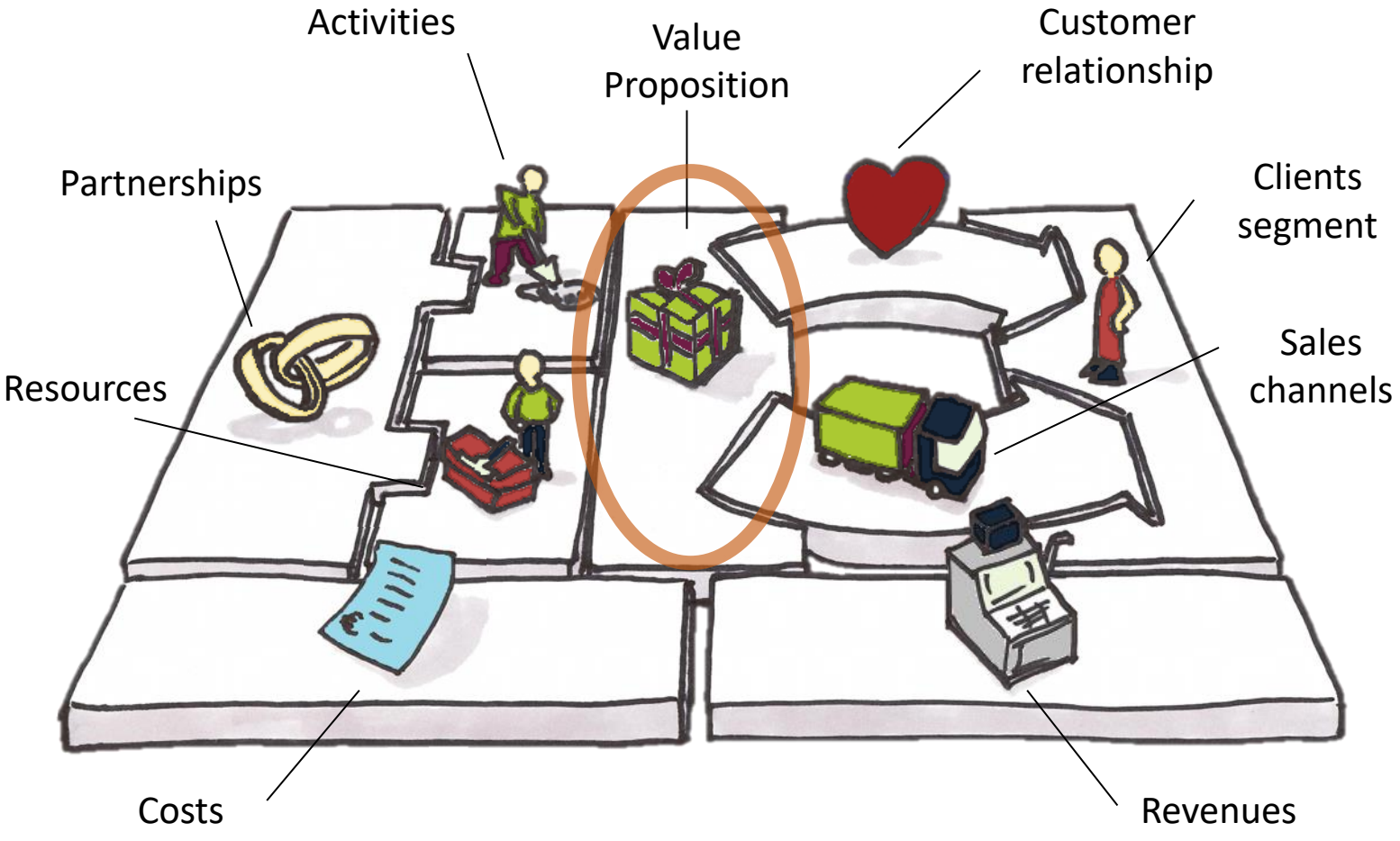
Video camera

Health monitor

Sport Monitor

Etc, etc....

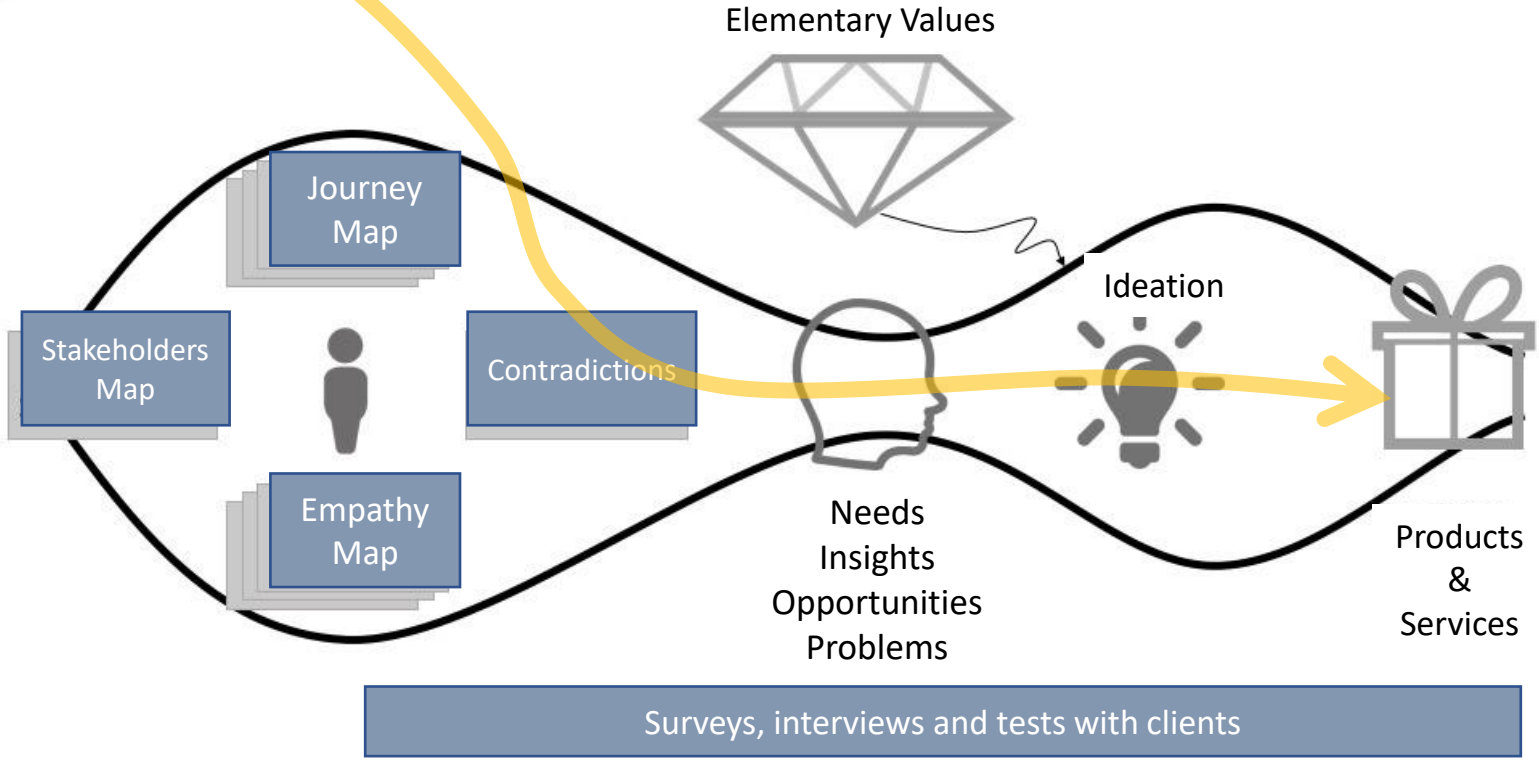
Value proposition: the hearth of a business model



Business Analysis

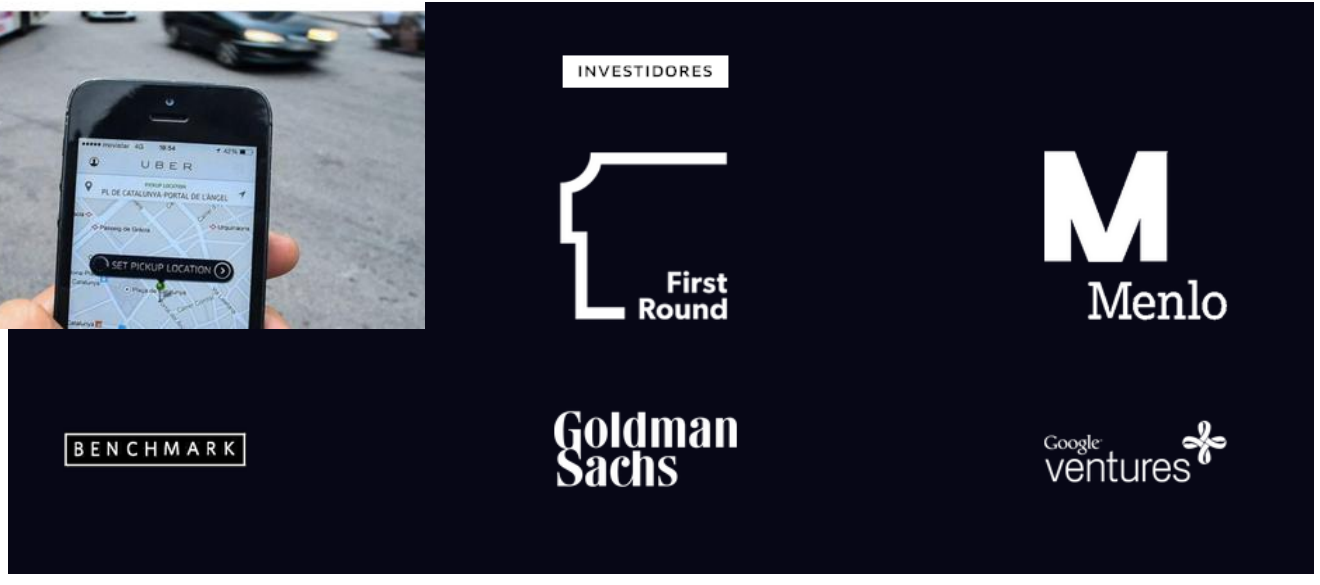
Building new value propositions

Value Proposition



Business drivers

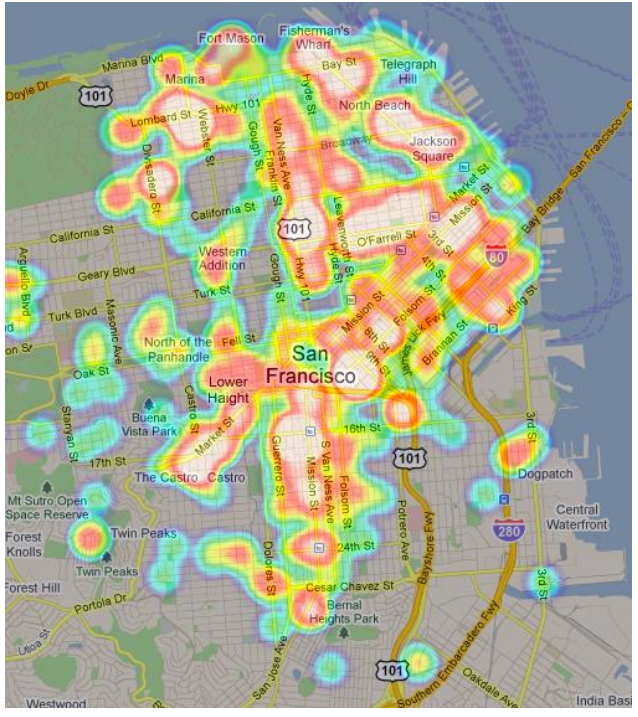
How UBER has created such huge value in just 5 years?



The UBER Business Features

Big data based system oriented to costumer needs:

- Excellent app (combining GPS, path, payment system and user evaluation)
- Business model that understands the client (stress with mobility, style, values/experience, quality)
- Reliable and predictable service
- Aggressive communication (crisis are part of it)
- Good management team
- Clear satisfaction indicators in all levels
- PSS concept



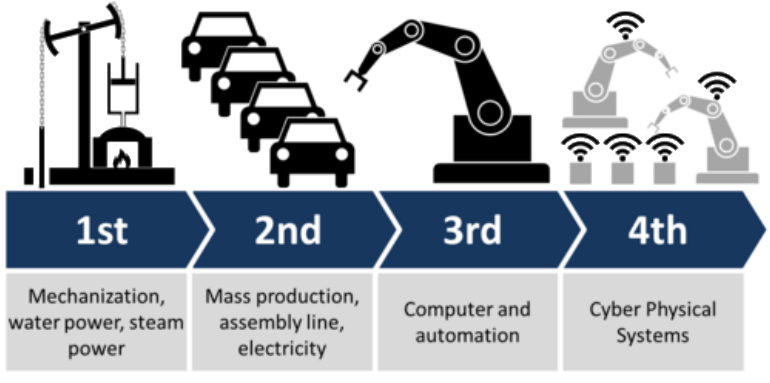
Impacts in the Future of Industry – Part 5

- **General Impacts:**
  - **New product characteristics for PSS (or selling the use, or shared use)**
    - Robust design for longer life,
    - Design for Retrofitting with minimum investment,
    - Minimum cost of use,
    - High reliability,
    - Structural and systems health monitoring,
    - IT integrated systems for easy access to users,
    - On board intelligence and connectivity,
- **Impacts on Industrial Employment:**
  - **New business models should support the services with smartphones, examples are:**
    - Traceability on products, delivery systems, App based services should automate most of the service sector.
    - With more services available on apps, product should have longer life (to feed the business model). So, less jobs in production.
    - Business models design and systems development is being highly demanded: see the lack of developers in the SV and now in Florianopolis (Br). The example of CKL.io

Industry 4.0

Automation in the Future (2025)

- **Online Service 24/7 via chat, Skype**,… Siri for Service?
- **Remote operation** → operator free mills (**much more usage of robots**)
- Service for wears and spares will be shifted to e-commerce
  "**Components order their spare parts automatically online**"
- Based on **BIG DATA** in combination with artificial intelligence and other algorithms design of plants and components will be optimized:
  → **Very accurate simulation of plants**
  → **New sales approach (online)**
- **Customers will configure there own plants with the best equipment from different suppliers.**
- **Business models will be changed dramatically, equipment will have reduced importance, data will be much more important as well as technological competence and of course competence in IT and Internet technology**
- **Not the big ones will win, the fast one's will win**



Source: Zeppelin Industries

Impacts in the Future of Industry – Part 6

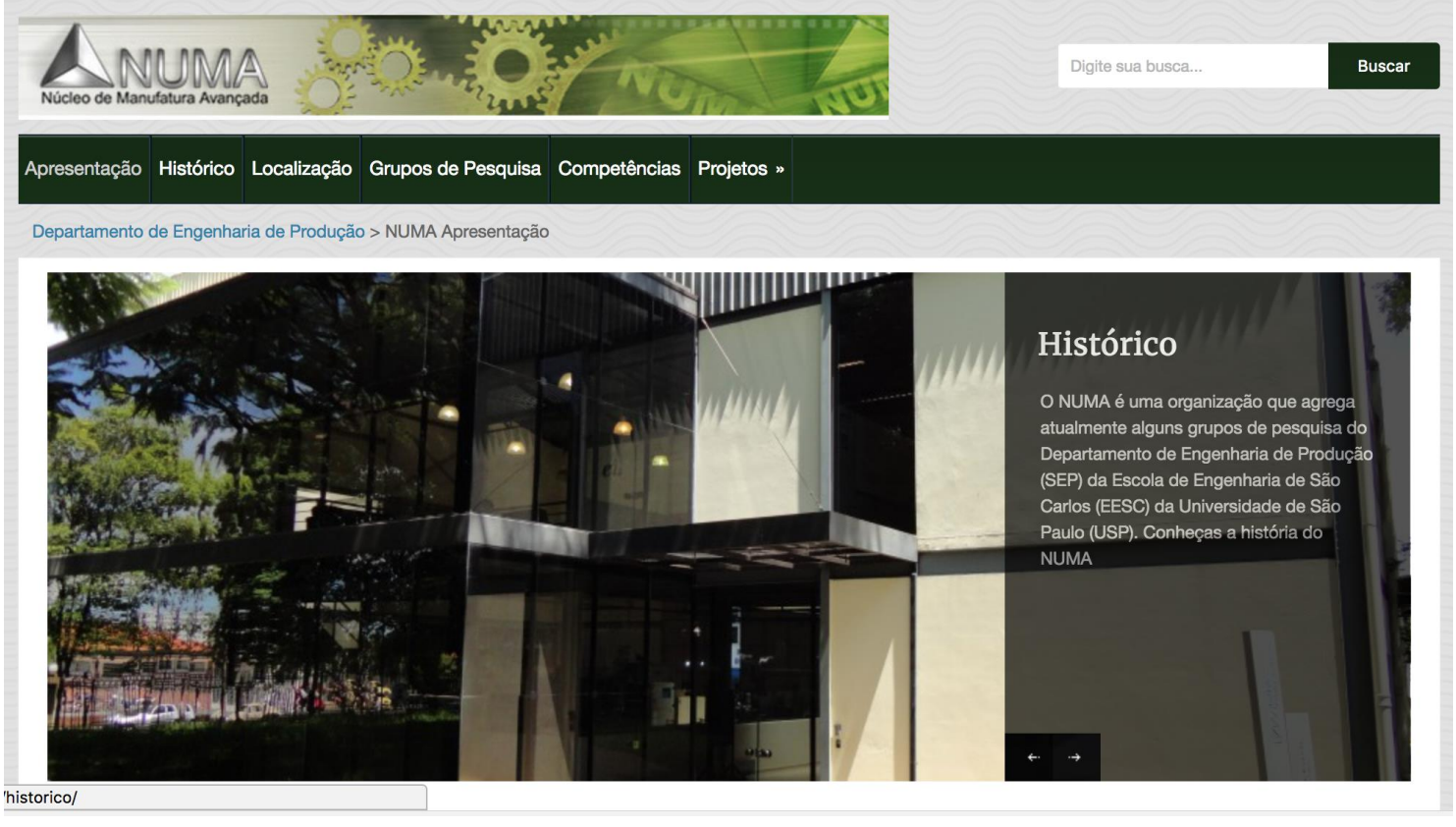
- **General Impacts:**
  - New 4.0 production lines with connected machines, tools and products
  - Need for real time data gathering on tools performance
  - Full control of production systems for extreme productivity
  - Integrated solutions for big data and factory optimization and control
- **Impacts on work:**
  - Smarter products with embedded sensors and cloud data transfer, should drive **lots of development work**, but much less basic work.
  - Control and monitoring systems via Apps, and other easy diagnosis solutions and user guides using advanced IT tech, such as augmented reality, etc should **reduce the needs of skills and increase the demand on experts**.
  - External big data processing and evaluation products for control optimization, predictive maintenance, etc. Less telephone calls, **more experts, again.**
  - High robustness and safety self controlled tools for industry with the use of advanced protocols and cyber security systems…**again less skills, more expertise.**
  - **New business models (again!)** with clear value for performance, intelligent online orders, systems integration, etc

Industry 4.0 in Brazil

Summary and opportunities

Who we are?

We are a research center working in Advanced Manufacturing in Brazil for the last 25 years



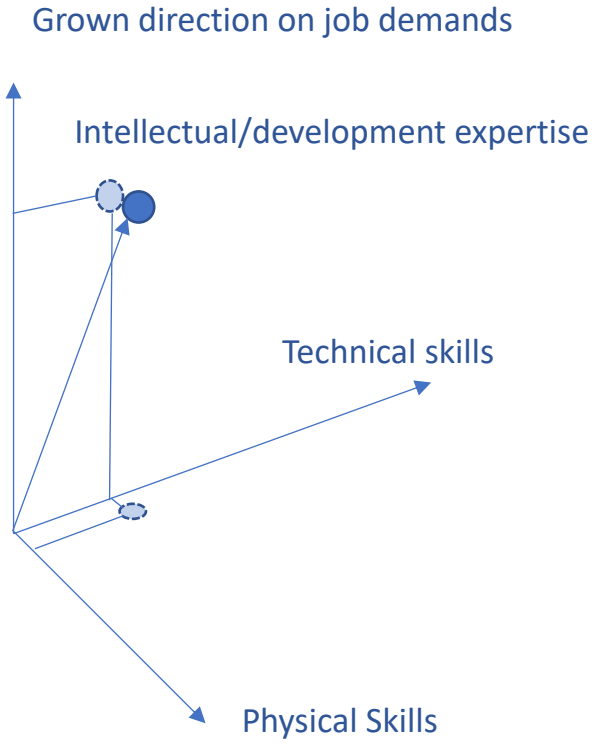
Some findings after an intense industrial interaction in Brazil

Assuming that I4.0 is a concept that is much related to the Manufacturing Industry (born with focus in the auto sector), Brazil shows the following problems:

- **Most of our R&D partners are not in Brazil:** It has been almost impossible to develop I 4.0 or Advanced Manufacturing Solutions for the factories in Brazil. Examples of clients along 20 years are: TRW (worldwide), Chrysler (USA), SAP (USA-Germany), Saint Gobain (USA). This is a sign: even with local competences, companies are not able to invest in I4.0 solutions.
- **Old factories, low performance, high product prices:** This has been the main reality in the auto sector in Brazil. It has been hard to automate and optimize manufacturing in such plants. They are capital intensive and the margins don't justify the investment.
- **Brazil should have difficulty in implementing I4.0** due to the challenging characteristics of the business environment. This can be a long discussion, but without a big change, manufacturing activity should keep focused in the local market and far from I4.0 standards.

Summary - on future of work – people needed

- The future of industrial work has been a topic for speculation since the beginning of automation and robots (CAD, CAM, CIM, CAPP, etc, etc).
- The subject gets more and more visibility with the recent changes in the use of smartphones, new business models, IoT, and I4.0
- The direction in the change of work opportunities seems to keep the same path, but now faster.
- It should depend a lot on the industrial segment, services, etc.
- Generally, the physical and technical skill will be less and less necessary opening a huge gap in the need for expert/intelectual work



A path for the industry Brazil?

- **Non competitive basic materials prices can kill the manufacturing industry**. Protecting the raw materials sector has shown a bad manufacturing competitiveness as result. Competitiveness is a global value, so market should be open.
- **Keep a strong industrial emphasis in sustainable technologies for energy and mobility**: A green path should bring competitiveness. This include light structures, use of high strength steels (e.g.: with Nb) or non metallic substitutions, circular models, etc.
- **Extend the successful agricultural and mining businesses along the value chain** (mainly when the client is small or acquirable). Remember that Nokia was a cellulose business.
- **Promote new business models based on new tech.** Uber is successful as a business (even in Brazil), and have created more value than any Brazilian industry.
- **I4.0 is here to stay,** it is the new industrial paradigm for manufacturing mass customization. With this in mind, jumping in the competition should get harder and harder.

Thanks/Obrigado