

## **Advances in IIoT and related tech: Digital Twins, AI, Data Spaces, Industrial Metaverse**

- **Intro & Learnings from Elon Musk's Alien Dreadnought factories**  
Pedro Maló, NOVA & UNPARALLEL, Portugal
- **Digital Twins and Circular Economy challenges (and the up-coming HORIZON Circular TwAI project)**  
Paolo PEDRAZZOLI, SUPSI, Switzerland
- **Trusted IIoT & AI Technologies for the Future of Manufacturing (H2020 STAR project)**  
Ioannis SOLDATOS, INTRASOFT, Greece
- **Data Spaces for Manufacturing: the AI REGIO project**  
Sergio GUSMEROLI, POLIMI, Italy

# Intro & Learnings from Elon Musk's Alien Dreadnought factories

Prof. Pedro Maló

NOVA & UNPARALLEL

Portugal

**“How many software engineers does it take to run a giant car factory, or a giant battery factory? A lot. In the era of ‘the Internet of Things’, software must be a big deal in a giant factory, especially in factories built and operated by a Silicon Valley company”  
– Elon Musk at (CleanTechnica, 2020)**

# Industrial Challenges for Sustainable Manufacturing

## **Challenge #1: Sustainable Manufacturing Methodologies**

- Manufacturing methodologies/philosophies that enable a highly efficient (thus competitive) production while drastically minimising environmental impacts and use of resources and materials while properly accounting for the human factors

## **Challenge #2: Drastic Processes' Improvement**

- Novel/optimised manufacturing processes that can radically accelerate processes rate and reduce process steps, materials usage, part counts, etc.

## **Challenge #3: Efficient and Reliable Supply Chains**

- Efficient and reliable supply chains for having a competitive and sustainable manufacturing that is not easily disrupted

## **Challenge #4: Beyond IT/OT convergence**

- Move beyond IT/OT convergence as IT and OT can no longer be considered separately for achieving unprecedented gains in manufacturing productivity and efficiency

# Elon Musk's/Tesla's "Alien Dreadnought" factories (aka the "machine than makes the machines")

*“the world still doesn't understand how disruptive Tesla will be when it comes to manufacturing innovation” (Musk, 2020)*

**The “Alien Dreadnought” is a branding of Tesla's manufacturing leadership ambitions – a manufacturing system that's radically different, largely built on self-innovation, able to output products at an unprecedented speed, dramatically reducing production costs and considerably save resources and energy.**

- **“dreadnought”** parallelism comes from the HMS Dreadnought, a Royal Navy battleship that entered service in 1906, which represented such an advance in naval technology that her name came to be associated with an entire generation of battleships, the "dreadnoughts", making the generation of ships she made obsolete known as "pre-dreadnoughts"
- **“alien”** alludes to a machine (factory, “machine that makes the machine”) that appears to have been made by aliens (rather than by humans) such is the difference from the existing manufacturing plants.



# Elon Musk's/Tesla's "Alien Dreadnought" factories (aka the "machine than makes the machines") 1/2

## Sustainable Manufacturing Methodologies: Automatic Factories

- *'You can't have people in the production line itself, otherwise you drop to people speed. So, there will be no people in production process itself. People will maintain the machines, upgrade them, and deal with anomalies.'* – Elon Musk at (Business Insider, 2016)

## Drastic Processes' Improvement: Highly-optimised self-engineered manufacturing processes

- *'It's not a single silver bullet that makes that [competitive advantage] possible. I would say the top (...) thing is (...) **the process itself and that's not standard, (...) it's something that we are engineering ourselves and we are improving ourselves**, with a lot of knowhow and a lot of hard work, what that really means is we get higher throughput, so we get higher yields, we get lower capex per unit output, which does translate into end cost because you are depreciating and amortizing the cost, so that's a key advantage.'* – Elon Musk at (Tesla Analyst Meeting at Gigafactory, 2017)

# Elon Musk's/Tesla's "Alien Dreadnought" factories (aka the "machine than makes the machines") 2/2

## Efficient and Reliable Supply Chains: Vertical Integration

- *'We're really going to be quite vertically integrated, now we're going to take this to a level that's far beyond river rouge, ideally, **I'd like to pop this factory over a mine and out comes a car.** In the limit, that's the ideal situation. Right now, (...) we've got this global supply chain still, where things coming from all over the world, and this is actually terrible for efficiency and for reliability of the supply chain. If you go to a global supply chain, you are essentially inheriting global force majeure. So, if it is hurricanes, earthquakes, fires, floods, somewhere in the world – I guarantee at any point in time there will be these things – if you have a global supply chain that means you have to take into account global force majeure, it's crazy. And we literally have had everything from ships sinking, to factories burning down, anything, it's tough to imagine, everything.'* – Elon Musk at (Tesla Analyst Meeting at Gigafactory, 2017)

## Beyond IT/OT convergence: Proprietary IT-based manufacturing

- (Musk, 2021) has tweeted that "Tesla is using only internal & open-source software"
- Warp Drive (aka 'WARP'), Tesla's ERP, TMOS, Tesla 'Manufacturing Operating System', Tesla MES, a 'Manufacturing Execution System', Tesla Executive Factory dashboard, Garage (or Garage Portal), etc.

# Call for “Made-in-Europe Super-dreadnought factories” ?

**Made-in-Europe Super-dreadnought factories, i.e., highly sustainable, and efficient factories built using European innovative technologies, European world-class knowledge, European unique societal principles**

- **Sustainable Manufacturing Methodologies: Collaborative Intelligence Manufacturing**
  - “Humans assisting Machines” and “Machines assisting Humans”
- **Drastic Processes’ Improvement: Next-Generation Data-Driven Manufacturing Innovation**
  - Data Spaces for Manufacturing, Testing and Experimentation Facilities (TEF) for Manufacturing, European Digital Innovation Hubs (EDIH) for Manufacturing
- **Efficient and Reliable Supply Chains: Cognitive Digitalised Supply Chains**
  - Dynamic, Flexible, Non-Hierarchical Supply Chains, Resilient Supply Chains, using IIoT data
- **Beyond IT/OT convergence: Software-Defined Manufacturing**
  - Cloud-Native (IIoT) Manufacturing Systems, Advanced/Interoperable real-time Digital Twins based on IIoT systems





# IOTWeek

Dublin — June 20-23, 2022

# Thank you!

Find more:

[iotweek.org](https://www.iotweek.org)