

INTRODUCTION TO AUTOMOTIVE EVOLUTION LESSONS

Introduction about the course objective



1. The objective of the course is **to share with you my long work experience** about Process Technology giving you not just a large amount of notions but clearing the rational behind the ideas. So, concepts largely applicable for sure in automotive even after the electrical transition but also in any type of Industry.
2. The logic of the teaching will be **to follow the historical evolution of the Production Technologies with a specific focus on the Propulsion Systems that are the most impacted by the electrical transition.** Examples of the difference with traditional powertrains for the electrified propulsion systems will be given as well.
3. **The lessons will not be history lessons anyway.** The “time schedule” approach will be only used to give a specific order to the Theory of Production Technologies or, using a more common term, **the Manufacturing Engineering concepts.**
4. **Very simple mathematics will be used**

Automotive evolution macro-program (1)- 24 hs



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1. Introduction about the course and the rational behind the Industrial culture; **Manufacturing engineering**
2. **Taylor and the principle of scientific management; Process cycle definition; Capacity/efficiency;** Engine assembly; Assembly technology basics.
3. **Gantt and program management; Product development process;** Engine machining: cyl. block, cyl. head, crankshaft; Transmission production: assembly, gears and shafts machining
4. **Ford and mass production; Parallel vs series;** Machining technology basics; Transfer vs job shop
5. **Crisis of industry due to social issues: Olivetti and Fanuc case study:** team approach and robotics

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6. **The flexibility and the premium production;** Queuing theory introduction; Planning/scheduling; **Pareto and ABC approach**
7. **The machine that changed the world: Japanese production system;** WCM; Vehicle production: welding, painting, stamping, assembly.
8. **The world is flat: the globalization; Business cases;** Production management.
9. **The electric transition.** Footprint management; EDM production (reducer assembly, e-motor); Battery cell production; Battery pack assembly; Giga-casting.

Further there will be exercises and possibly (to be verified) one or two visit in an Automotive Plant.

AUTOMOTIVE EVOLUTION

Introduction to the current status

Which are the current challenges for Automotive



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- Emission regulations in Europe are forcing the Electrical transition in 2035. This is based on a Political decision, not economical or technological reasons, so **no one knows if the available technologies will be mature enough or economically accessible to a large portion of populations.**
- The rest of the world is not following this commitment so it is clear that **the international customer expectations will be not homogeneous in the next future.**
- Governments are imposing the electrical solution even if **other technologies might be ready like hydrogen, bio-fuel**
- Currently battery electrical vehicles (BEV) are a direct evolution from internal combustion engine(ICE) vehicles. This must be considered a temporary assumption. At the beginning of XX century the first vehicle were evolved from horse-drawn carriage. Only after many years the cars have started to be structured differently. The same, in a shorter time for sure, will happen now but it is not clear **today** which will be the new standard. **Automotive competitor are forced to to invest without having a steady picture of the future.**

Other directions



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- Hydrogen :
 1. Catalyzers
 2. Fuel cell with Hydrogen tank that feed a BEV on board
 3. ICE with Hydrogen tank
- Bio-fuel :
 - with renewable energies able to reuse the CO2 in the atmosphere
 - Through chemical natural process (agricultural recycling and other)
- Circular economy:
 - product re-use
 - material recycling