IoT challenges
in pit-stop manufacturing
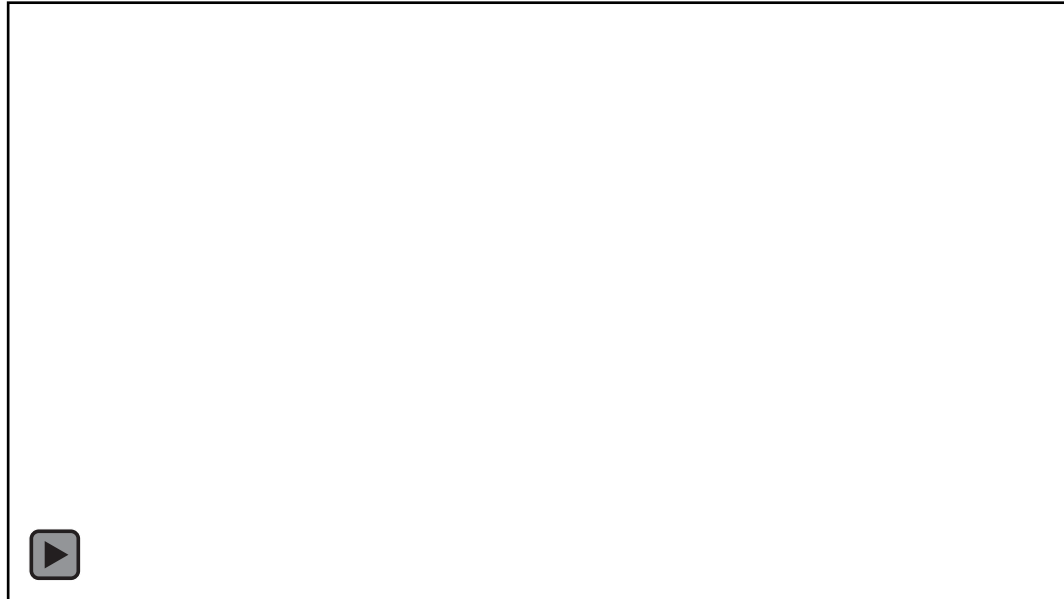
Maria Chiara Magnanini

Department of Mechanical Engineering

Politecnico di Milano, Milan, Italy

POLITECNICO
MILANO 1863

Why pit-stop manufacturing

Pit-stop manufacturing aims at improving system performance by reducing the impact of system pit stops.

POLITECNICO MILANO 1863

Example: Evolution of pit-stop

POLITECNICO MILANO 1863

Aspects affecting a pit-stop

➢ **Duration**: how fast is each pit-stop

➢ **Probability of unforeseen events** (damaged or malfunctioning components); sensors reduce unforeseen events

➢ **Number of scheduled pit stops** (depends on wear)

➢ **Exact Timing of a pit stop** (selection of the time to call the car to the box within a time window)

Why pit-stop manufacturing

As in car races, the competition runs on different levels:

During the race...

➢ **Short term**:

- Keeping the system running as much as possible
- Minimizing the duration of stoppages

➢ **Medium term**:

...Between races...

- Minimizing the frequency of stoppages
- Ramp-up management
- Selecting and sequencing improvement actions

➢ **Long term**:

...Before next GP

- Proactively redesigning the system
- Rethinking the system

POLITECNICO MILANO 1863

IoT and pit-stops

- IoT is a key technology for manufacturing operations

- Information can be made available in a fast, clean and trustful way

- Information can be used to solve pit-stop manufacturing issues

IoT and pit-stop manufacturing: short term

During the race...

In racing cars...

- During a race pit stops frequently decide the result

- In the short term the car is given as well as the team in the box

- Emphasis on the **humans** in the racing teams helped by data and models of the existing car

In manufacturing systems...

- **Unexpected** faults deeply affect the manufacturing performance
- **Big data** are relevant as well as modelling tools
- **Real time availability** and **trustfulness** of the data should be targeted
- **Operators** should be trained to use data for proactive decisions

POLITECNICO MILANO 1863

IoT and pit-stop manufacturing: medium term

...between races...

In racing cars...

In manufacturing systems...
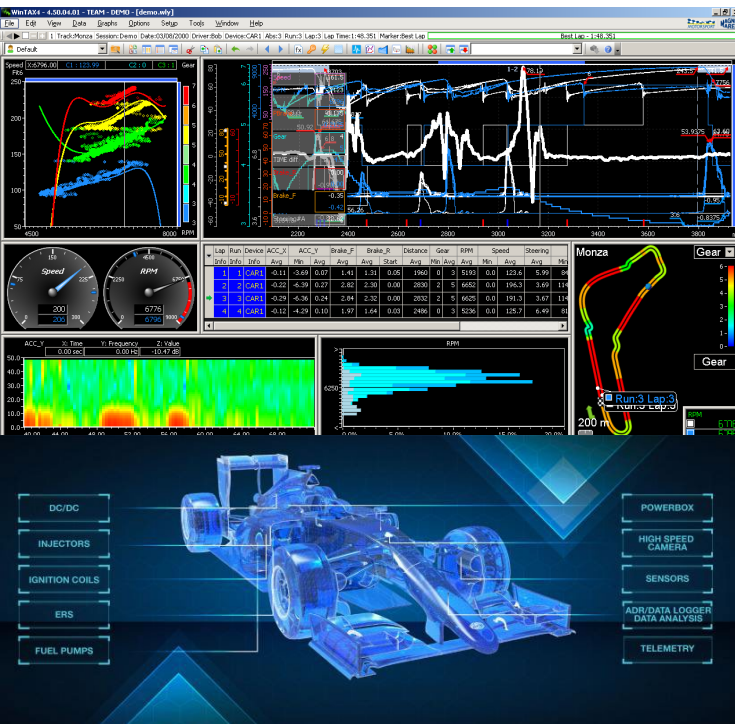
- Between races the car is improved to make it more reliable and obtain the best performance

- Data should be used to identify critical issues
- IoT should rely on correct data models for synthesis purposes
- The goal of data is to feed decision-support tools to reduce the impact of pit stops
- Methods for data repairs, data analytics, modelling are key!

Why pit-stop manufacturing

- However, the system has a limit, which is the system itself.

1950
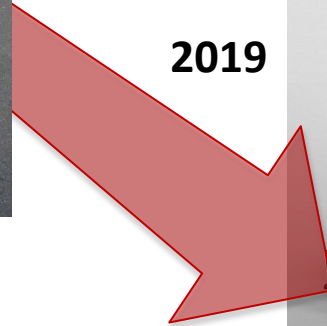
2019

- Therefore, the system must consistently change to improve

Pit-stop manufacturing: long term

...between two championships

In racing cars...

- A car can be redesigned in order to improve the performance

In manufacturing systems...

- Systems may be optimized to reduce the impact of pit stops
- Models are used to predict the performance of the new system

POLITECNICO MILANO 1863

Evolution of manufacturing systems

The challenge is the following:

- How to make decisions for the design and operation of a manufacturing system that does not exist yet?

- Future scenarios and boundary conditions are extremely relevant
- Creativity is key

- **What is the role of IoT?**
- **Which applications can support strategic goals?**

Conclusion

- The goal of manufacturing companies is therefore dynamically and continuously following an improvement trajectory, instead of statically optimizing the system;

- IoT supports pit-stop manufacturing on multiple levels and with different goals;

- Challenges arise as soon as strategic decisions are involved.

POLITECNICO MILANO 1863

IoT challenges
in pit-stop manufacturing

Maria Chiara Magnanini

Department of Mechanical Engineering

Politecnico di Milano, Milan, Italy

mariachiara.magnanini@polimi.it

POLITECNICO
MILANO 1863