Flexible Manufacturing System(FMS)
--for Small Batch Customized Production

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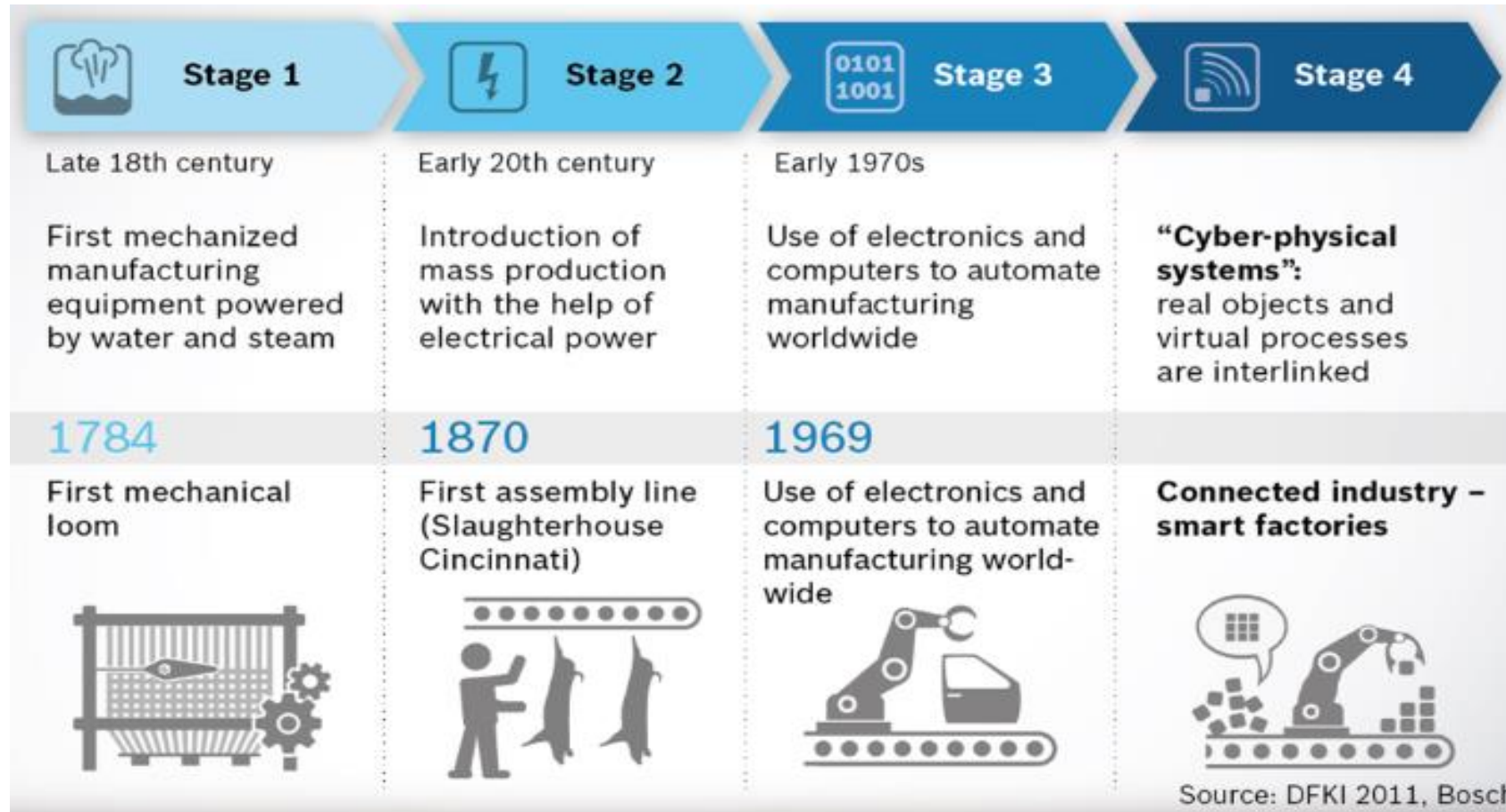
IEC/IEEE 60802, July 2018, Frankfurt

Flexible Manufacturing is the Key Feature of I4.0

Stage 1	Stage 2	Stage 3	Stage 4
Late 18th century	Early 20th century	Early 1970s	
First mechanized manufacturing equipment powered by water and steam	Introduction of mass production with the help of electrical power	Use of electronics and computers to automate manufacturing worldwide	"Cyber-physical systems": real objects and virtual processes are interlinked
1784	1870	1969	
First mechanical loom	First assembly line (Slaughterhouse Cincinnati)	Use of electronics and computers to automate manufacturing world-wide	Connected industry – smart factories

Source: DFKI 2011, Bosch

I4.0: Devices, Manufactures, Customers will be connected closely. _Customized production_ is highly demanded

Classical FMS—Static Scheduling based on Production Sequence

A Digital Factory in Cheng Du

RFID CAR

An Automotive Soldering Factory

ALC(Automation Line Control)

Robot/NC/Tool/IO

- ✓ Product with same mechanical framesize use one type RFID CAR；
- ✓ The trace of RFID CAR is determined by the scanning results；
- ✓ Up to 100 types of production test and assembly in one line；
- ✓ **Static scheduling and configuration, still belongs to mass production；**
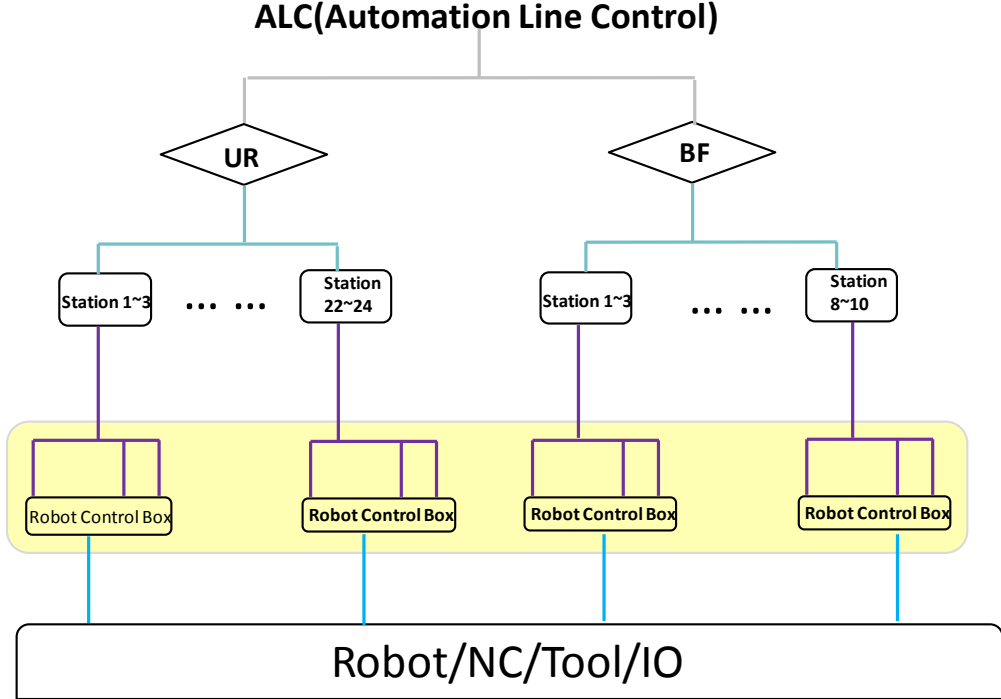
- ✓ Station controller distribute car information to Robot Control Box;
- ✓ Robot Control Box select corresponding PLC sub program based on car Info.
- ✓ Three different types of car can be soldered in the same soldering line；
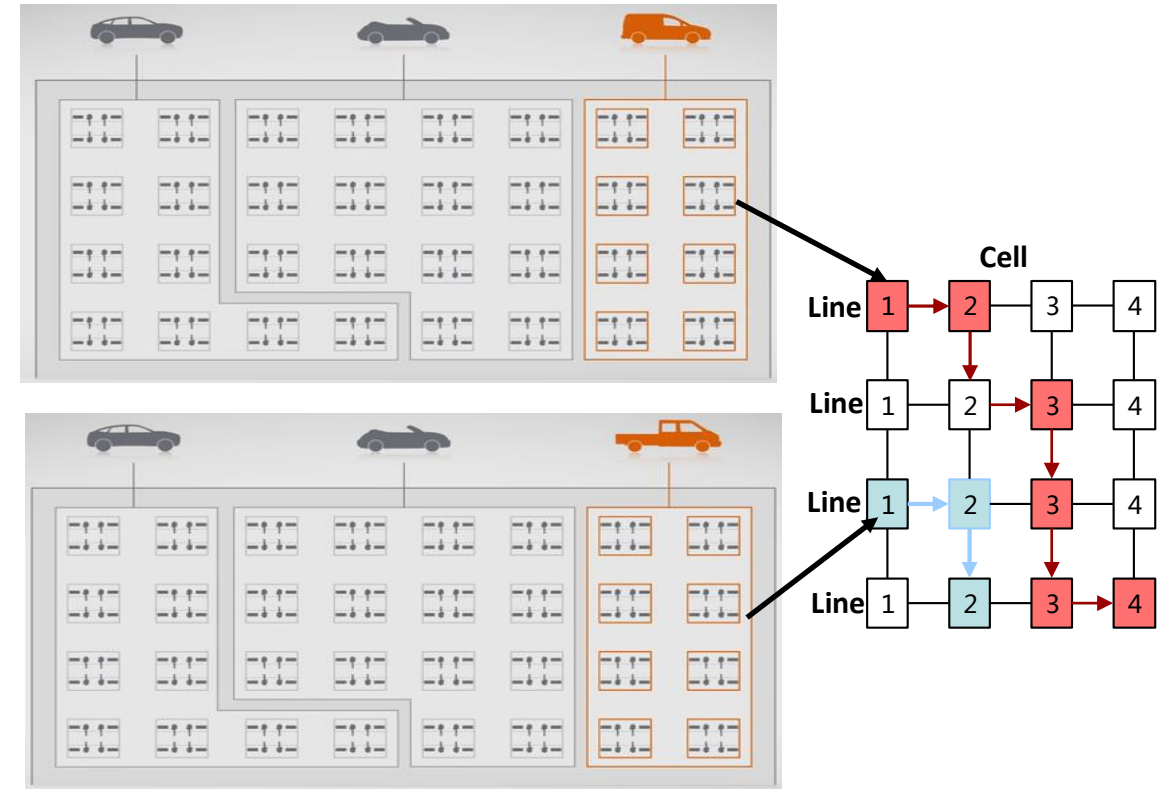- ✓ **Static scheduling and configuration, still belongs to mass production；**

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Advanced FMS—
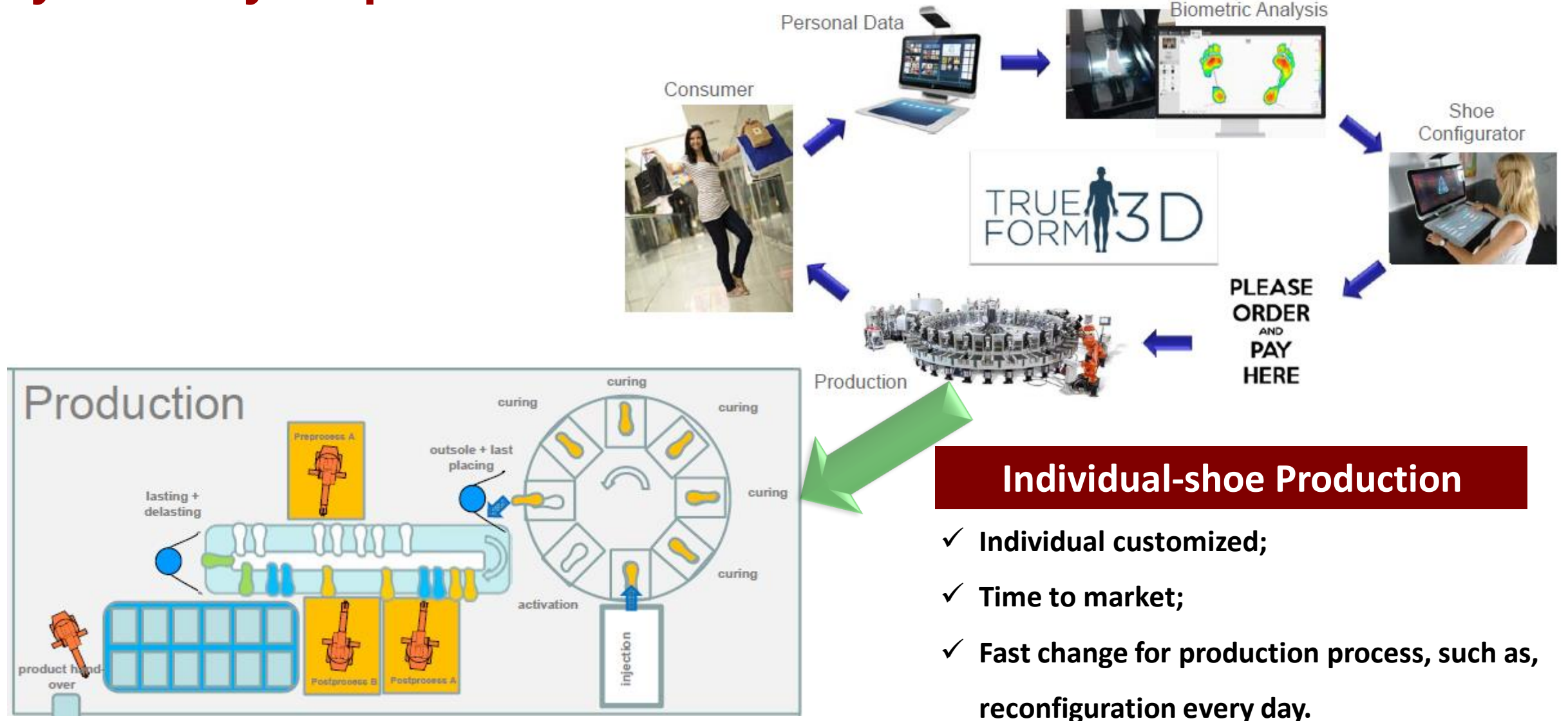# Dynamically Response to Customer Requirement and Market Vibration
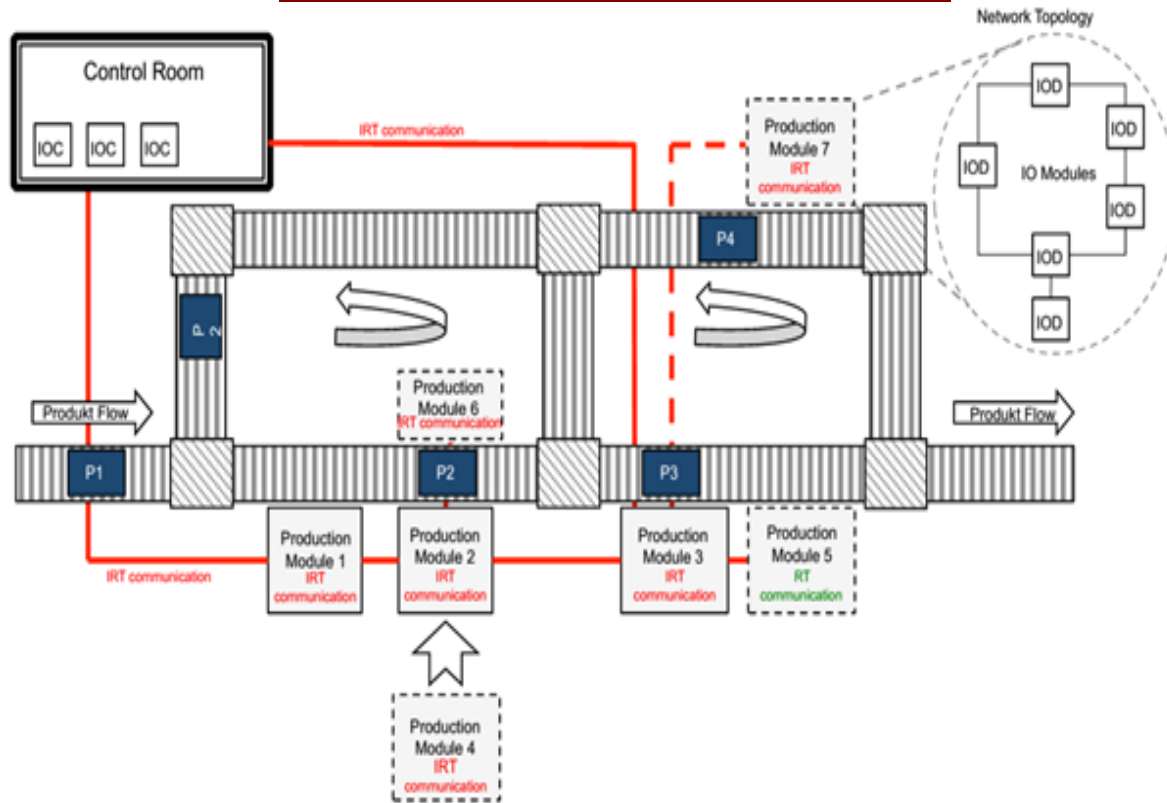
✓ **Online replacement for original module**,

  e.g., Module 2 changed to Module 4

✓ **Online add new module,** e.g., Module 7

Different cell from different line can be **dynamically connected.**

Advanced FMS—
Dynamically Response to Customer Requirement and Market Vibration

Individual-shoe Production

✓ **Individual customized;**

✓ **Time to market;**

✓ **Fast change for production process, such as, reconfiguration every day.**

Advanced FMS Potential Requirements on Industrial Network

- ✓ **Dynamic topology change, plug & plug;**

- ✓ **Dynamic & online reconfiguration;**

- ✓ **Fast response to diverse applications;**

- ✓ **Simplified network configuration; such as, Intent-Driven network interface that is familiar with automation engineer.**

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Thank you

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