Industrie 4.0
A successful and continuous path at Infineon

Klaus Buchwald, Hans Ehm

2024-02-01

Why are we here today?

Infineon won the Industrie 4.0 Award in 2021 convincing with end-to-end, resilient and customer-oriented smart supply chain solutions

- **Digitalization for input**
  - Advanced machine learning capabilities optimize our forecast
  - Comprehensive change management for a successful digital transformation from technical and human perspective
  - Gamification approaches

- **Digitalization for execution**
  - One global factory
  - Automation is the normal
  - Global production network allows us to be flexible even in case demands change quickly
  - Daily execution of global flexibility

Who are we?
What happened in the last 3 years?

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Infineon at a glance

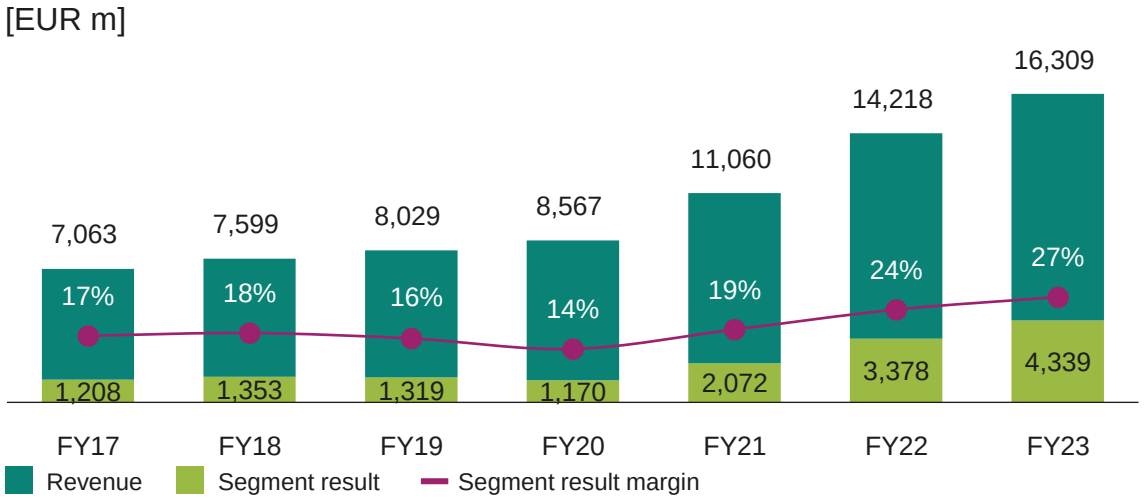
Addressing long-term high-growth trends

Energy
green and efficient

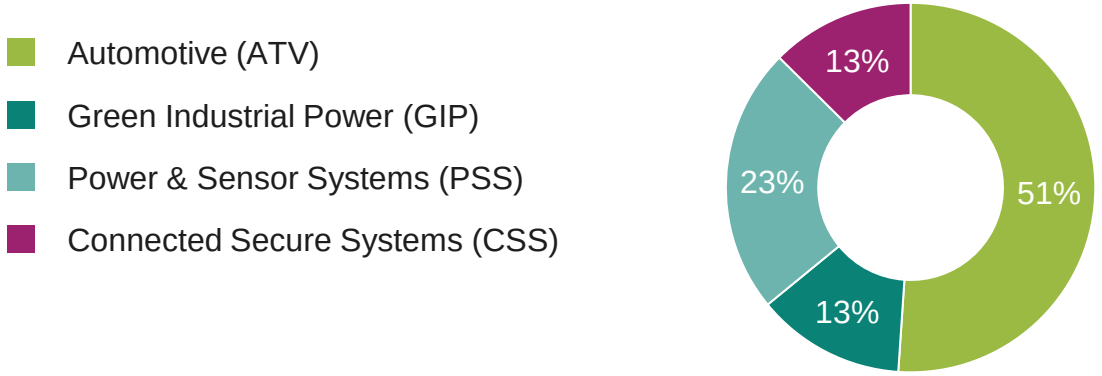
Mobility
clean and safe

IoT
smart and secure

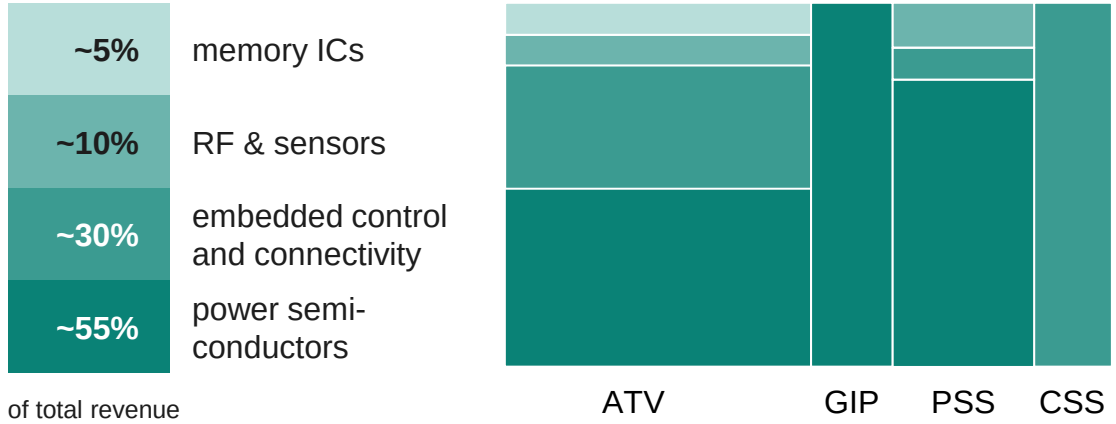
Financials



FY23 revenue by segment

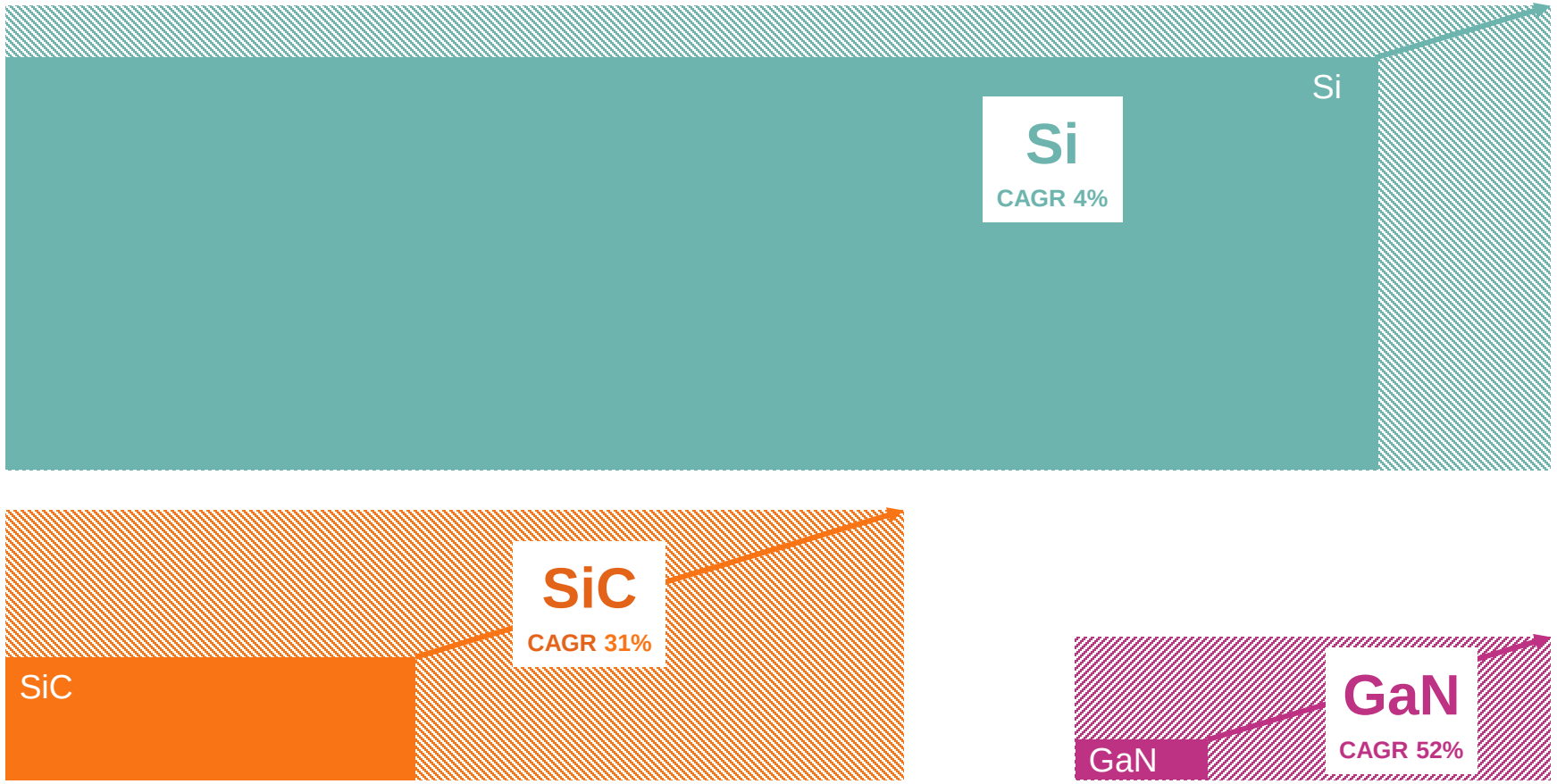


FY23 revenue by product category



Growth with existing and new technologies: Infineon is leveraging its leadership in Si and strengthens its position in wide bandgap

Market size (2022 vs. 2028)



– **Different applications require different solutions**

– Infineon offers the broadest portfolio in silicon, silicon carbide and gallium nitride

– **The wide bandgap technologies SiC & GaN grow significantly faster than Silicon and will increase their market share significantly.**

The boxes' area represents 2022 (solid) and 2028 (shaded) market size;
Yole Intelligence: Compound Semiconductor Market Monitor-Module 1 Q2 2023.

As key markets grow, we expand our in-house manufacturing and build-up key partnerships. Resilience and Scale matters.

Driving Decarbonization & Digitalization. Together.

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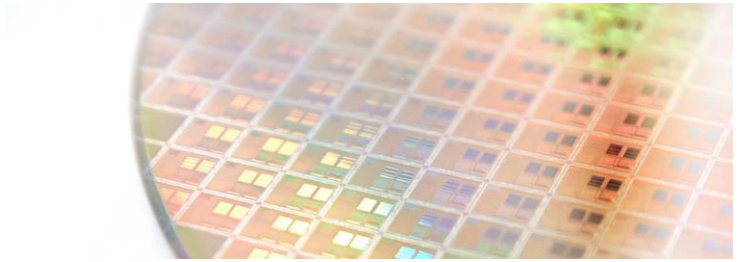
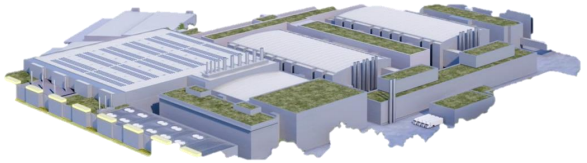
Semiconductors are extremely complex to manufacture and prone to high demand fluctuations requiring an exceptional Supply Chain

Complexity



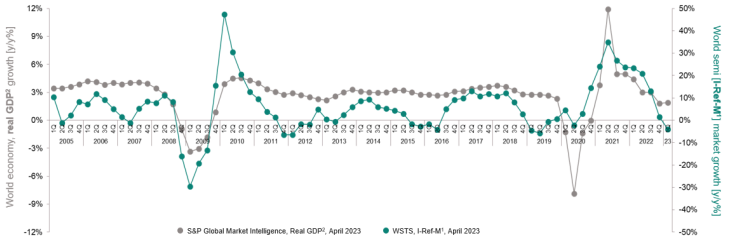
High **complexity** of **semiconductor** manufacturing process (>1,000 process steps, 6+ months Cycle Time), **shortening life** cycle of **end products** (S-Curves) and **Fabs** running **365/24/7 in a global network** (business continuity)

Capital Intensity



Need for **large investments**, e.g., Fab Dresden € 5bn and securing **liquidity** and **operating cashflow**

Volatility



Extreme **demand volatility** of the **semiconductor market** with **amplifications** of **fluctuations** called the **Bullwhip effect** (~5-10x higher than GDP)

This results in a need to **constantly improve** & **innovate** our Supply Chain Operations to **achieve** an **exceptional**, **resilient** and **efficient Supply Chain** for our Customers!

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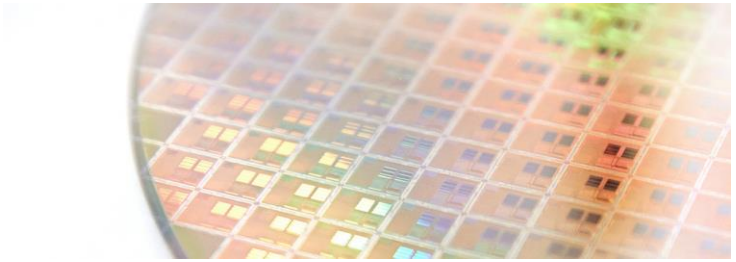

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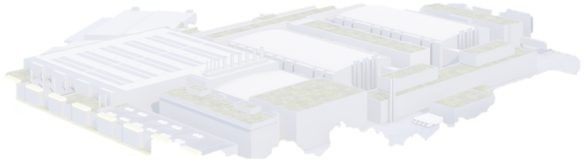

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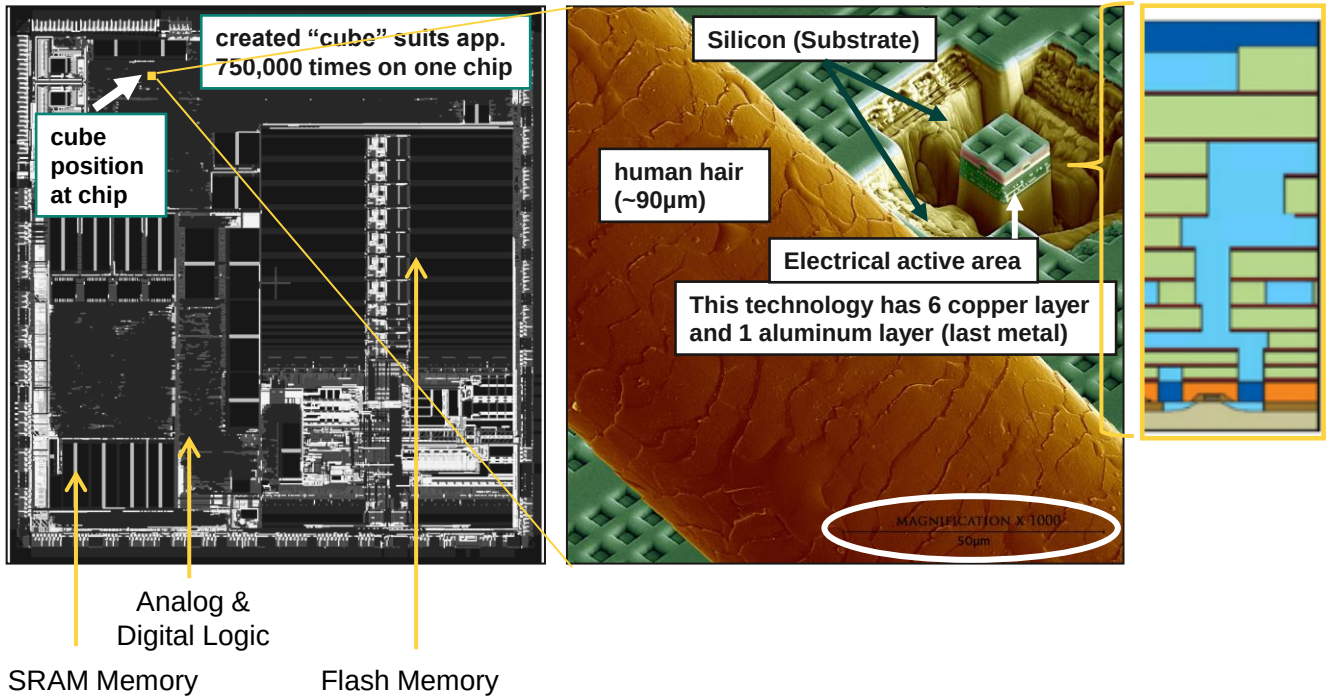
For one Semiconductor ~1,000 process steps in a global network – More than 1bn transistors at the size of your fingertip for EUR <5

Complexity

Complex products with extremely small components...



...manufactured in a global SC network

Semiconductors manufacturing is **physically inflexible** and **cannot** be **parallelized**.
Fabs are **running 365/24/7** due to **short end-product life cycles** and **extreme capital intensity**.

Besides physical flexibility in our Make & Plan processes, re-Plan process needs to continuously get the best out of physical flexibility

Complexity

Supply

Daily

Demand

“Inventing every day” with daily >1 Million Order (Re-)Confirmations & Improvements – We consider this our competitive advantage

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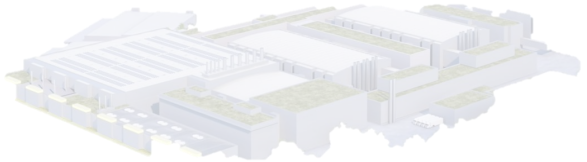

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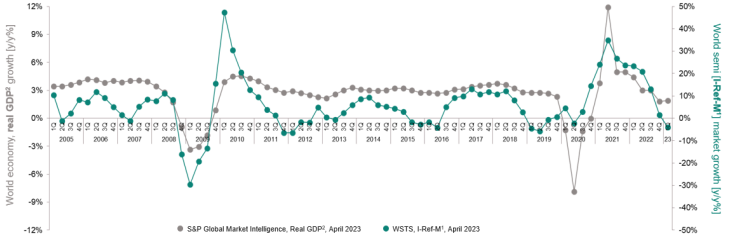

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The Bullwhip Effect is of paramount importance for our planning and operations in our Supply Chain due to effect amplification

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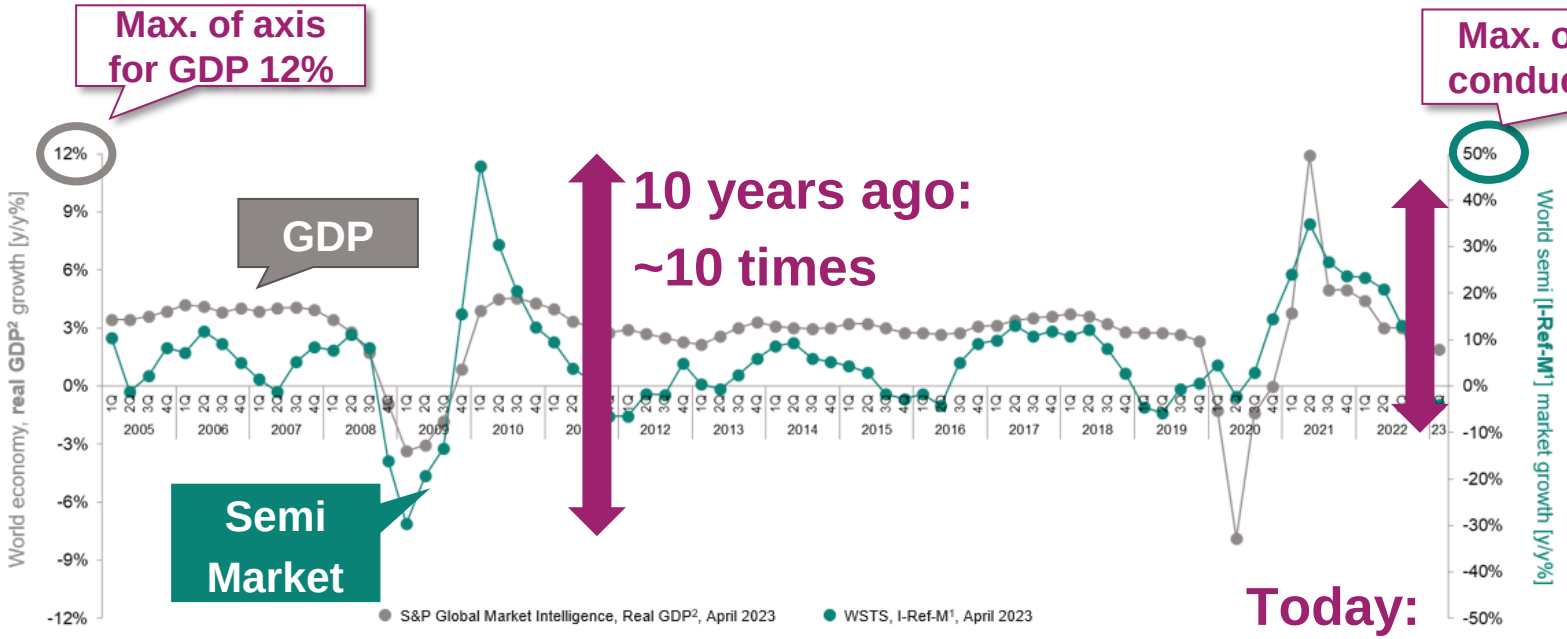


Infineon always **strives** to further reduce the **Bullwhip Effect**.

Tools such as **AI Based Forecast, Lead Time based Pricing** and **Surveys** have enabled us to **lower** these **effects.**

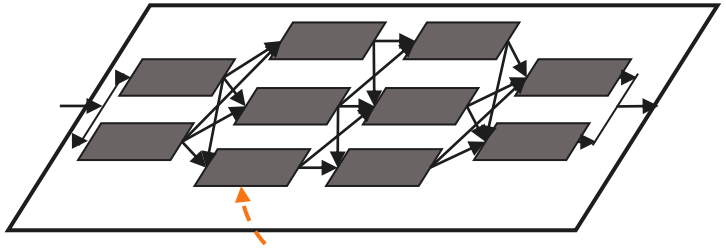
The effects are multdimensional and hard to calculate so we are using End-to-End level Simulations to gain insights

Volatility

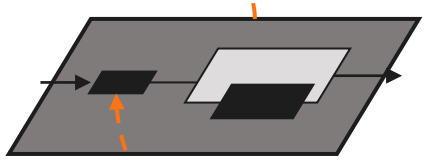
Our Levels of Simulation

= *bottom-up composition*

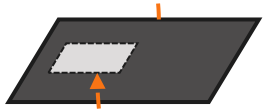
Level 4:
End-To-End SC



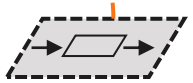
Level 3: IFX SC



Level 2: Production Site



Level 1: Cluster/Equipment



Examples at Infineon

Automotive Supply Chain

Infineon Global Virtual Factory

Fab Dresden

Scheduling/ Batching Lithography

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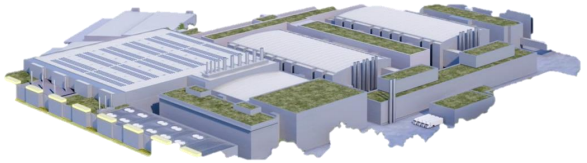

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The manufacturing complexity has an extreme price tag e.g., our new Dresden Fab for EUR 5bn for Power Semiconductors

Capital Intensity

Infineon starts building €5 bn semiconductor plant in Dresden

May 2, 2023

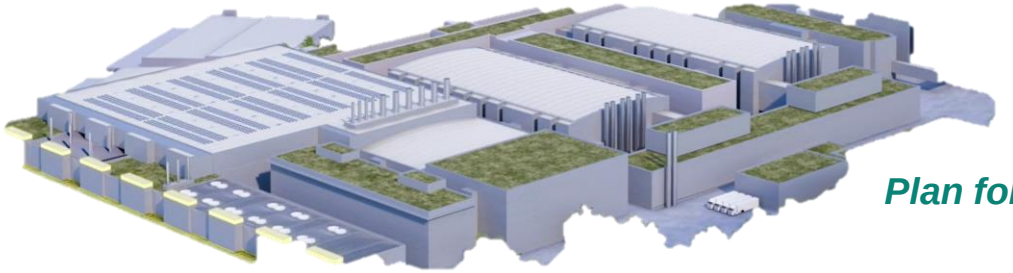
TelekomLead, 02.05.2023

TSMC, Bosch, Infineon, and NXP Establish Joint Venture to Bring Advanced Semiconductor Manufacturing to Europe

EUR ~10bn

Aug 8, 2023 | Business & Financial Press

Infineon Press Release, 08.08.2023



Plan for Dresden

1 Lithography Machine alone EUR >50m

Clean rooms >1,000x cleaner than hospital operating rooms

Up to 5 years lead time until full operationality

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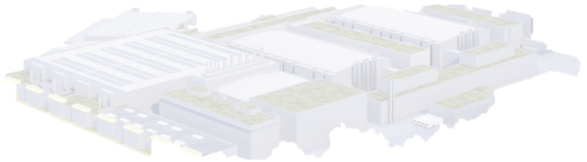

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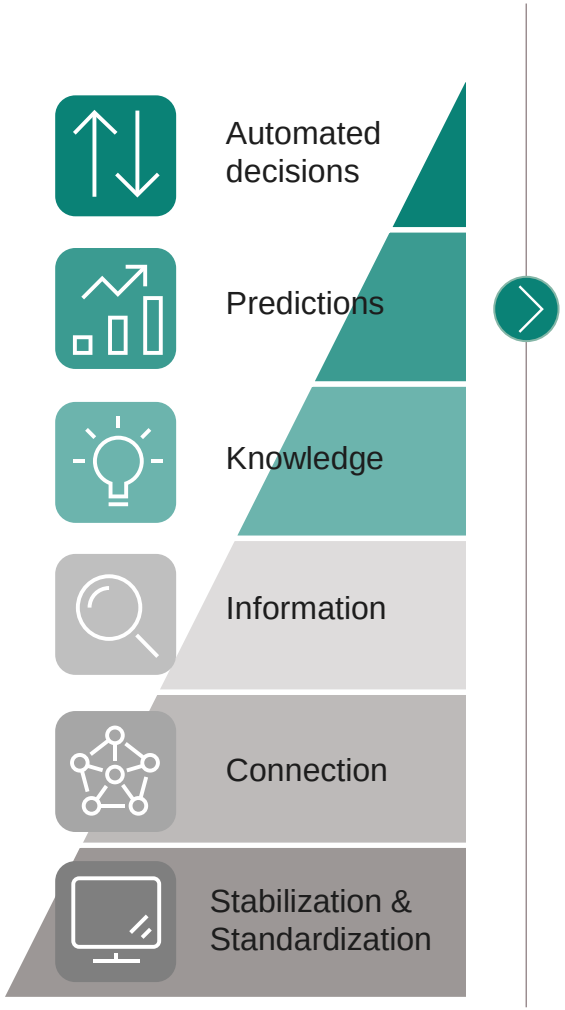
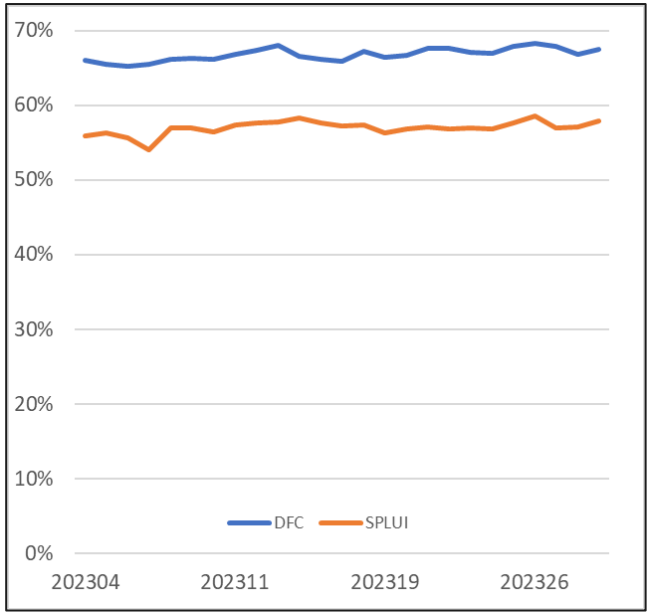
Smart Supply Chain

Leading edge machine learning model enables automated and intelligent demand forecast and improves the forecast accuracy

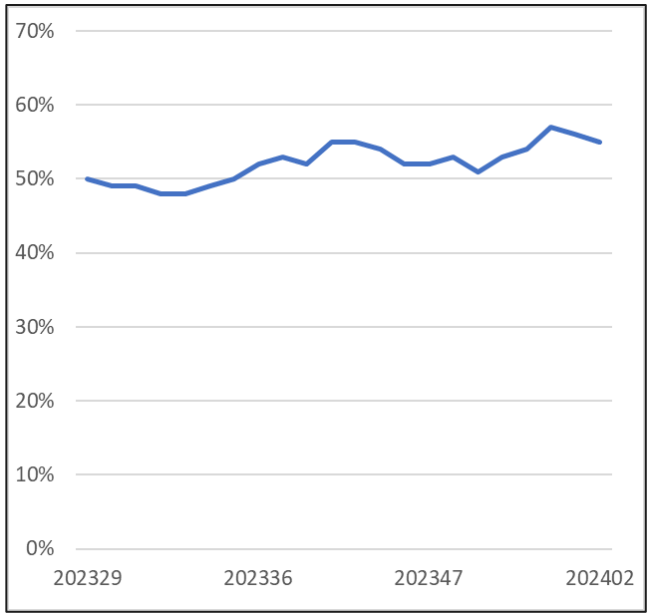


- **Demand Forecaster 4.0 is a complex machine learning model** based on historical customer demand, current customer forecast and orders
- **Improved forecast accuracy** and **increased efficiency** with human in the loop **over different business cycles**

~10%pt better forecast accuracy



55% of IFX Demand is forecasted with the DFC 4.0



Digital Transformation powered by Change Management

Five key benefits of the DFC 4.0 communicated in '**Espresso Mails**'

1. DFC 4.0 **improves forecast accuracy**
2. DFC 4.0 is **well-integrated** in IFX's tool landscape
3. DFC 4.0 **ensures scalability** to tackle exponential growth
4. DFC 4.0 **adapts to business cycles**
5. DFC 4.0 is a **learning booster**

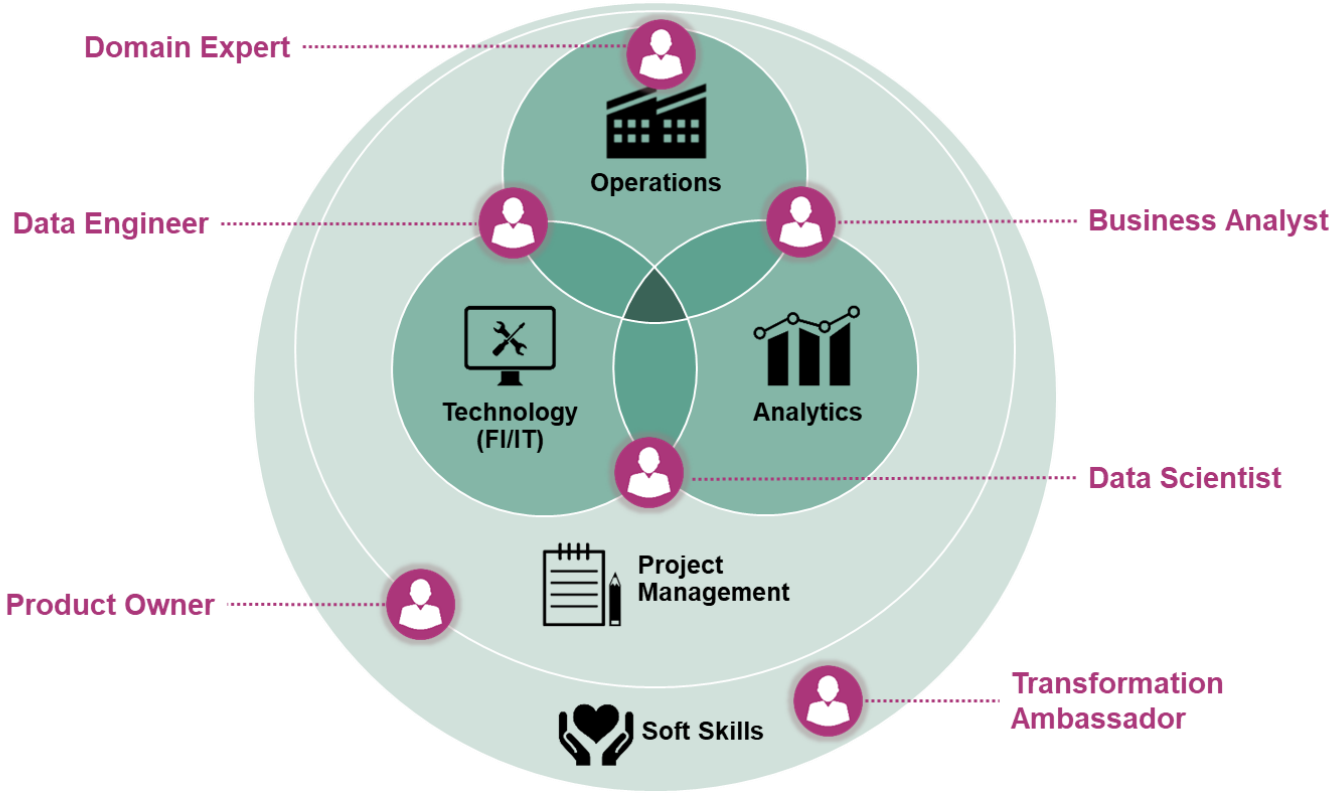
Gamification with the HAI Game increased under-standing of **Human and AI interaction**

„Our ambition is operational excellence enabled by innovation.

The **DFC 4.0 is a great example** as it allows us to **drive efficiency** and **forecast accuracy**."

Jochen Hanebeck, CEO of Infineon

Common understanding on roles and responsibilties lead to more successful AI use cases within Operations



We have overachieved our AI@CSC target

 # Ucs per Phase
6 Idea | 6 Feasibility | 5 Implement | 8 Prod

 # Active Ucs per Function
3 CLM | 7 E | 0 LOG

Mio € FY 22/23
5.6 Generated | 5.0 Target

Mio € Total
21.6 Generated | 32.0 Pipeline

High-Tech chip factory on 300mm thin wafers

Example Villach, Austria

More than 50 years of strategic growth and innovation in Villach

1970
Start as an extended workbench

1979
R&D competencies added to portfolio

1984
Start chip production on 5-inch (120mm) wafern

1997
Global competence center for power electronics

Start chip production on 6-inch (150mm) wafern

2000
Start chip production on 8-inch (200mm) wafern

2001
The world's first SiC diode was launched

2013
First-ever power semiconductor on 300mm thin wafers

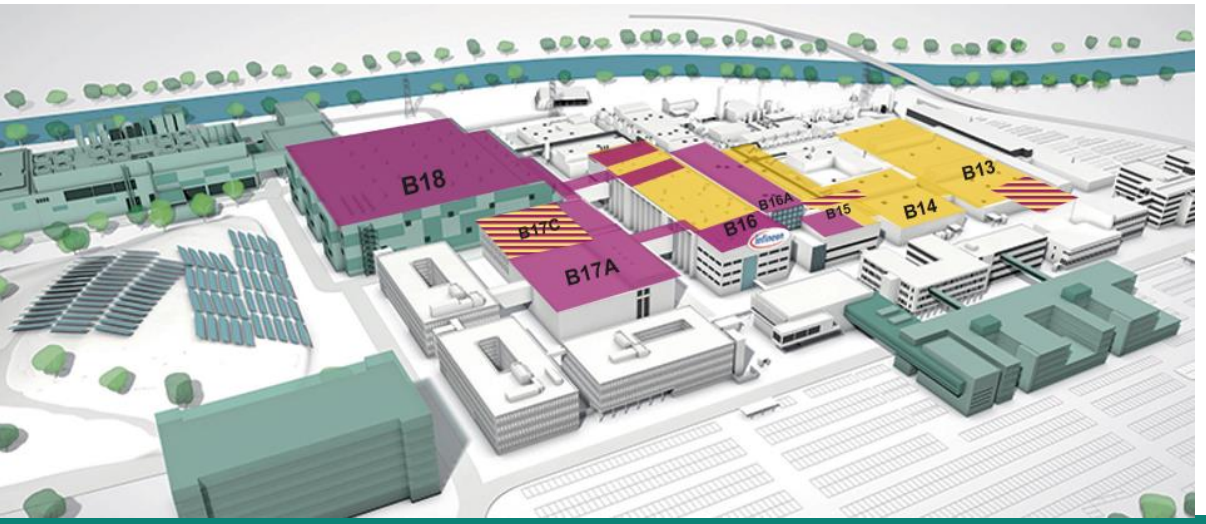
2017
Global competence center for new semiconductor materials (SiC, GaN)

2020
First GaN product produced in Villach

2021
New fully & automated fab for 300mm

2023
Global EPI Competence Center for WBG (SiC & GaN)

We automate to a maximum

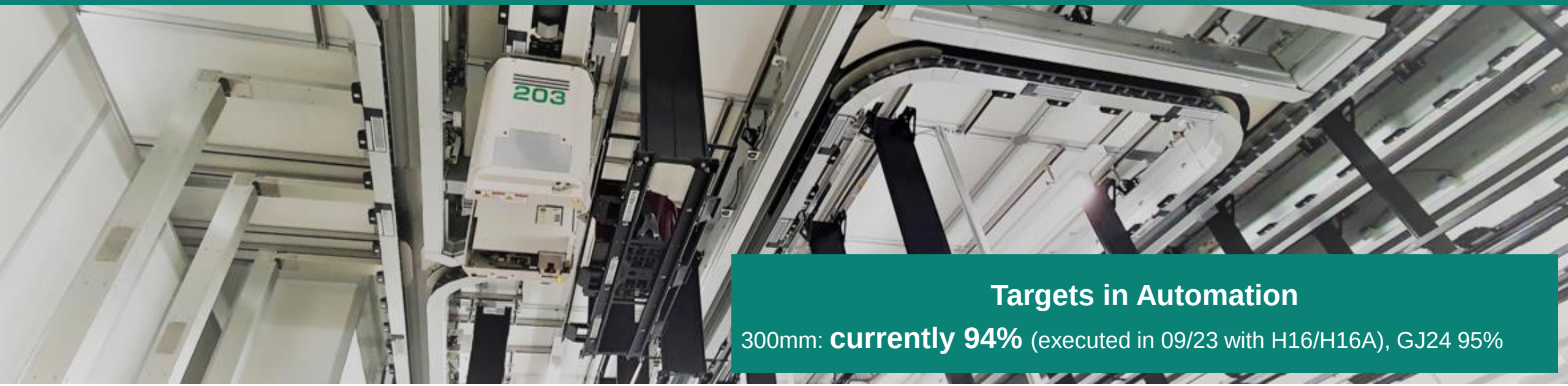


- High-automated area
- In preparation for high-automation
- Smart automated area

Technical Details:

Conveyor system:	**1 400 m**
OHT track length:	**7 300 m**
Stocker/OHB storage bins*:	**~ 20.000**
iRobotics systems:	**17**

* Storage and DieBank capacity will be continiously increased according to ramp steps and FFF projects



Targets in Automation

300mm: **currently 94%** (executed in 09/23 with H16/H16A), GJ24 95%

Insight into the fully automated fab for 300mm in Villach, Austria

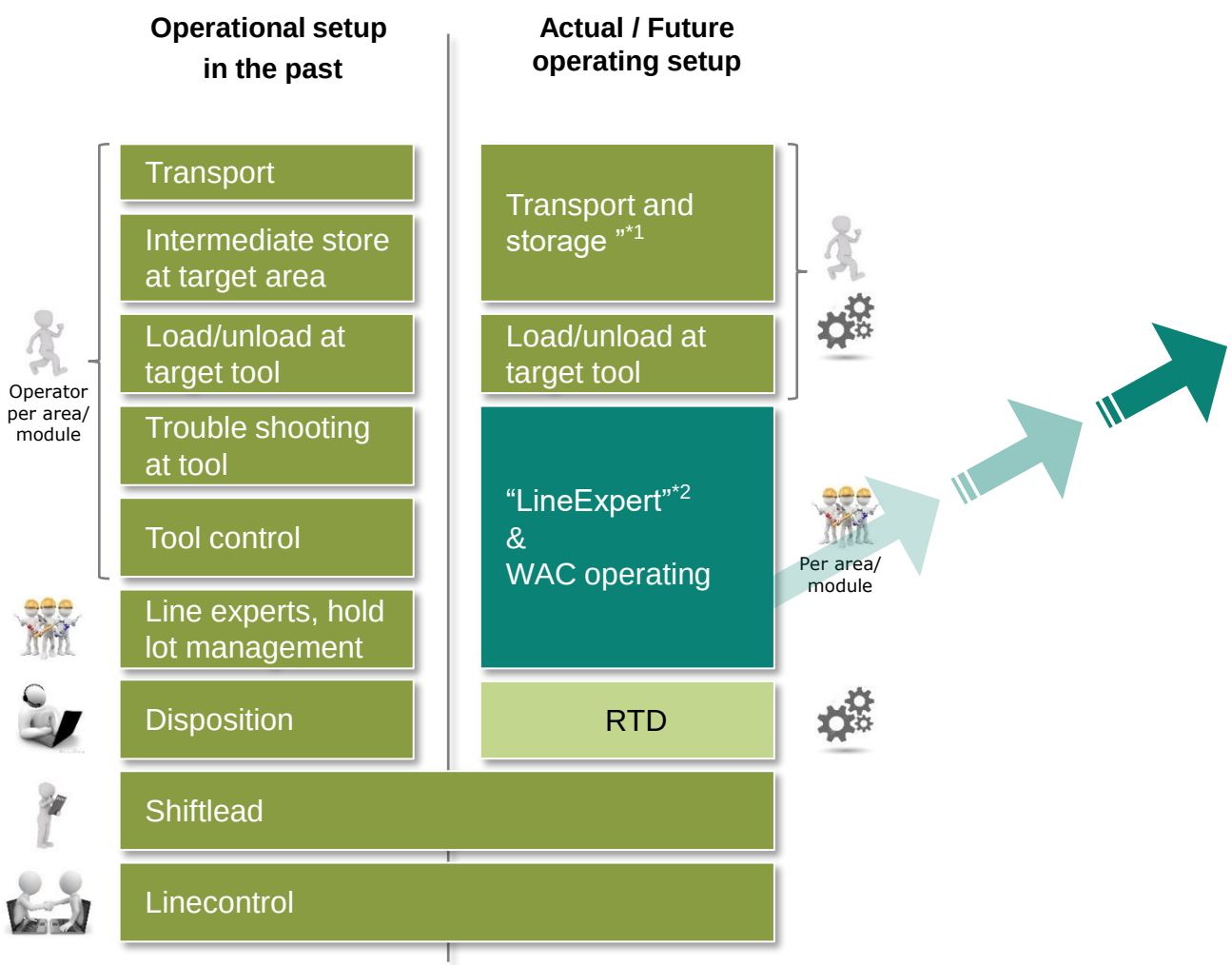
Mission Future
GP300 Launch Journey to World Class 300mm Production

1 GP300 Production System Transfer Finished (**2020**)

2 GP300 Capacity Ramp Started (**2021 … 2025**)

3 Remote Operation Control Center (Start **2023**)

Infineon Technologies Austria AG
Transition driven by Remote Operation Control Center (ROCC)



*1 … Transport from/to tool by operator, in new building the automated transport system will be utilized
*2 … Job enrichment from Operations, UnitProcessEngineering and Maintenance incl. soft skills

- Logistic **decision** level of **all specific** areas in one area
- Capability to react **effectively/timely** to machine downtime **considering overall** performance **indicators**
- **Change** affects about **1200 people**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Questions & answers


Infineon