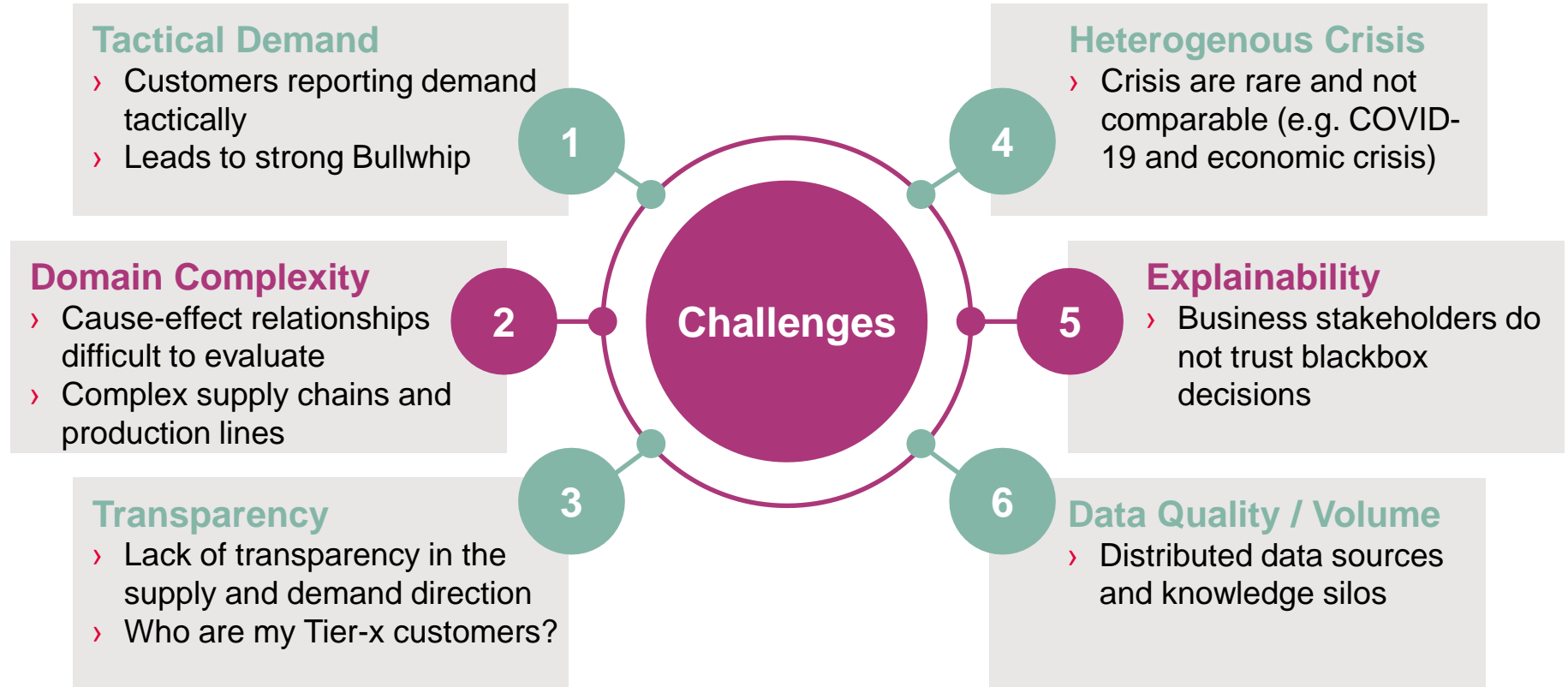# Challenges for Achieving Supply Chain Resilience and Transparency within CoyPu
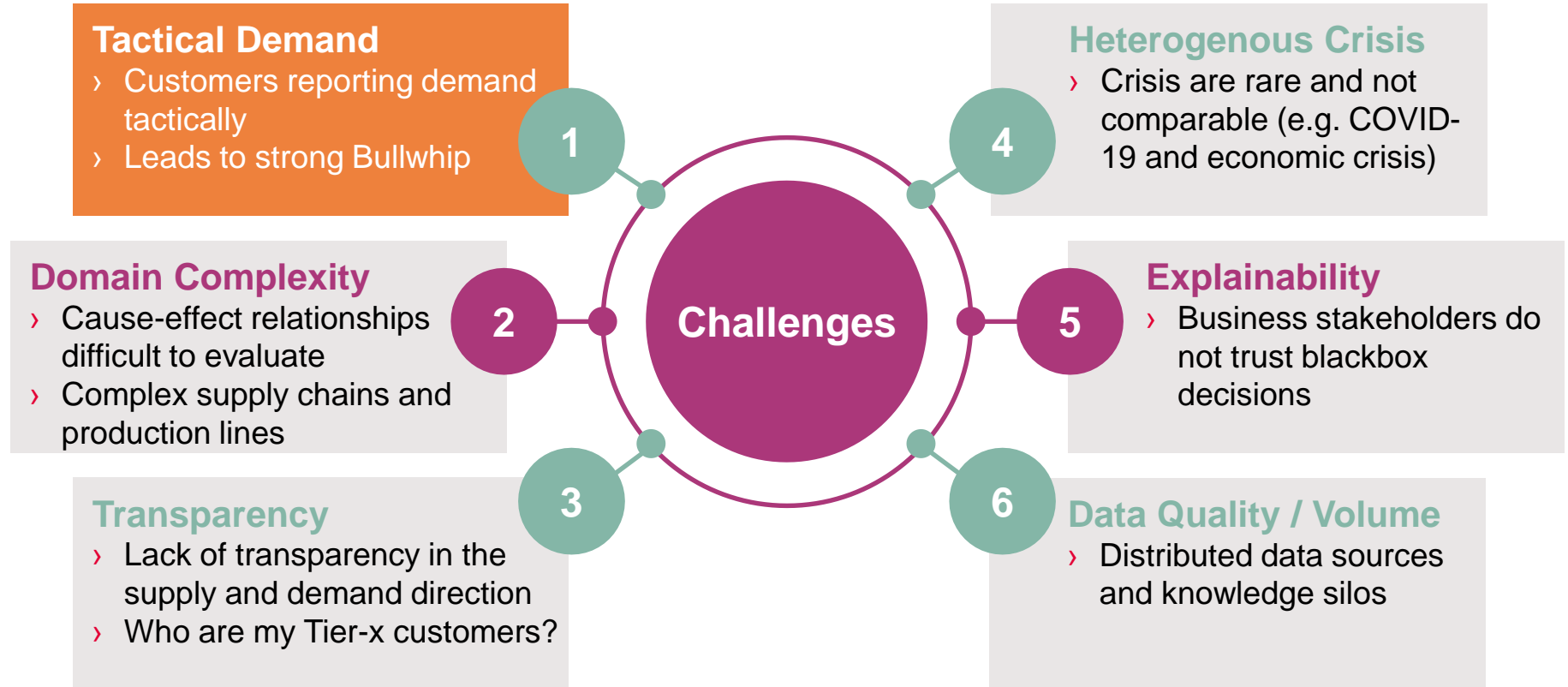
Data Week 06.07.2022
Philipp Ulrich
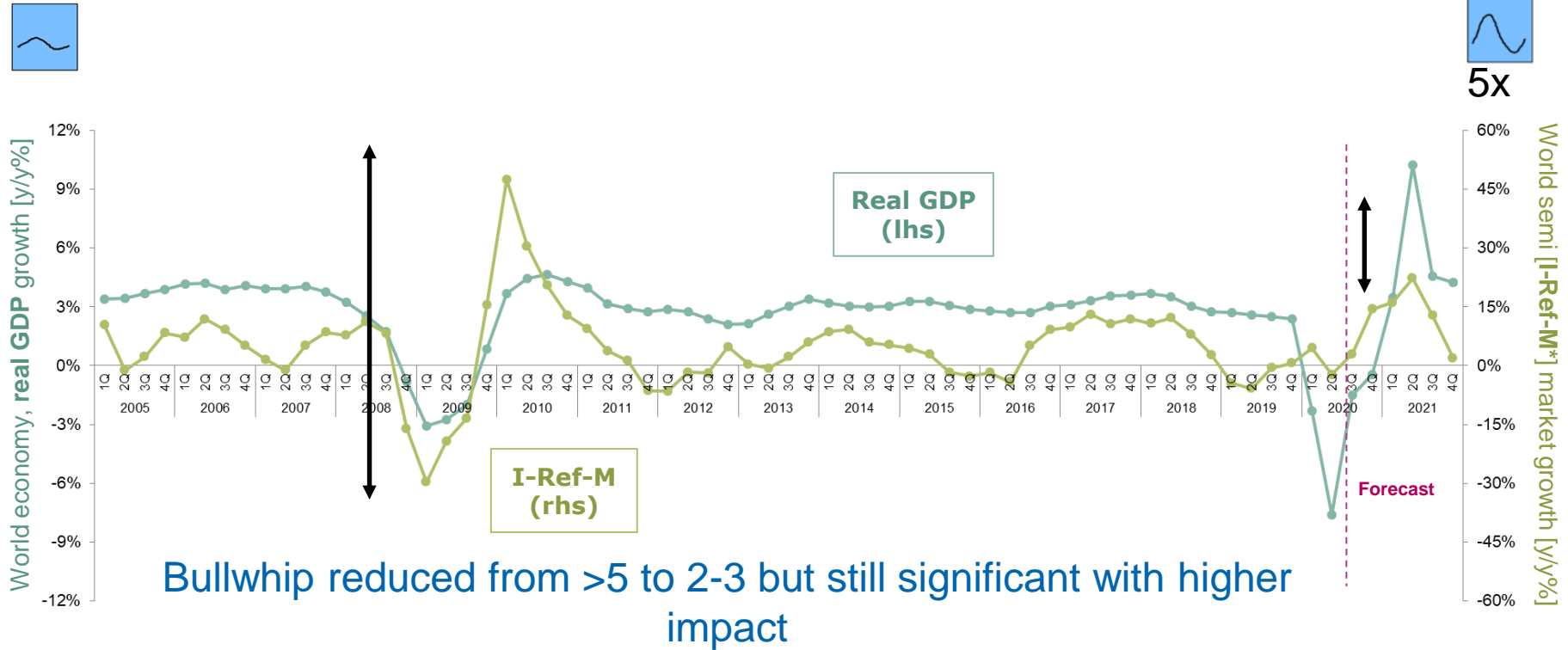
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Challenges for Achieving Supply Chain Resilience

Tactical Demand
› Customers reporting demand tactically
› Leads to strong Bullwhip

Heterogenous Crisis
› Crisis are rare and not comparable (e.g. COVID-19 and economic crisis)

Domain Complexity
› Cause-effect relationships difficult to evaluate
› Complex supply chains and production lines

Explainability
› Business stakeholders do not trust blackbox decisions

Transparency
› Lack of transparency in the supply and demand direction
› Who are my Tier-x customers?

Data Quality / Volume
› Distributed data sources and knowledge silos

Challenges

1
2
3
4
5
6

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Semiconductor market growth de-coupled from crash caused by COVID

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5x

Real GDP (lhs)

I-Ref-M (rhs)

Forecast

Bullwhip reduced from >5 to 2-3 but still significant with higher impact

Y-axis (left): World economy, **real GDP** growth [y/y%] — 12%, 9%, 6%, 3%, 0%, -3%, -6%, -9%, -12%

Y-axis (right): World semi [**I-Ref-M***] market growth [y/y%] — 60%, 45%, 30%, 15%, 0%, -15%, -30%, -45%, -60%

X-axis: 1Q 2Q 3Q 4Q per year 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021

*I-Ref-M = Infineon Reference Market = Total semiconductor US-Dollar based market revenues excl. DRAM, NAND Flash, MPU. – Real GDP = Inflation adjusted (real) Gross Domestic Product of all countries of the world; total of local values converted with in each case current US-$ exchange rates. World real GDP is from chain-weighted index. Quarterly data (year-over-year growth rates)
Sources: WSTS Bluebook for Historical Data, 30 November 2020 & Forecast Update, November 2020; based on or includes content supplied by IHS Markit Economics & Country Risk, Comparative World Overview Tables, 17 November 2020
Specific disclaimer for Omdia and IHS Markit data: Information is not an endorsement of Infineon Technologies AG. Any reliance on these results is at the third party's own risk
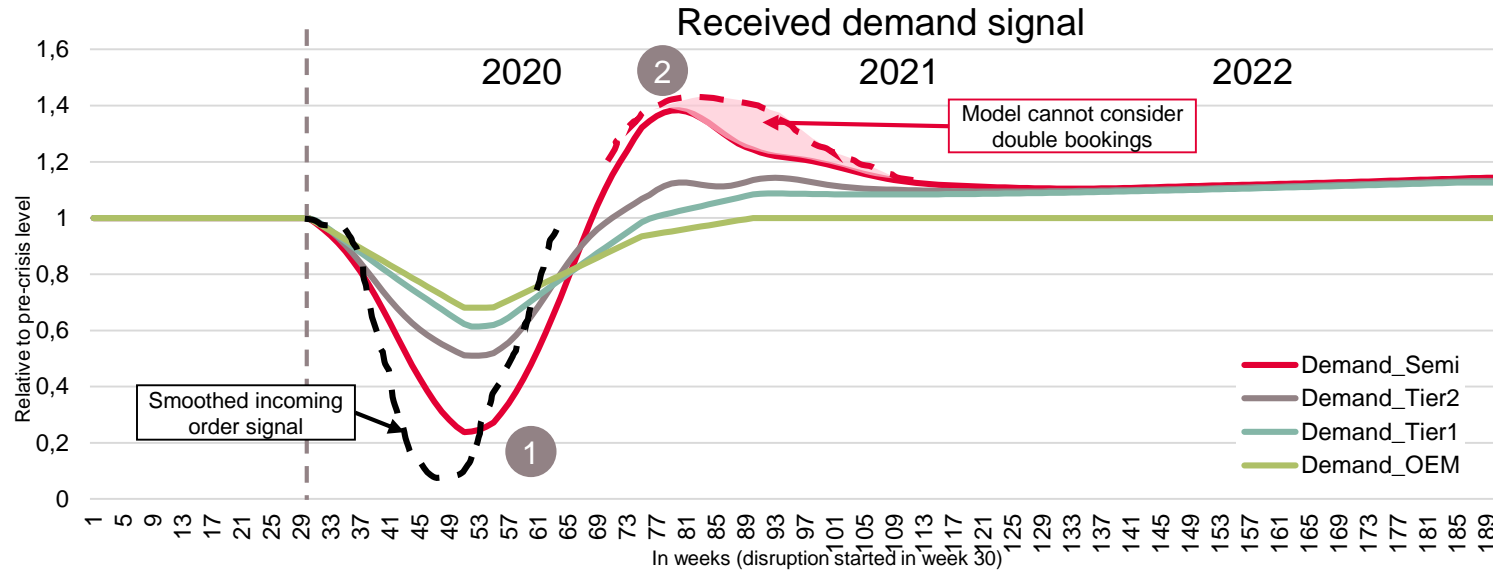
Actors in Semiconductor Supply Chains

Downward physical flow → Tier-2 Semiconductor* → Downward physical flow → Tier-1 supplier* → Downward physical flow → OEM* → Downward physical flow →

Upward propagating demand signal ← ← Upward propagating demand signal ← ← End market demand signal ←
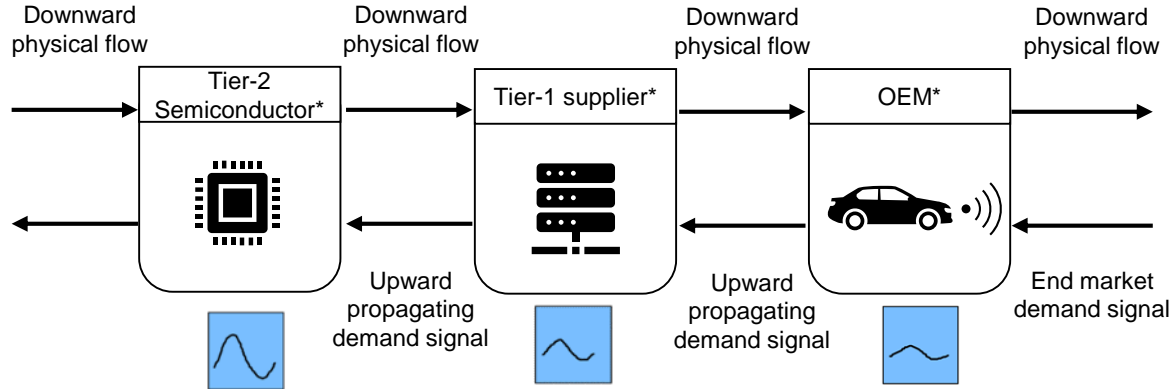
› Excerpt of major actors from an automotive supply chain
  − **OEM:** Companies producing cars and reacting to the end market demand
  − **Tier 1 Supplier:** Companies delivering components and parts for the cars
  − **Tier 2 Semiconductor:** Companies delivering needed semiconductors

⚠ Each actor is highly connected to subsequent tiers on a global scale influencing each other

After the demand for semiconductors collapsed orders harshly recovered during end market demand recovery

Received demand signal

Relative to pre-crisis level

Chart axis values: 1,6 · 1,4 · 1,2 · 1 · 0,8 · 0,6 · 0,4 · 0,2 · 0

Year labels: 2020 · 2021 · 2022

Annotations:
- **2** Model cannot consider double bookings
- **1** Smoothed incoming order signal

X-axis: In weeks (disruption started in week 30)

Legend:
- Demand_Semi
- Demand_Tier2
- Demand_Tier1
- Demand_OEM

1 The results of the simulation model show a clear **amplification of the change** in the end market for light vehicle sales. The more upstream in the supply chain, the larger the drop in the received demand signal during the crisis.

2 The recovery phase in end market demand shows high amplification of demand increase. The incoming demand for the semiconductor echelon **exceeds end market demand** by about 40% with a doubled amplification compared to Tier-2.

Tactical Demands are Bullwhip Drivers in Supply Chains

› Collaboration and communication along the semiconductor supply chain allow us to get a better understanding of the current situation (demand, overheating)
› Precise forecasts are important in semiconductor supply chains for the planning of production
  − Semiconductors have a very long lead time
  − Semiconductor production cannot be parallelized

Problem
› Companies strategically do not want to disclose their true demand to competitors or suppliers
› Instead they communicate a tactical demand to suppliers
› Goal is to make sure the own demand will be fulfilled
› The result is an inflated demand amplified by the Bullwhip Effect

Bias and Noise Hindering Collaboration

Highly fluctuating Semiconductor Demand

- True Demand
- Noisy Demand
- Biased Demand

Time
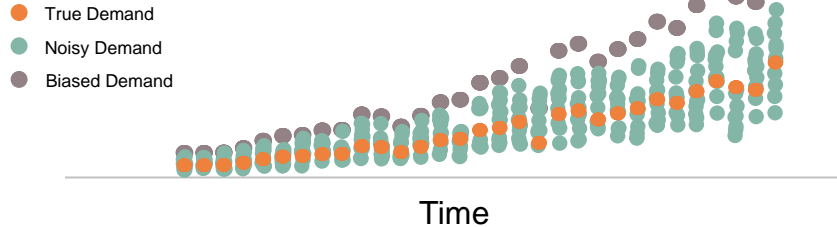
Bias
Systematic Deviations

- During start of Pandemic, orders were cancelled in large quantities
- After Demand Recovery, customers order higher quantities as a tactical demand

+

Noise
Random Scatter

- Bullwhip Effect amplifies any noise from upstream the supply chain

→

Hindering Collaboration

- Decision Observer does not work in the current setting. Competitors do not want to share their True Demand among each other

- Noisy and biased Data is not suitable for AI algorithms, clean data is required to allow for better forecasting
- With better forecasts, faster demand fulfillment is possible

Possible Solution Approaches to mitigate the Bullwhip Effect

Demand Understanding

Marketing Demand

› Capture complex interdependencies in semiconductor supply chains in knowledge graphs based on external factors
› Understanding influence factors and demand drivers besides customer demand itself

Anonymous True Demand

› Remove incentive to communicate tactical demands with anonymous surveys to come to a true(r) demand on a high level
› Decoupled of ordering system for benchmarking
› Identify overheating and smoothening of demand

Importance of Semantics for Solution Approaches

Semantic Web for Complexity Management

› Semantic Web can be used to
   › break the high level forecast down to the needed level (graph structure)
   › provide services based on the enhanced demand on fine granularity
   › provide common understanding across supply chain tiers (vocabulary & ontologies)

Supplier › Semiconductor Industry › EMS, Automotive Industry (Tier 1 and OEM) › End Customer

Collaboration, Communication & more Transparency

Thank you!