

**Elias Auberger**

Institute of Innovation and Industrial Management

Graz University of Technology

# Integration of internal production network interrelations into factory planning under uncertainty

**Konzeptpräsentation**

27. Techno-Ökonomie-Kolloquium, 02.07.2020



# Agenda

- 1 Problem description
- 2 Research question & contribution
- 3 Research method
- 4 Literature

## Problem description

# Production networks have a great potential for cost reduction and are an important lever during volatile times

„Nach einem **starken Wachstum** in den vergangenen Jahren stehen globale Produktionsnetzwerke vor neuen Herausforderungen. Unvorhersehbare Ereignisse wie die weltweite **Corona Pandemie**, aufkommende Handelskonflikte oder schwankende Auftragseingänge haben weitreichende **Auswirkungen** auf **Produktionsnetzwerke** sowie Lieferketten.“ [Schuh, 2020]

...increasing globalization and uncertainty

„In the current era of **increased uncertainty**, leaders need to maintain **multiple options** for responding to **changing conditions**. Increased optionality can be built into both the **network design** and the implementation road map.

To meet expectations for **shorter lead times**, companies must **design their manufacturing networks** to meet different levels of lead-time requirements, **optimizing for efficiency** in the **short term** and **agility in the longer term**.” [McKinsey, 2017]

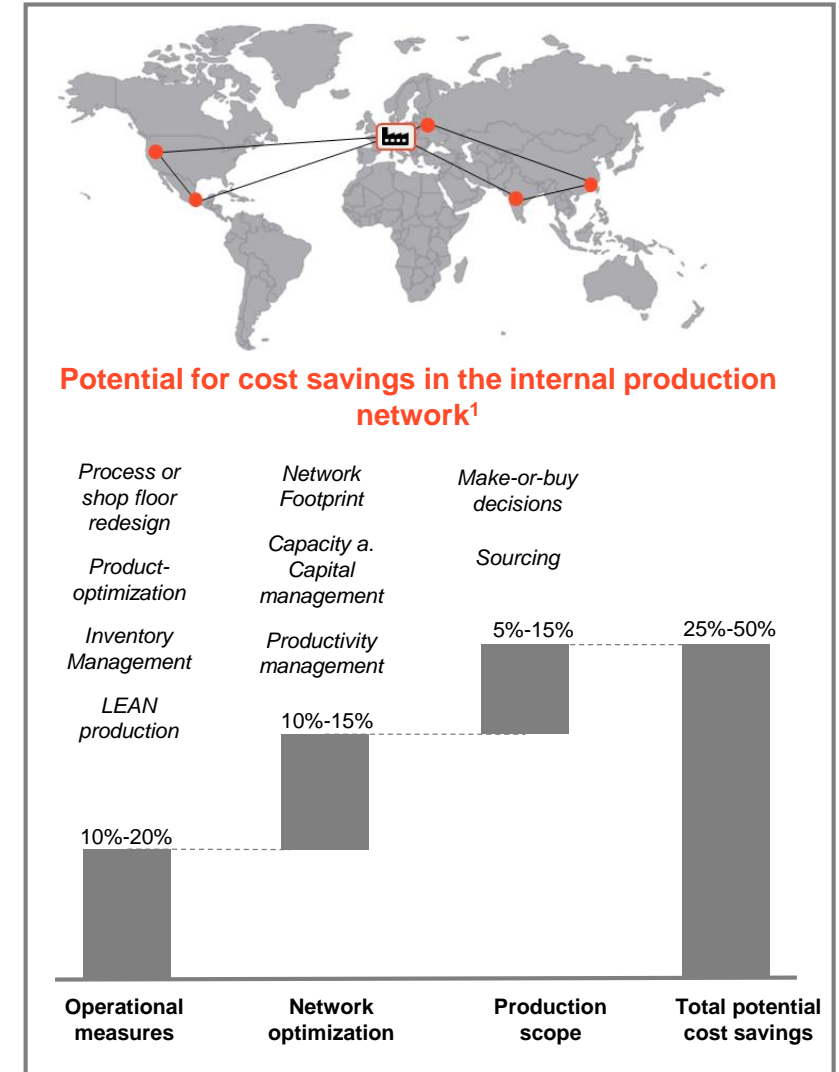
...complex decision making

Production networks often expand through the **acquisition of individual sites** as well as short-term decisions. Such **historically grown** production networks hold hidden potential for **efficiency improvement** which could lead up to cost savings of around 45%. e.g. the use of redundant production technologies in multiple locations is one root-cause of inefficiencies.“ [Lanza, 2017]

...high potential for cost savings

„Sowohl die **Agilität** als auch die **Resilienz** werden zukünftiger bei der Auslegung von Produktionsnetzwerken wichtige Gestaltungsfaktoren sein. Dabei muss Stückweit zwischen einem **kostenoptimalen** und einem **krisensicheren** Netzwerk abgewogen werden. Die Erhöhung der **Transparenz** im Netzwerk stellt dabei einen zentraler Erfolgsfaktor dar“ [Gützlaf, 2020]

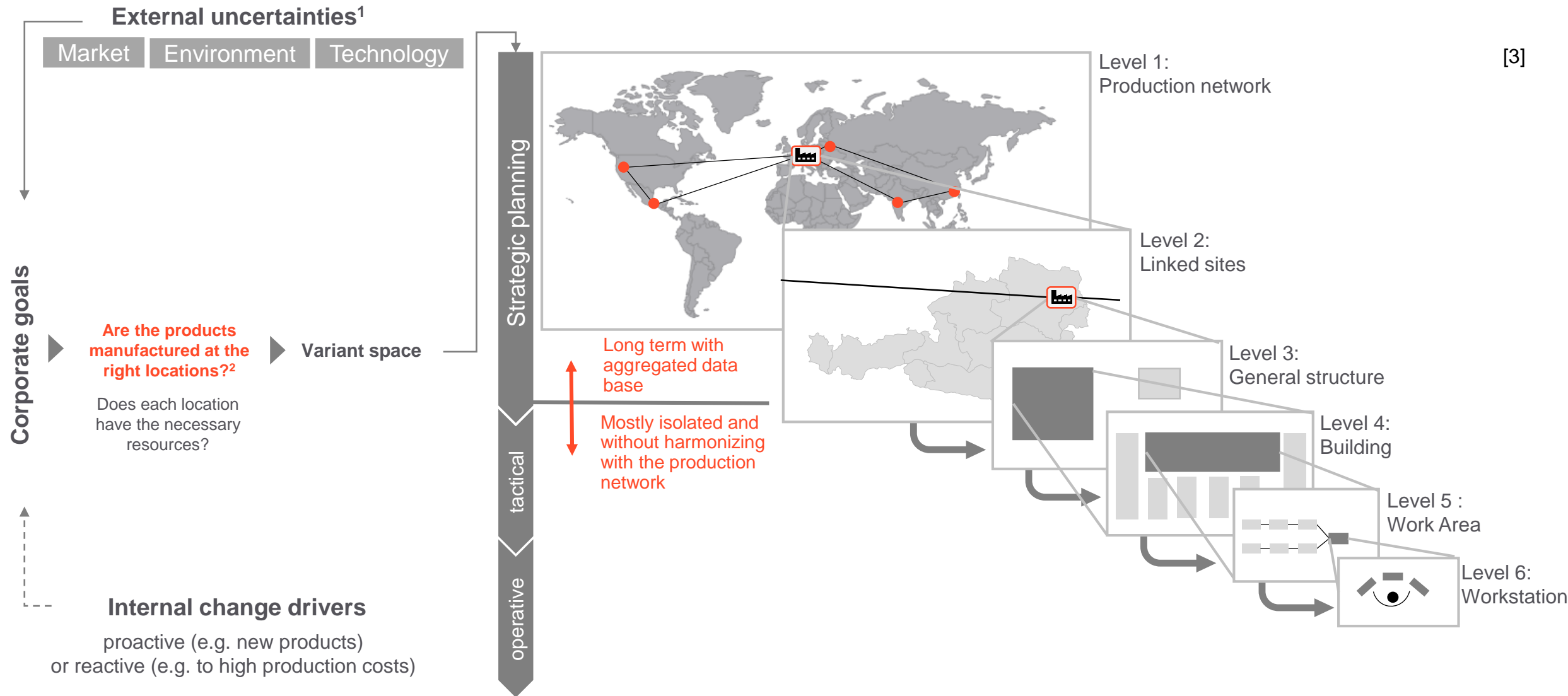
...transparent and well configured PN can counteract uncertainty



[1] BCG, The Power of Cost Transparency – Finding Hidden Value in Manufacturing Networks (2009);

# Problem description

## Strategic planning procedure for production in networks in practice



[1] Pawellek (2008), [2] Ferdows (2014), [3] Westkämper (2003), Krebs (2012)

- **Decisions** on plant roles **affect other plants** and the manufacturing network. Consequently, **decisions** on **plant roles** should be considered as **network decisions** and cannot be taken in isolation. Instead they need to be considered in an **integrated fashion**. [Feldmann, 2013, Blomqvist, 2019, ]
- **Plant level:** Much attention is paid to single plants and not on the IMN. Its unclear how the evolution of one plant affects others and how this leads to network changes as a whole.  
**Network level:** studies focus on (re-)location decisions without delving into what happens inside the plants and neglect the dynamics of IMNs  
→The existing literature lacks overall evidence about the **interactions between the individual plants** and the manufacturing **network** as a **whole**. [Cheng, 2015]
- Bisherige Ansätze in Forschung und Praxis beinhalten **Planungsvorgehensweisen** für **Wertschöpfungsnetze**. Es werden jedoch nur davon unabhängige **Gestaltungsvorschläge** für **Fabriken** innerhalb dieser Netzwerke aufgezeigt, eine **durchgängige Verknüpfung** erfolgt nicht. [Sager, 2017]

### ...interrelations

- The planning and implementation of the changes and adaption of specific factories are either based **on long-term project approaches** or on individual, often **locally isolated changes** or investment decision on factory level. This involves challenges of on the one hand dealing with a huge **amount of interdependencies** in **networks**, and on the other hand to **continuously improve isolated factories** and conduct local investments without knowing its **impact** on the **network level**. [Schuh, 2018]
- Choosing the right **abstraction level** by determining the trade-off between **model accuracy** and **effort for modeling** is crucial for developing viable and applicable models. [Benfer, 2019]

### ...complexity

- **Insulation** and **silos thinking** instead of **transparency** and **collaboration** are predominant behavioral thinking patterns. At operational level, disruptions influence the network performance negatively. [Friedli, 2014]
- In future the potential of increased **transparency** and standardization in the production network must be examined in particular. [Lanza, 2018]

### ...transparency

- In current approaches for the production network planning **data collection**, which involves considerable effort and therefore has to be **performed iteratively**, is largely neglected. [Sager, 2019]

### ...iterative

## Approach is required which...

- Increases the **transparency** of **interrelations** between network and plant level
- Defines the right level of **abstraction** of **data** for specific corporate goals (adequate modelling effort for practical use)
- Including required changes and optimization potentials on the factory level **not isolated** but in an **iterative** manner in the strategic decision making process.

# Agenda & Zielsetzung

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2 **Research question & contribution**

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# Research questions & contribution

**RQ:** How can **interrelations** between the network and factory level be **considered** in an approach for the **scenario-based configuration** of brownfield intra-firm production networks?

RQ1.1: What abstraction level and related data is required to increase transparency in decision making to achieve specific corporate goals?

RQ1.2: What are suitable evaluation criteria for assessing the scenarios including the interrelations?

## Expected outcome:

An approach which supports the management during decision making by...

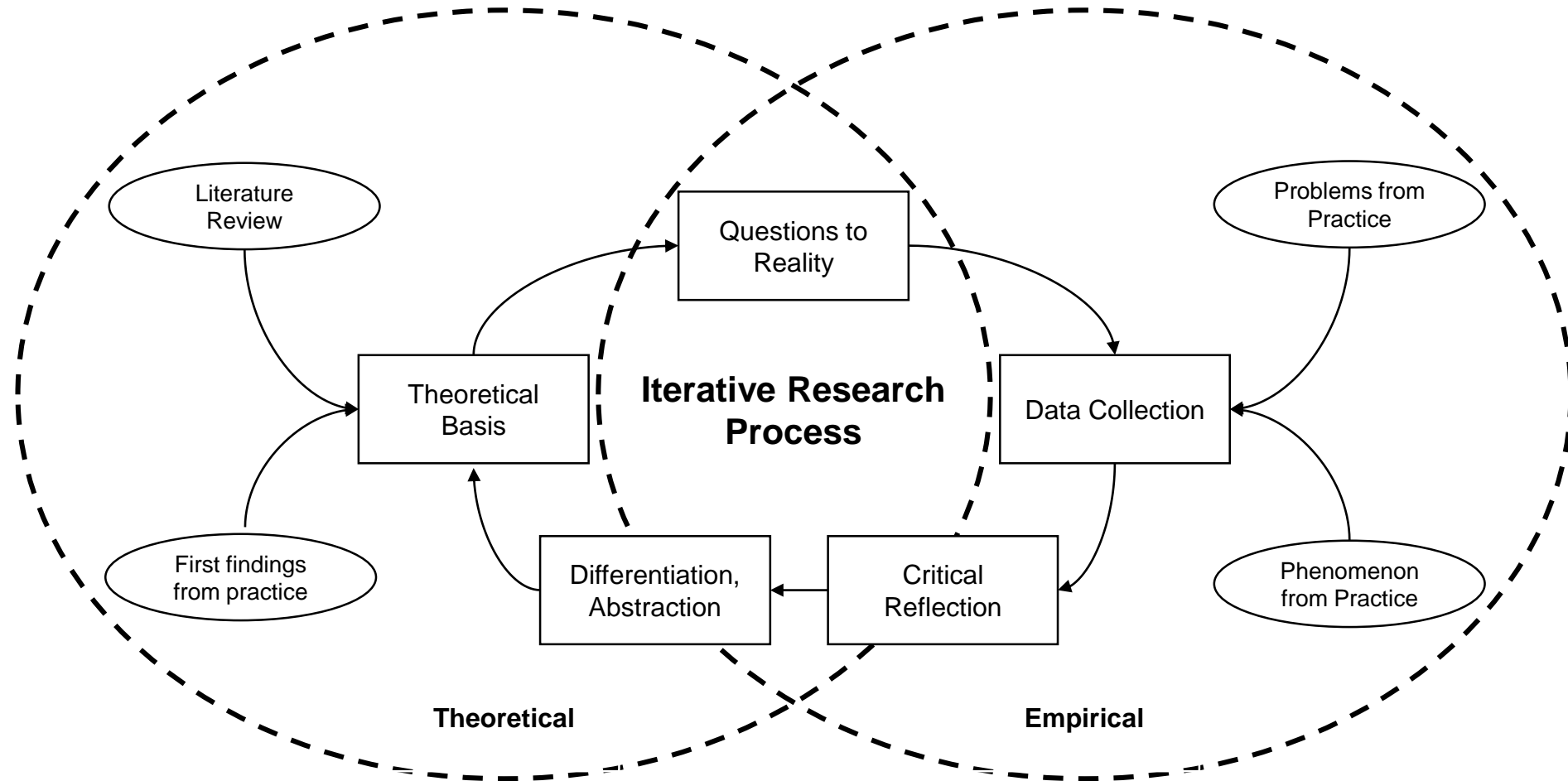
...increasing the **transparency** through the consideration of the interrelation between the network and factory level

...including required **changes** and **optimization potentials** on the factory level of subsequent processes in an **iterative** manner in the **strategic decision making process**

...**low effort oriented** modelling by providing the required level of **abstraction** of data for specific corporate goals

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## Iterative Research Process:

**Production networks** are understood as **complex systems**. The prevailing complexity means that production networks are neither fully controllable nor can they be described completely and objectively in a model. In order to approach the complex production network systems, an **iterative learning** process is applied.

based on Gassmann (1999), Tomczak (1992), Kubiczek (1977)

# Research approach and methods

## Research clarification

### Observation in practice

Practical cases in different companies

### Overview of related theories



- ▶ Identification of the research gap,
- ▶ Definition of research objective

### Clarification

## Literature analysis

### Literature study on related theories

*Management (strategic) perspective:*

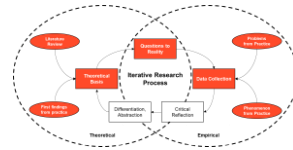
- Production network planning
- Performance measures
- Performance management
- Decision making
- Decision support systems

*Operations (tactical) perspective:*

- Factory Planning
- Operations improvement methods

### Observation and expert interviews

Practical cases in different companies



- ▶ Literature study to gain deeper understanding
- ▶ Problem & Phenomenon in practice

### Investigation

## Explorative - empiric case study

### Applied Case Study & observation

*Industry: Maintenance of rail vehicles*

- Historically grown production network (>8 sites)
- Highly complex products
- Low transparency
- Strategic decisions are pending
- Optimization potential on both, factory and network level
- Main focus on increase in efficiency and delivery reliability

### Data analysis & expert interviews



- ▶ Critical Reflection
- ▶ Differentiation and abstraction
- ▶ Deriving requirements

### Development

## Confirmatory - empiric case Study

### Applied Case Study & observation

*Industry: Production of agricultural machinery*

- Global production network (>4 sites)
- Highly complex products
- High logistic costs
- Performance depending on lot-sizes and set-up times
- Partly optimized sites

### Validation with expert interviews



- ▶ Empirical evaluation of the methodology
- ▶ Contribution to existing theory

### Application

Methodology conception

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## Management (strategic) perspective

### Production Network Planning (Global Production, Manufacturing Networks)

- Cheng Y. *et al.*, International manufacturing network: Past, Present, and future, International Journal of Operations & Production Management, 2015
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### Performance measures & management

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## Operations (tactical) perspective

### Factory Planning

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- Womack J. *et al.*, The Machine that changed the world. Based on the Massachusetts Institute of Technology 5-million dollar 5-year study on the future of the automobile. New York: Rawson Associates., 1990
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Institute of Innovation and Industrial Management

Graz University of Technology

# Thank you



### DI Elias Auberger

Project Assistant

P +43 316 873 7792  
M [elias.auberger@tugraz.at](mailto:elias.auberger@tugraz.at)  
W [iim.tugraz.at](http://iim.tugraz.at)

### Head of Institute

Christian Ramsauer

Univ.-Prof. Dipl.-Ing. Dr.techn.

### Graz University of Technology

Institute of Innovation  
and Industrial Management

Kopernikugasse 24 / II

8010 Graz / Austria

Phone +43 316 873 7291

Fax +43 316 873 7791

E-Mail [iim@tugraz.at](mailto:iim@tugraz.at)

Web [iim.tugraz.at](http://iim.tugraz.at)

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**McKinsey. 2017:** Salo Olli, How to creat an agile organization, Survey

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