



# KS SUPPLY CHAIN FUNDAMENTALS

## 01 Basics

SS 2025



PLM Institute of  
Production and  
Logistics Management

# Learning Goals

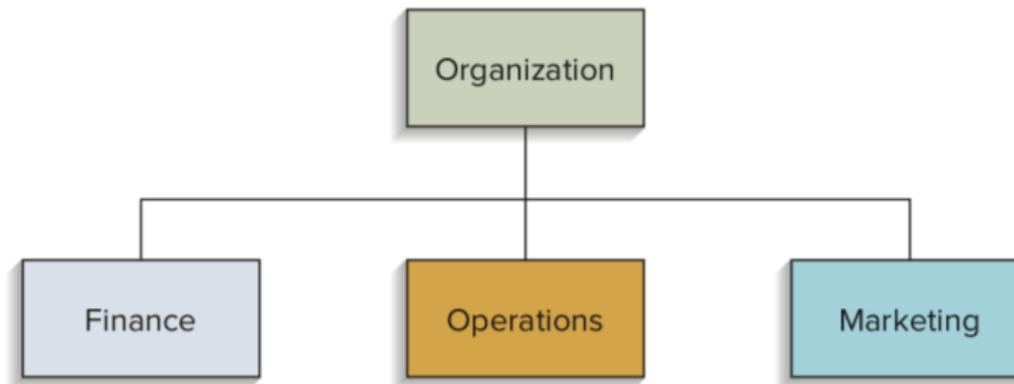
- Understand the role of Operations Management.
- Understand the concept of "Supply Chain".
- Understand the roles of decisions and analytics.
- Understand what a model is.

*Stevenson, WJ: Operations Management. McGraw-Hill Education Ltd; last edition - Chapters 1 and 15*

**Acknowledgements:** icons are by fontawsome (latex) or by Pixelmeetup from [www.flaticon.com](http://www.flaticon.com)

# Operations Management

- **Goods** physical objects, produced by companies.
- **Services** activities and immaterial objects provided by a company
- **Operations** produces goods and services
- **Operations Management** management of systems and processes to create goods as well as provide services.



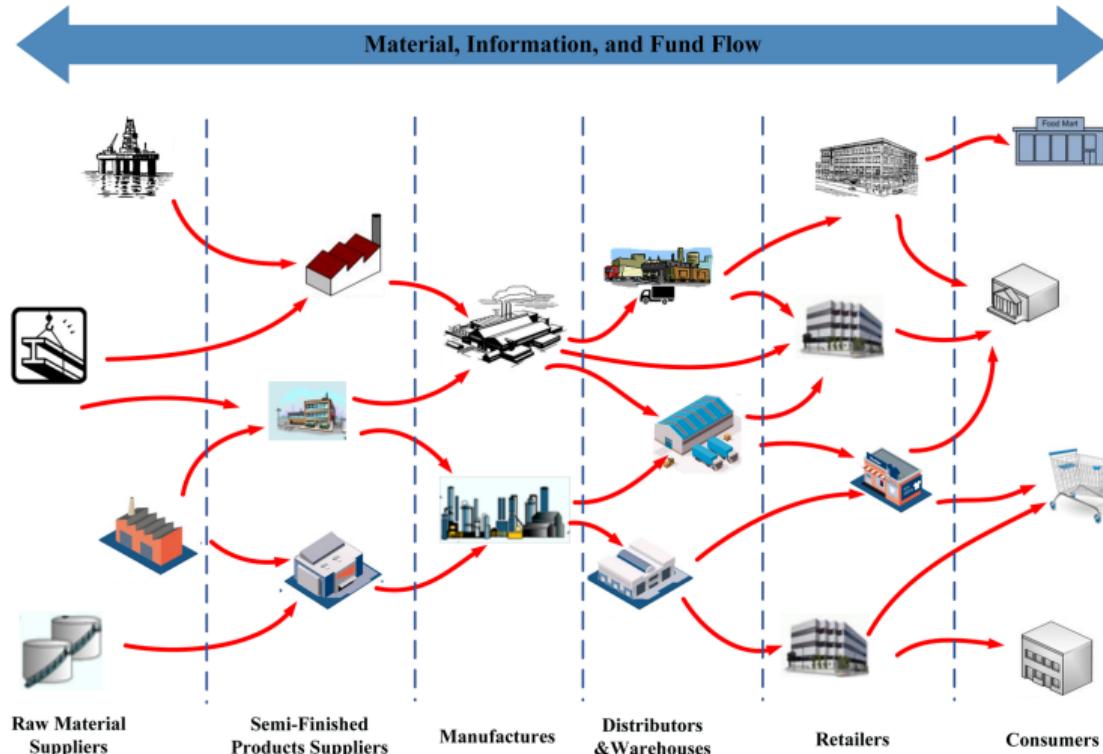
# Supply Chain



A supply chain usually does not look like a chain but more like a tree with many branches or a network.

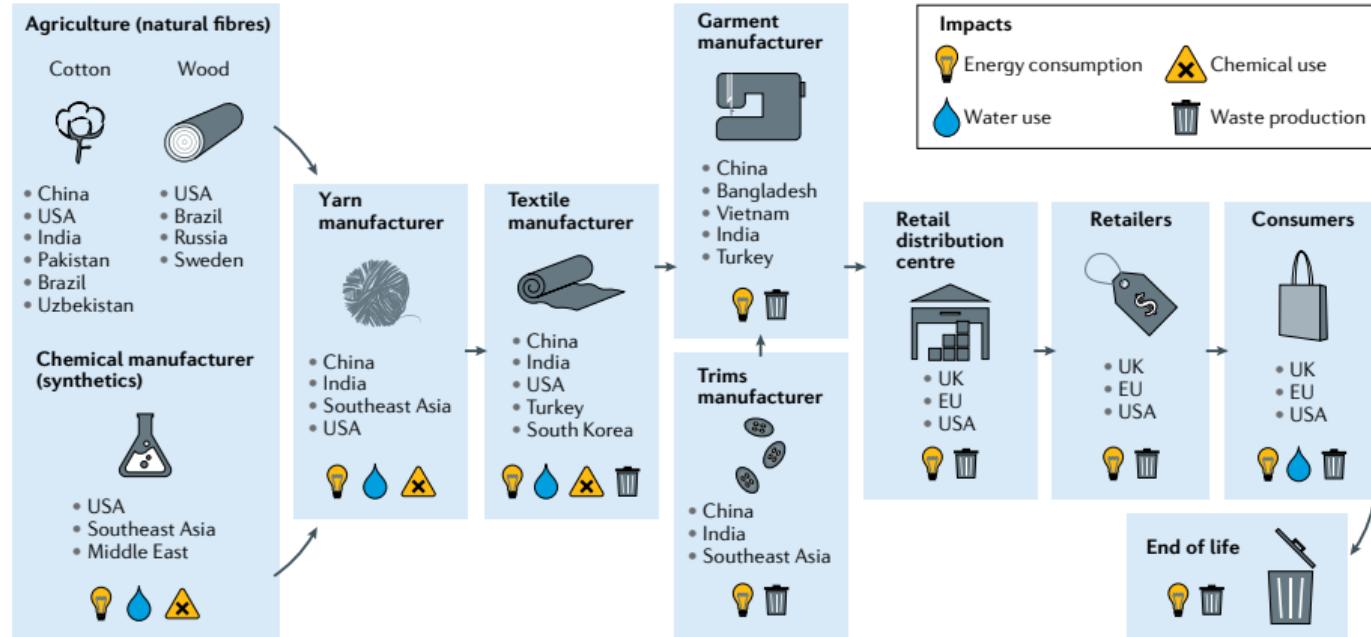


# Supply “Chain”...?



<https://doi.org/10.1371/journal.pone.0191180> CC BY 4.0

# Example: Apparel Supply Chain



Source: Niinimäki, K., Peters, G., Dahlbo, H., Perry, P., Rissanen, T., & Gwilt, A. (2020). The environmental price of fast fashion. *Nature Reviews : Earth and Environment*. 1. 189-200. <https://doi.org/10.1038/s43017-020-0039-9>

# Activities along the Supply Chain

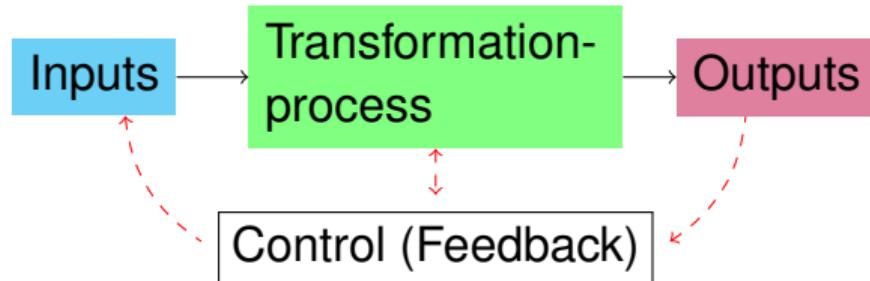
- **Forecasting\***
- Purchasing
- **Inventory Management\***
- Information Management
- Quality Assurance
- **Scheduling\***
- **Production \***
- **Distribution \***
- Customer Service
- ...

# Supply Chains



- **Internal** and **external** to the organization.
- External **inputs** include raw materials, parts, equipment and supplies.
- Internally, the supply chain is a part of Operations: supply of goods and materials, performing work on products and performing services
- The **outputs** of the organization are delivered to its customers.

# Value-added



**Value-added:** Difference between the cost of inputs and the value or price of outputs.

Inputs	Transformation	Outputs
<ul style="list-style-type: none"><li>■ Work</li><li>■ Assets</li><li>■ Raw Materials</li><li>■ Machines</li><li>■ Energy</li><li>■ ...</li></ul>	<ul style="list-style-type: none"><li>■ transport</li><li>■ cut</li><li>■ drill</li><li>■ debug</li><li>■ repair</li><li>■ ...</li></ul>	<ul style="list-style-type: none"><li>■ Houses</li><li>■ Cars</li><li>■ Clothes</li><li>■ Computers</li><li>■ Machines</li><li>■ ...</li></ul>

# Products

Products are almost always a combination of goods and services.

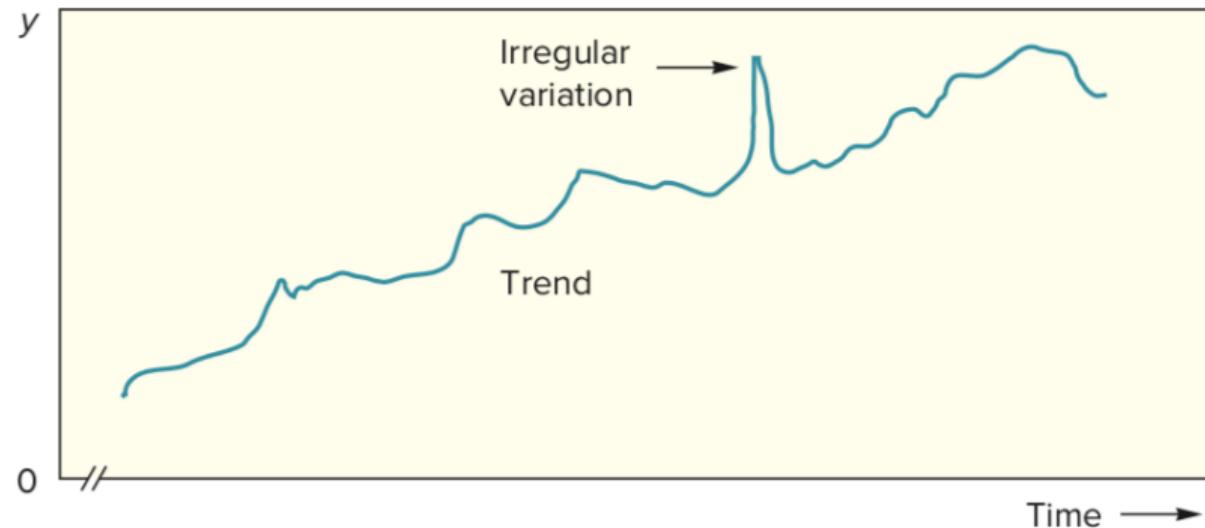
Goods	Services
	Teaching 
	Software-Development 
	Computer-Repair 
	Car-Repair 
	Grocery Sales 
Steel Production 	

# Independent of the products being goods or services...

...the following activities are part of Operations and Supply Chain Management:

- Forecasting and capacity planning
- Process management
- Managing product variety
- Monitoring costs and productivity
- Inventory management
- Location planning
- Quality control
- Sequencing/Scheduling

# Forecasting and capacity planning



- How high was my demand during the last couple of periods?
- What does this mean for the future?
- What capacities will be needed to meet the forecast demand?

# Process management

Process = one or multiple activities that transform inputs into outputs.

1. **(Upper) Management processes.** e.g. Governance and Strategy
2. **Operational processes.** e.g. Production, Marketing & Sales
3. **Supporting processes.** e.g. Accounting, HR, IT

A single main process can contain a large number of sub-processes.

**Operations & SCM:** Managing processes to meet the demand and account for process variability.

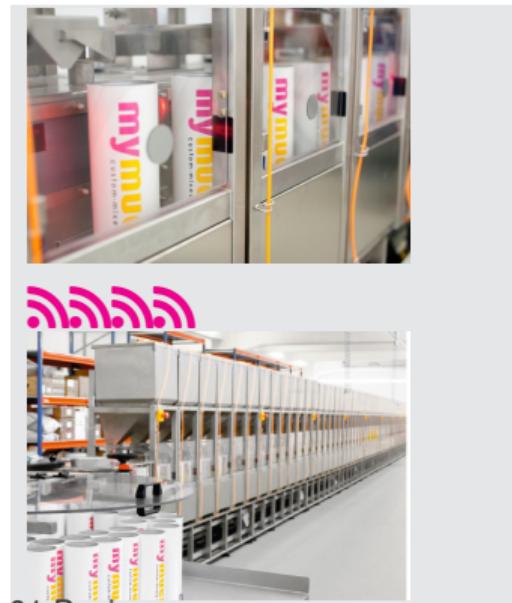
# Managing variants/product variety



Founded in 2007 by 3 students, located in Passau

[www.mymuesli.com](http://www.mymuesli.com)

	8 Freunde
	1x Apfelstücke
	1x Ananas
	1x Cranberries
	1x Cashewkerne
	1x Mandeln



# Inventory management



When to order how much and of what?

# Location planning



Source: <http://www.amazon-logistikblog.de/standorte/> (March 2018)

# Sequencing/Scheduling

Example	Machine 1    Machine 2	
	Job I	4              1
	Job J	1              4

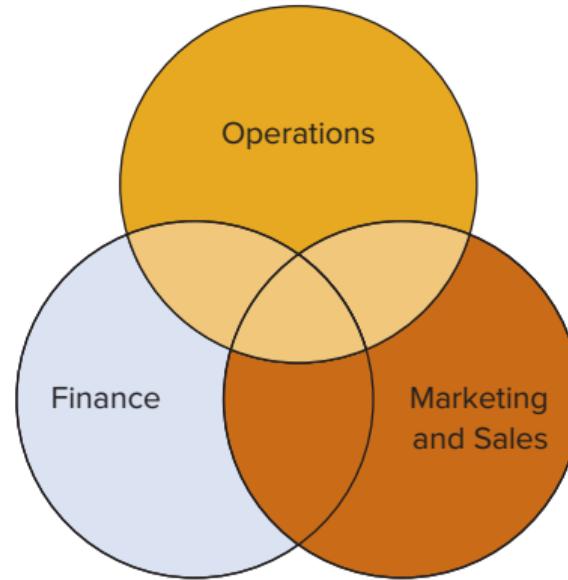
Both jobs are to be scheduled first on machine 1 and then on machine 2.

Multiple Options:



... Makespan = time between starting time of first job and completion time of last job.

# Why learn about operations and supply chain management?



**... every company is part of at least one Supply Chain!**

# Operations management and decision making

The key role of an operations manager is that of a planner and decision maker.

Decisions should be made **informed**.

These decisions include:

- **What** resources will be needed, and in what amounts?
- **When** will each resource be needed? When should the work be scheduled? When should materials and supplies be ordered? When is corrective action needed?
- **Where** will the work be done?
- **How** will the product or service be designed? How will the work be done? How will the resources be allocated?
- **Who** will do the work?

# What is a model?

A **model** is an abstraction of reality, a simplified representation of "something".

A toy car  is a model of a real automobile.

## Classifying models:

- **Physical models** look like their real-life counterparts (e.g. a toy car).
- **Schematic models** are more abstract than their physical counterparts (e.g. drawings).
- **Mathematical models** are the most abstract: They do not look at all like their real-life counterparts (e.g. numbers, formulas, symbols). They can be adapted easily and are important inputs for computers.

**Models provide decision support!**

# Models are helpful, as they ...

- require users to organize and sometimes quantify information (indicating areas with information gaps!)
- increase the understanding of the problem
- enable managers to analyze what-if questions
- serve as evaluation tools and provide a standardized format for analyzing a problem
- allow users to use the power of mathematics for problem solving ☺

## Analytics and data-driven management

# Formal models have limitations (1)

- Quantitative information may be emphasized at the expense of qualitative information.
- Models may be incorrectly applied, e.g., when highly-sophisticated models are placed in the hands of users who are not sufficiently knowledgeable in their use.
- **The use of models does not guarantee good decisions.**

“Austria’s employment agency rolls out discriminatory algorithm, sees no problem” @ algorithm watch [Link](#).

“Automated translation is hopelessly sexist, but don’t blame the algorithm or the training data” @ algorithm watch [Link](#)

Use **Google to translate** “une historienne écrit un livre” into German and think about the result.

# Formal models have limitations (2)

## Discrimination

Parts of the analysis have been made public. [One document](#) shows that, under a certain model, women are given a negative weight, as are disabled people and people over 30. Women with children are also negatively weighted but, remarkably, men with children are not.

```
BE_INT  
= f( 0.10  
    - 0.14 x GESCHLECHT_WEIBLICH  
    - 0.13 x ALTERSGRUPPE_30_49  
    - 0.70 x ALTERSGRUPPE_50_PLUS  
    + 0.16 x STAATENGRUPPE_EU  
    - 0.05 x STAATENGRUPPE_DRITT  
    + 0.28 x AUSBILDUNG_LEHRE  
    + 0.01 x AUSBILDUNG_MATURA_PLUS  
    - 0.15 x BETREUUNGSPFLICHTIG  
    - 0.34 x RGS_TYP_2  
    - 0.18 x RGS_TYP_3  
    - 0.83 x RGS_TYP_4  
    - 0.82 x RGS_TYP_5  
    - 0.67 x BEEINTRÄCHТИGT  
    + 0.17 x BERUFSGRUPPE_PRODUKTION  
    - 0.74 x BESCHÄFTIGUNGSTAGE_WENIG  
    + 0.65 x FREQUENZ_GESCHAFTSFALL_1  
    + 1.19 x FREQUENZ_GESCHAFTSFALL_2  
    + 1.98 x FREQUENZ_GESCHAFTSFALL_3_PLUS  
    - 0.80 x GESCHAFTSFALL_LANG  
    - 0.57 x MN_TEILNAHME_1  
    - 0.21 x MN_TEILNAHME_2
```

An excerpt from the AMS algorithm's documentation.

The image shows a screenshot of the Google Translate interface. At the top, it says "google translate". Below that is a navigation bar with links for "Alle", "Videos", "Bilder", "Web", "Bücher", "News", "Kurze Videos", and "Mehr". The main area has two input fields: the left one is set to "Französisch" and the right one is set to "Deutsch". Between them is a double-headed arrow icon. Below these fields, the French sentence "une historienne écrit un livre" is shown with a red "X" icon next to the verb "écrire". To its right, the German translation "Ein Historiker schreibt ein Buch" is displayed. At the bottom of the interface are standard Google Translate controls: a download icon, a speaker icon, and the Google logo.

# Additional aspects

- **Quantitative Approaches** can be used because of the computing power available today.  
However, decisions are often based on a combination of qualitative and quantitative approaches.
- **Performance Metrics** allow managing and monitoring operations.
- **Trade-offs** Often an improvement in one aspect (e.g. costs) leads to a decrease in another (e.g. service quality).
- **Systems Perspective** The “big picture” view - local improvements may be possible but may not lead to improvements of the whole system.
- **Prioritization** Some issues or items are more important than others, they have a higher impact. These should be focused.

# Planning levels

- **strategic** (long-term) Location planning, network configuration, capacity planning, distribution strategy, strategic partnerships, ...
- **tactical** (medium-term) Forecasting, inventory management, transportation planning, sourcing, ...
- **operational** (short-term) Scheduling, maintenance, quality control, shipping, ...

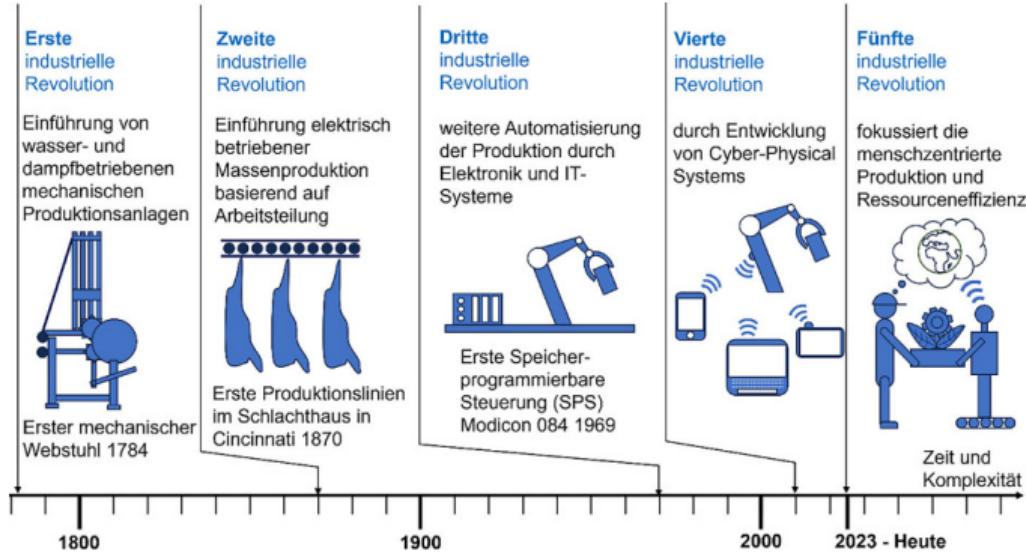
# A short history

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1776	Division of Labor	Adam Smith
1911	Principles of scientific management	Frederick W. Taylor
1912	Chart for scheduling activities	Henry Gantt
1913	Moving assembly line	Henry Ford
1940	Operations research	different groups
1947	Linear programming	George Dantzig
1951	Commercial computers	IBM
1950s	Automation	-
1980s	Lean production	Toyota
1980s	Quality focus	K. Ishikawa
1990s	Internet, SCM	-
2000s	Outsourcing, social media  , YouTube  , ...	-
2013	Industrie 4.0	
since then	Industrie 5.0, KI, ChatGPT...	

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# Was ist Industrie 5.0?



Source: Vogel-Heuser, B., Bengler, K. Von Industrie 4.0 zu Industrie 5.0 – Idee, Konzept und Wahrnehmung. HMD 60, 1124–1142 (2023).  
<https://doi.org/10.1365/s40702-023-01002-x>

"A cyber-physical system (CPS) or intelligent system is a computer system in which a mechanism is controlled or monitored by computer-based algorithms. In cyber-physical systems, physical and software components are deeply intertwined, able to operate on different spatial and temporal scales, exhibit multiple and distinct behavioral modalities, and interact with each other in ways that change with context."

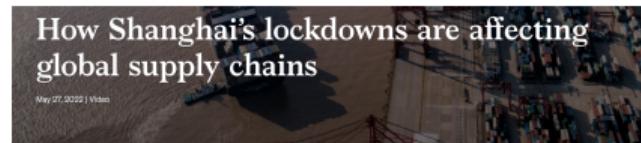
[https://en.wikipedia.org/wiki/Cyber-physical\\_system](https://en.wikipedia.org/wiki/Cyber-physical_system) (Oct, 2021)

# Production in the past and today

- Ford Model T <https://www.youtube.com/watch?v=IXkxl8dSXb4>
- BRP-ROTAX  
<https://www.youtube.com/watch?v=G3rwXDiQpjw>

# Today (1)

- Uncertainty has increased (war in Ukraine, COVID-19 pandemic)
- Supply chain resilience
- Globalization is being questioned (reshoring/nearshoring, multiple sourcing/diversification...)



## How Shanghai's lockdowns are affecting global supply chains

May 27, 2022 | Video

By Steve Saxon

Share Print Save

McKinsey's Steve Saxon explains why severe restrictions in Shanghai reinforce the importance of diversification.



SUPPLY CHAINS AFTER COVID-19 –  
THE CALL FOR CHANGE

Samstag, 27. August 2022

## Wirtschaft

Rene Jünger Zeitung

## Zurück nach Europa – schwieriger, als viele Firmen glauben

Der Fahrradhersteller Woom wollte die Produktion von Asien nach Polen verlagern und stieß an Grenzen

DANIEL IWINKIEWICZ, WIEN

Wieder vermehrt in Europa statt in Asien produzieren: Das sogenannte Reshoring war in der Pandemie nicht nur ein Schlagwort, sondern beiunter anderem Konzept des Fahrradherstellers Woom auch ein konkretes Projekt. Das Management hatte gar Ambitionen, die weit über das eigene Unternehmen hinausreichten. Nach dem Debakel verschwanden die Pläne.



<https://www.mckinsey.com/industries/travel-logistics-and-infrastructure/our-insights/how-shanghais-lockdowns-are-affecting-global-supply-chains>  
<https://www.velojournal.ch/aktuell/nachrichten/detail/woom-reshoring-mit-hindernissen/>  
<https://www.eurobike.com/en/topics/more-topics/business-solutions/supply-chains-after-covid-19-the-call-for-change/>

# Today (2)

## Green Deal

- Efficient use of resources, circular economy: Products should last longer, should be easily repairable
- Restoration of bio-diversity, pollution abatement
- Europe aims to become the first climate-neutral continent by 2050

Der erste klimaneutrale Kontinent bis 2050	Mindestens 55 % weniger Netto-Treibhausgasemissionen bis 2030 gegenüber 1990	3 Milliarden zusätzliche Bäume in der EU bis 2030
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[https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal\\_de](https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_de)

